

## Quirks of Human Anatomy: An Evo-devo Look at the Human Body

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(2009).

By Lewis I. Held, Jr, 260 pp,  
Cambridge University Press.

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*Quirks of Human Anatomy: An Evo-devo Look at the Human Body*, by Lewis I. Held, Jr. is a lively romp through the evolution of the human body – with particular attention to traits that do not work so well, which he calls “quirks”. He wrote the book for last year’s celebration of Darwin’s 200<sup>th</sup> birthday and the 150<sup>th</sup> anniversary of the publication of *Origin of Species*, but it will easily stand on its own now that the champagne has been drunk and the party hats put away. The book is well written, with humor and a real passion for the subject. The illustrations are clear and informative, and, as the text, packed with details.

To quote Held, “This book was written as a kind of amusement park. Its thematic ‘pretend game’ is to inspect each body part through the eyes of an alien visitor who asks, ‘Why is it *this* way and not *that*?’” His answers are based on current developmental genetics, explained within a Darwinian evolutionary framework.

Held organizes his discussion around issues that have long occupied developmental biologists: the symmetry and asymmetry of the body plan, organization along the midline, segmentation and modularity, sexual dimorphism, and the evolution of intelligence. And then he asks questions such as why we are symmetric on the outside but asymmetric within, why our ears start out on our neck, why men go bald, or how and why humans acquired intelligence.

So, why *are* we symmetric outside but asymmetric within?

*The paradox of outer symmetry and inner asymmetry actually makes sense from an evolutionary perspective. Our outer shell of bones and muscles has*

*always served a locomotor function. External symmetry allowed our aquatic ancestors to be streamlined for speed, and it has been retained ever since because it is just as useful for walking as it was for swimming. In contrast, the only locomotory restriction on our inner organs has been that their weight be distributed evenly relative to the midline. (p. 17)*

But, some quirky asymmetries, he says, can be dangerous, such as the fact that we have only one “unilateral pacemaker” in our hearts, when we would be better off if we also had a back-up pacemaker. The book is filled with similar examples of quirky traits that we would be better off without: the ability to choke, cramped teeth, small pelvises in women, which can make childbirth dangerous, a long umbilical cord, which can strangle its bearer, and so on. His point, of course, is that we are clearly not intelligently designed; evolution has done some things well, but others, not so well.

That’s hard to argue with; however, I have a bit of trouble with Held’s frequent invocation of the idea, as above, that the architecture of some traits ‘makes sense’ or not, as though evolution was in the business of being sensible rather than just cobbling traits together from available bits and pieces, and whatever works, works. Another such example is in the list of adaptive quirks of human anatomy on page 137: “Erotic role of breasts (exposed by lack of fur) makes sense as an indicator of fecundity.” In general, there is a bit too much stress on standard Darwinian selectionism in this book for my taste, but I recognize that not every reader will share my view.

The evo-devo perspective he takes is a useful one, but I think he could have developed it further. Evo-devo is a relatively new field devoted to understanding how traits develop and how they evolved. Molecular biology has made fundamental contributions to the field as the function of more and more genes and their pathways during development have become known, and Held gives numerous examples of such genes. In addition, molecular biology has allowed extensive and deep comparison of genes among species, at the DNA sequence level as well as in terms of gene expression and function, to help biologists build a picture of how genes, and the traits to which they contribute, evolved. Evo-devo asks questions such as: Have the same genes and pathways been involved in building similar traits in different species over evolutionary time? Is the sequence of a particular gene conserved among species, suggesting that natural selection had a role in its maintenance? Again, with attention to such questions, Held cites many examples of specific genes and pathways.

But I quibble with Held's evo-devo framework in the following way. He names a lot of genes in this book, and indeed, evo-devo as a field, because

of its emphasis on gene phylogenies and comparative genomics, has itself stressed the role of specific genes in development, and their evolution. But, genes do not explain developmental *processes*, and it is essentially processes that Held is discussing in this book, but he reduces them to the level of single genes, as if they were *the* cause of the trait or *the* most important genes. This may reflect the history of discovery, or important aspects of the gene, but not the cause of the trait. I think his explanations would have been well served by a broader discussion. Indeed, evo-devo is now recognizing that classical protein-coding genes themselves are only a part of the picture, as, for example, the importance of numerous non-translated RNAs in gene expression and thus development becomes clearer, as well as of gene pathways where it is the combination of interacting components that is critical.

In addition, evo-devo is mature enough that we can now discern basic principles from what the field has taught us over several decades, which we can generalize to life on both the developmental and evolutionary time scales. Held flirts with some of these principles (modularity, chance, and the importance of signaling), but he

might have used his quirky examples in service to a broader explanation of evolution and development than he finally arrives at. But this is asking him to have written a different book, I know, and these points are not fundamental to the value of his book.

In his introduction, Held writes that this book is intended primarily for advanced or honor undergraduates. I think the humor and enthusiasm with which Held writes will hold many students' attention, but better still if they have first had a solid foundation in genetics. Otherwise, this will likely be too technically advanced.

Held notes that he includes an extensive bibliography, and indeed, with 2924 references, the bibliography stretches to almost 90 pages in a 240-page book. The thoroughness here is laudable, and indeed the references are useful, except that in a field changing as quickly as evo-devo, references are quickly out-of-date, and the topics readily searchable online anyway.

In conclusion, except for my wish that the book were a more synthetic treatment of evo-devo, this is a nice informative and enjoyably idiosyncratic tour through the evolution of the human form.