

Book Review: Patterns of Growth and Development in the Genus Homo. JL Thompson, GE Krovitz, & AJ Nelson, Eds. 2003. Cambridge University Press.

By: Robert L. Anemone

[RL Anemone](#), (2004) *Patterns of Growth and Development in the Genus Homo*. JL Thompson, GE Krovitz, & AJ Nelson, Eds. 2003. Cambridge University Press. *Journal of Human Evolution*, 46(6):785-787.

Made available courtesy of Elsevier:

<http://www.sciencedirect.com/science/article/pii/S0047248404000570>

*****Reprinted with permission. No further reproduction is authorized without written permission from Elsevier. This version of the document is not the version of record. Figures and/or pictures may be missing from this format of the document. *****

Abstract:

The study of the growth, development, and life history of primates has seen a resurgence of interest among biological anthropologists over the past two decades. In particular, paleoanthropologists have broadened their analyses of fossil hominins to include aspects of development as it relates to phylogenetic and functional questions. As the editors of this volume make abundantly clear in their introductory essay, there are several compelling reasons why paleoanthropologists need to pay attention to the analysis of form and function throughout all life stages. Much evidence suggests that morphological change within and between species often results from ontogenetic changes (e.g., heterochrony), and that understanding the developmental basis of morphological traits is critical to determining their phylogenetic relevance. The editors of this volume have brought together an international group of developmental researchers (originally at a symposium at the 2001 AAPA meetings in Kansas City) and asked them to consider the origins of the distinctively human pattern of growth and development. The result is an interesting volume, highly diverse in its approaches, methods, and data sets, but unified in its overall focus on attempts to understand ontogeny and life history of fossil members of the genus *Homo*.

Keywords: book reviews | biological anthropology | paleoanthropology | human evolution | fossil hominins

Article:

The study of the growth, development, and life history of primates has seen a resurgence of interest among biological anthropologists over the past two decades. In particular, paleoanthropologists have broadened their analyses of fossil hominins to include aspects of development as it relates to phylogenetic and functional questions. As the editors of this volume make abundantly clear in their introductory essay, there are several compelling reasons why

paleoanthropologists need to pay attention to the analysis of form and function throughout all life stages. Much evidence suggests that morphological change within and between species often results from ontogenetic changes (e.g., heterochrony), and that understanding the developmental basis of morphological traits is critical to determining their phylogenetic relevance. The editors of this volume have brought together an international group of developmental researchers (originally at a symposium at the 2001 AAPA meetings in Kansas City) and asked them to consider the origins of the distinctively human pattern of growth and development. The result is an interesting volume, highly diverse in its approaches, methods, and data sets, but unified in its overall focus on attempts to understand ontogeny and life history of fossil members of the genus *Homo*.

In the first of the three sections that comprise this volume, the focus is on exploring the uniqueness of modern human ontogeny as a prelude to later discussions of the growth and development of fossil taxa. The second section concerns early and middle Pleistocene hominins (both *Australopithecus* and *Homo*), while the final section deals with archaic and anatomically modern humans from the late Pleistocene. Each of these units includes a summary chapter by the editors that highlights the results of the individual chapters and offers a useful synthesis of the larger context of this research. The anatomical coverage is quite balanced, with five chapters devoted to studies of craniofacial growth (authored by McBratney-Owen and Lieberman, Strand Viðarsdóttir and O'Higgins, Williams et al., Antón and Leigh, and Krovitz), four on the mandible and dentition (Liversidge, Coqueugniot and Minugh-Purvis, Bermúdez de Castro et al., and Kuykendall), and three on the postcrania (Humphrey, Kondo and Ishida, and Majó and Tillier). The range of methodological and analytical approaches taken by the various investigators is broad and includes geometric morphometric approaches (McBratney-Owen and Lieberman, Strand Viðarsdóttir and O'Higgins, and Krovitz), regression based heterochronic approaches (Williams et al. and Antón and Leigh), and literature reviews (Bogin, Kuykendall, and Liversidge).

A chapter by Bogin presents his influential classification of human life history into five clearly defined stages and his suggestion that the stages of childhood and adolescence (including the presence of an adolescent growth spurt) are unique to humans among living primates. Bogin also includes a useful history of studies of mammalian growth and development, as well as a summary of his well-known thesis on the adaptive significance of adolescence in males and females. Concerning fossil hominins, Bogin suggests that while childhood may have its origins among early (e.g., *H. habilis*) and middle Pleistocene (e.g., *H. erectus*) members of genus *Homo*, adolescence first appears among early *H. sapiens* (possibly including Neandertals). The contribution by Liversidge is a masterful review of the current state of knowledge concerning variation in dental development among modern human populations, including both tooth

eruption and tooth formation. Liversidge is aware of the difficulties of synthesizing much of this literature due to the differing methods of data collection and analysis used by different investigators and the lack of developmental standards for comparison outside of Euro-American populations. In spite of these difficulties, she builds a strong case for the existence of only minimal differences in the timing and pattern of dental development among modern human populations, confirming the orthodox position that the developing dentition is characterized by a less plastic response to environmental perturbations than most other developmental systems (e.g., skeletal). Kuykendall expertly summarizes the wealth of information on the developing dentitions and other details of life history of modern humans, chimps, and australopithecines to argue for the presence of unique ontogenetic patterns among early Pleistocene hominins. Apparent differences between “gracile” and “robust” australopithecines may reflect different adaptive and dietary strategies, but more work needs to be done before we can claim to understand the details of life history variation (and their phylogenetic significance) in these taxa. What is clear from Kuykendall's review is that early Pleistocene hominins predate even the earliest hints of the development of the distinctive modern pattern of human ontogeny.

McBratney-Owen and Lieberman test the hypothesis that facial retraction (“an anteroposteriorly short and superoinferiorly vertical face that is tucked almost entirely underneath the anterior cranial fossa”; pp. 45–46) in anatomically modern humans can be explained by ontogenetic differences in growth of the cranial base and facial skeleton. Digitizing landmarks on cross sectional samples of human and chimp radiographs, the authors use a type of geometric morphometric analysis known as Euclidean distance matrix analysis, or EDMA, to explore the timing and pattern of growth differences in the cranial base and face. This careful and well-executed study provides strong support for the suggestion that craniofacial growth may have been the proximate mechanism for the development of this important autapomorphy of modern humans. Krovitz also uses EDMA to analyze the development of craniofacial shape differences between Neandertals and modern humans and to evaluate their relevance for species-level taxonomy. Her results support a species-level distinction based on the presence of major differences that first appear at an early age (prior to three years of age), persist throughout the entire life span, and which “are also accentuated through localized differences in growth patterns, with different growth events taking place at different times in Neandertals and modern humans” (p. 334).

Although all of the papers in this volume are well written and interesting contributions, this reader found himself wondering at times if the conclusions drawn by some authors were fully warranted by the available data. The chapter by Antón and Leigh on cranial growth and life history of *Homo erectus* provides at least three illustrations of this point. They assert (p. 228) that the modern human adult cranial shape resembles the juvenile shape of its presumed ancestor

Homo erectus (reflecting paedomorphosis) on the basis of a visual (not statistical) comparison of a single three dimensional plot (Fig. 9.1) of angular measurements of the frontal, parietal, and occipital bones in three Asian *H. erectus* specimens, only one of which (Mojokerto) is a juvenile (Sangiran 2 and Ngandong 6 are the adult specimens). They then suggest (pp. 229–230) that the presence of “size and shape dissociations” reveals that the underlying heterochronic process is neoteny. This conclusion is supported by bivariate plots of size (represented by the geometric mean of the three cranial chord measurements) vs. shape (the three cranial bone angular measurements). The data are clearest with respect to the parietal chord measurement (Fig. 9.2), where many of the adult *H. sapiens* points fall in the “*H. erectus* subadult morphospace” (p. 230) and where the regression lines for the two taxa are clearly different in slope and intercept. However, Antón and Leigh define the “*H. erectus* morphospace” by isometric lines (i.e., lines of slope=1 on a log-log plot) drawn through the smallest (and only!) *H. erectus* juvenile skull (Mojokerto) and the smallest adult skull (Sangiran 2). This approach seems unnecessarily ad hoc: presumably, if the smallest fossil skulls in our sample were of a different size, this analysis could yield very different results. Finally, in their attempt to test for the presence of an adolescent growth spurt in the facial skeleton, Antón and Leigh create “arithmetic-velocity curves” for modern human skeletal populations and for the *H. erectus* sample. Although they are well aware of the difficulties in attaining true growth velocity estimates from cross sectional data sets, they suggest that the fossil data are sufficient “to urge caution in dismissing the idea of an adolescent growth spurt in early *H. erectus*” (p. 241). The problems associated with this analysis are severe and exacerbated by the very limited sample of juvenile fossils, great uncertainty concerning the chronological age of these fossils, and the simple fact that growth velocity can only be accurately measured in longitudinal samples (preferably of known chronological age). The surprising degree of variability in the calculated values for growth velocity through adolescence in mandibular height for the two skeletal samples of modern humans (Alaskan and Australian, Table 9.2) does not increase one's confidence in these analytical methods.

What is abundantly clear upon reflecting on the varied contributions to this excellent volume is that growth and development and life history have finally become mainstream components of paleoanthropological inquiry. The contributors to this volume demonstrate that developmental data and life history methods can elucidate taxonomic, functional, and phylogenetic questions of great interest in the study of human evolution. The study of ontogeny truly does lead to a better understanding of phylogeny, although the path is often darkly lit and circuitous.