Contents

About the Editors, xv
Notes on contributors, xvii
Foreword, xxiii
Series preface, xxv
Acknowledgments, xxvii

1 The theoretical and scientific foundations of forensic anthropology, 1
C. Clifford Boyd Jr and Donna C. Boyd
1.1 Introduction, 1
1.2 A selective history of theory in forensic anthropology, 2
1.3 A modern perspective on forensic anthropology theory, 5
  1.3.1 Three forms of logical reasoning, 8
  1.3.2 Theory building in forensic anthropology: Linking logic and theory, 10
1.4 Forensic anthropology theory and modern practice, 12
1.5 Final comments, 15
References, 15

Part 1 Bias and objectivity in forensic anthropology theory and practice, 19

2 Subjective with a capital S? Issues of objectivity in forensic anthropology, 21
Allysha Powanda Winburn
2.1 Introduction, 21
2.2 Objectivity, subjectivity, and forensic anthropological theory, 22
2.3 Subjectivity in science, 24
  2.3.1 Subjectivity in forensic anthropology, 24
  2.3.2 Effects of bias on forensic anthropology, 25
  2.3.3 Subjective science is not bad science, 26
2.4 Mitigated objectivity: A path forward..., 27
  2.4.1 Constraining subjectivity and bias, 28
  2.4.2 The continuing process of constraint, 33
2.5 Conclusion, 34
References, 34

3 Navigating cognitive bias in forensic anthropology, 39
Michael W. Warren, Amanda N. Friend and Michala K. Stock
3.1 Introduction, 39
3.2 Types of cognitive bias, 40
3.3 Research versus applied science, 41
3.4 Recommended solutions to mitigate confirmation bias, 43
3.5 Challenges unique to forensic anthropology, 44
  3.5.1 Anthropologists work in a variety of professional contexts, 44
  3.5.2 The uniqueness of the forensic anthropology testing sample, 45
  3.5.3 Multiple tests to reach a single conclusion, 45
3.6 An example of how bias affects procedures, 46
3.7 Workable solutions, 49
3.8 Summary, 49
  References, 50

4 Theoretically interesting: Different perspectives of the application of theory to forensic anthropology practice and research, 53
  Soren Blau
  4.1 Introduction, 53
  4.2 Practising in context, 56
  4.3 Ethical considerations for the development of theory, 58
  4.4 Can theories be applied universally?, 59
  4.5 Conclusion, 59
    Acknowledgements, 61
    References, 61

Part 2 The theory and science behind biological profile and personal identification, 65

5 From Blumenbach to Howells: The slow, painful emergence of theory through forensic race estimation, 67
  Stephen Ousley, Richard L. Jantz and Joseph T. Hefner
  5.1 Introduction, 67
  5.2 Race as a concept and theory, 68
    5.2.1 Evolution, rather than race, explains human biological variation, 70
    5.2.2 Human variation is continuous, 72
    5.2.3 Human biological variation involves many traits that typically vary independently, 73
    5.2.4 Genetic variation within so-called races is much greater than the variation among them, 74
    5.2.5 There is no way to consistently classify human beings by race, 75
  5.3 Anthropology and race, 79
  5.4 Forensic anthropology and race, 85
  5.5 Race and the future, 90
    Acknowledgments, 92
    References, 92
6 The application of theory in skeletal age estimation, 99
   Natalie R. Langley and Beatrix Dudzik
   6.1 Introduction, 99
   6.2 Skeletal age, 101
   6.3 Historical context, 101
   6.4 Forensic anthropology and evolutionary biology, 102
   6.5 Potential solutions to the problem of age estimation, 105
   6.6 Final comments, 107
     References, 109

7 Theory and histological methods, 113
   Christian M. Crowder, Deborrah C. Pinto, Janna M. Andronowski
   and Victoria M. Dominguez
   7.1 Introduction, 113
   7.2 Foundational theory in bone biology, 114
   7.3 Interpretive theory in bone biology, 115
     7.3.1 Form and function, 115
     7.3.2 The mechanostat and Utah paradigm, 116
     7.3.3 Exploring the effectors of the mechanostat, 117
   7.4 Methodological theory in bone biology, 119
     7.4.1 Histological age estimation, 120
     7.4.2 Determining human versus nonhuman bone, 121
   7.5 Conclusions, 122
     References, 123

8 Forensic applications of isotope landscapes (“isoscapes”):
   A tool for predicting region‐of‐origin in forensic anthropology cases, 127
   Lesley A. Chesson, Brett J. Tipple, James R. Ehleringer,
   Todd Park and Eric J. Bartelink
   8.1 Introduction, 127
   8.2 What are isotopes?, 128
   8.3 Why do isotope compositions of human tissues differ?, 129
     8.3.1 Hydrogen and oxygen isotopes, 130
     8.3.2 Strontium isotopes, 130
     8.3.3 Carbon, nitrogen, and sulfur isotopes, 132
   8.4 How do we interpret isotope data collected for forensic human
      identification?, 133
     8.4.1 Oxygen isotopes in drinking water and hair keratin, 134
     8.4.2 Oxygen isotopes in drinking water and skeletal
        bioapatite, 137
     8.4.3 Strontium isotopes of local bedrock and skeletal remains, 138
   8.5 Examples of the application of isotope analysis to unidentified remains, 139
     8.5.1 Jane Doe from Salt Lake County, 139
     8.5.2 Mandible from Siskiyou County, 141
Part 3 Scientific foundation for interpretations of antemortem, perimortem, and postmortem processes, 149

9 The anatomical basis for fracture repair: Recognition of the healing continuum and its forensic applications to investigations of pediatric and elderly abuse, 151
   Donna C. Boyd
   9.1 Introduction: Diagnosing pediatric and elderly non-accidental injury, 151
   9.2 Theoretical basis for fracture healing and TSI estimation, 153
   9.3 Anatomical basis for fracture healing, 154
      9.3.1 Bone growth and development, 155
      9.3.2 Fracture healing, 157
   9.4 Factors affecting the rate of bone healing, 162
      9.4.1 The biological profile (age, sex, ancestry), 162
      9.4.2 Type, location, cause, severity, and number of injuries, 163
      9.4.3 Injury treatment and local biomechanical factors, 164
      9.4.4 Systemic and other factors, 165
   9.5 Fracture healing stages and dating systems, 166
   9.6 A new model for fracture repair, 174
   9.7 Expanding and refining TSI estimation through the Antemortem Fracture Archive, 181
   9.8 Theory and the future of TSI estimation, 184
      References, 184
      Appendix A, 195
      Major fracture repair stages and TSI estimations, 195

10 Theoretical foundation of child abuse, 201
   Jennifer C. Love and Miriam E. Soto Martinez
   10.1 Introduction, 201
   10.2 Case study, 201
   10.3 Anthropologists and child abuse, 202
   10.4 Foundational theory, 203
   10.5 Interpretive theory, 204
      10.5.1 Bone biomechanics, 205
      10.5.2 Motor skill development, 207
   10.6 Methodological theory, 207
   10.7 Conclusion, 209
      References, 209
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Authors</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Bone trauma analysis in a forensic setting: Theoretical basis and a practical approach for evaluation</td>
<td>Hugh E. Berryman, John F. Berryman and Tiffany B. Saul</td>
<td>213-232</td>
</tr>
<tr>
<td>11.1</td>
<td>Introduction</td>
<td></td>
<td>213</td>
</tr>
<tr>
<td>11.2</td>
<td>Theory</td>
<td></td>
<td>214</td>
</tr>
<tr>
<td>11.2.1</td>
<td>Foundational theory</td>
<td></td>
<td>215</td>
</tr>
<tr>
<td>11.2.2</td>
<td>Interpretive theory</td>
<td></td>
<td>216</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Methodological theory</td>
<td></td>
<td>217</td>
</tr>
<tr>
<td>11.3</td>
<td>Fundamental principles in bone fracture interpretation</td>
<td></td>
<td>218</td>
</tr>
<tr>
<td>11.4</td>
<td>A practical approach to bone trauma evaluation and hypothesis building</td>
<td></td>
<td>226</td>
</tr>
<tr>
<td>11.5</td>
<td>Conclusion</td>
<td></td>
<td>232</td>
</tr>
<tr>
<td>12</td>
<td>Thinking outside the box: Theory and innovation in sharp trauma analysis</td>
<td>John A. Williams and Ronald W. Davis</td>
<td>235-248</td>
</tr>
<tr>
<td>12.1</td>
<td>Introduction</td>
<td></td>
<td>235</td>
</tr>
<tr>
<td>12.2</td>
<td>Transfer of evidence</td>
<td></td>
<td>235</td>
</tr>
<tr>
<td>12.3</td>
<td>Theory connections</td>
<td></td>
<td>236</td>
</tr>
<tr>
<td>12.4</td>
<td>The human skeleton as transfer evidence</td>
<td></td>
<td>237</td>
</tr>
<tr>
<td>12.5</td>
<td>A primer on saws and dismemberment</td>
<td></td>
<td>238</td>
</tr>
<tr>
<td>12.6</td>
<td>Geographic information system</td>
<td></td>
<td>240</td>
</tr>
<tr>
<td>12.7</td>
<td>Applications of GIS in forensic anthropology and human osteology</td>
<td></td>
<td>241</td>
</tr>
<tr>
<td>12.8</td>
<td>GIS: innovation in cut mark striation interpretation</td>
<td></td>
<td>242</td>
</tr>
<tr>
<td>12.9</td>
<td>Locard and the twenty-first century: It's all a matter of scale</td>
<td></td>
<td>247</td>
</tr>
<tr>
<td></td>
<td>References</td>
<td></td>
<td>248</td>
</tr>
<tr>
<td>13</td>
<td>The forensic anthropologist as broker for cross-disciplinary taphonomic research related to estimating the postmortem interval in medicolegal death investigations</td>
<td>Daniel J. Wescott</td>
<td>251-264</td>
</tr>
<tr>
<td>13.1</td>
<td>Introduction</td>
<td></td>
<td>251</td>
</tr>
<tr>
<td>13.2</td>
<td>Taphonomy and taphonomic theory</td>
<td></td>
<td>252</td>
</tr>
<tr>
<td>13.3</td>
<td>Forensic taphonomy</td>
<td></td>
<td>254</td>
</tr>
<tr>
<td>13.4</td>
<td>Taphonomy and the estimation of time since death</td>
<td></td>
<td>255</td>
</tr>
<tr>
<td>13.5</td>
<td>The necrobiome</td>
<td></td>
<td>256</td>
</tr>
<tr>
<td>13.6</td>
<td>Cross-disciplinary research</td>
<td></td>
<td>257</td>
</tr>
<tr>
<td>13.6.1</td>
<td>Need for cross-disciplinary research in PMI estimation</td>
<td></td>
<td>257</td>
</tr>
<tr>
<td>13.6.2</td>
<td>Cross-disciplinary approaches</td>
<td></td>
<td>258</td>
</tr>
<tr>
<td>13.7</td>
<td>Overcoming barriers to cross-disciplinary research</td>
<td></td>
<td>262</td>
</tr>
<tr>
<td>13.8</td>
<td>Forensic anthropologists as brokers for unified theories in forensic taphonomy</td>
<td></td>
<td>264</td>
</tr>
<tr>
<td>13.8.1</td>
<td>Forensic anthropologists are already major players</td>
<td></td>
<td>264</td>
</tr>
<tr>
<td>13.8.2</td>
<td>Anthropologists have a long history of conducting taphonomic research</td>
<td></td>
<td>264</td>
</tr>
</tbody>
</table>
13.8.3 Anthropology is traditionally a holistic field, 265
13.8.4 Forensic anthropology has its roots in academic research, 265
13.9 Conclusions, 265
Acknowledgments, 266
References, 266

Part 4 Interdisciplinary influences, legal ramifications, and future directions, 271

14 Archaeological inference and its application to forensic anthropology, 273
  C. Clifford Boyd Jr and William W. Baden
  14.1 Introduction, 273
  14.2 Agency and nonlinear systems theories, 274
  14.3 Nonlinear modeling of the decomposition process, 277
  14.4 Discussion, 284
  References, 292

15 Arrows of influence: The give and take of theory between forensic anthropology, archaeology, and geophysics, 297
  John F. Schweikart and Cheryl A. Johnston
  15.1 Introduction, 297
  15.2 Influences of archaeology on forensic anthropology, 299
  15.3 Influences of geophysics on forensic anthropology, 301
  15.4 “Backflow” to other disciplines: Site formation processes in archaeology, 302
  15.5 Backflow: Interpretation/understanding of geophysical signatures, 303
  15.6 Conclusion, 305
  References, 305

16 Forensic anthropology, scientific evidence, and the law: Why theory matters, 307
  Donna C. Boyd and C. Clifford Boyd Jr
  16.1 Introduction: Theory in practice, 307
    16.1.1 Commonwealth of Virginia v Lockett: Why theory matters, 307
  16.2 Science and the law: The disconnect, 309
  16.3 Science and the law: Commonalities, 310
    16.3.1 Legal and scientific dialogue, 310
    16.3.2 Abductive reasoning, 311
    16.3.3 Probabilistic evaluation of the strength of evidence, 312
  16.4 Forensic anthropologists as expert witnesses, 315
  16.5 Admissibility of forensic anthropology evidence in the post-Daubert world, 316
16.6 The legal application of forensic anthropology: Why theory matters, 318
16.7 Final comments, 319
    Acknowledgments, 320
    References, 320

17 Epilogue: Theory and science in forensic anthropology: Avenues for further research and development, 325
    C. Clifford Boyd Jr and Donna C. Boyd
17.1 The science of forensic anthropology, 325
17.2 Looking forward, 327
    References, 328

Index, 329