



Understanding life through metaphors

Andrew S. Reynolds: Understanding metaphors in the life sciences.
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There is a deep-seated neopositivist view which regards the language of science as a neutral medium of communication, radically different from indirect symbolic forms of discourse characteristic of arts and humanities. But naturalists, like poets and social scientists, also draw on the dominant images in their culture to organize their thoughts and simplify complex concepts. By conceptualizing one thing in terms of another, metaphors in science not only aid mutual communication between researchers but also structure their understanding of experience and reality. Too transparent to be noticed and critically analyzed within the framework of science itself, metaphors act as lenses, making selected aspects of complex phenomena visible to study and investigation (Reynolds 2018). By linking two seemingly unrelated ideas, for example, those of a machine and DNA replication, metaphors establish new interactions of meaning evoking shared associated connotations between these interacting concepts (Black 1962). This, in turn, may not only transform the perception of a target domain but also open up new prospects for experimental and interpretative avenues.

Understanding Metaphors by Andrew Reynolds draws on this vision of metaphors as indispensable tools of scientific thinking to elucidate their role in the life sciences. Following a general presentation of the figurative framework of the life sciences (Chapters 1 and 2), the author provides a synthetic overview of metaphors in genetics (Chapter 3), protein biology (Chapter 4), cell biology (Chapter 5), evolutionary biology (Chapter 6), ecology (Chapter 7) and biomedicine (Chapter 8). Although not exhaustive, the selection of metaphors in the book is representative of the spectrum of these figures of speech showing their diversity and power to transform the life sciences. Indeed, a deeper reflection on this list brings a moment of revelation that the conceptual edifice of science rests on images that resonate with cultural meanings that, if uncritically adopted by the research community, may limit

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scientific inquiry and public understanding. Since technology use and social interactions are among the most tangible aspects of our daily existence, metaphors in the life sciences are accordingly infused with these connotations, making us think about biological structures as computers, machines, factories, or social agents (14–26). As shown in the book, these and other metaphors also have weaknesses and should be used with caution.

For each major metaphor analyzed in the book, Reynolds considers its historical origin, scientific meaning, and adequacy. About the metaphor of natural selection, he writes that it was introduced by Darwin as an analogue of intentional human selection and that despite capturing the process of differential survival and reproduction, it also bears some unwanted anthropomorphic connotations that may obscure the agentless character of the process (94–96). While evaluating metaphors by weighing their positive and negative connotations, Reynolds emphasizes that they should also be considered in terms of their heuristic power and the potential to transform reality. In fact, as shown in the book, metaphors do not only serve to represent biological phenomena in a certain way but also to evoke previously unanticipated inferences and make new theoretical predictions. This is illustrated among other things by circuit-related metaphors in cell biology that helped to formulate questions of signal transduction, transmission, and on/off switching (51–52). If interaction between molecules was not conceived in terms of information and signaling, these vital questions would not arise or would be formulated differently. Finally, as emphasized by Reynolds, metaphors have the potential to guide novel ways of thinking and physically transform reality operating like technological instruments by mediating technological changes in the material world (164). The metaphor of a cell factory brilliantly illustrates this role. Coined in the nineteenth century to represent interconnected chains of chemical reactions in a cell, it was later invoked to embolden gene recombination efforts to turn bacteria into manufacturing plants that synthesize various chemicals on an industrial scale (71–75). While some of these themes were already considered in Reynolds' acclaimed book *The Third Lens* (2018), the present book adds a new dimension to these earlier studies showing how these earlier concepts, as well as new ideas, apply to various branches of the life sciences.

Discussing the historical origin of the metaphors, Reynolds considers their place in the larger culture, as a metaphor needs to resonate with the dominant values and icons of the society to become influential. While aiding mutual communication, this dependence of a metaphor on cultural sources might be a cause of bias and distortion in the understanding of empirical data. This is illustrated by the example of gender stereotypes infusing embryology with associated images, which inform researchers' interpretations of reproductive processes (84–86). As noted by other authors, the transfer of meanings from a society to science, which metaphors mediate, transforms the perception of reality, which in turn can result in a feedback effect on the society (Larson 2011). Examples include the idea of the struggle for existence, which, rooted in the social values of individualism and liberalism, has been used to explain ubiquitous interactions in nature, thereby also legitimizing liberal economy and social Darwinism.

The editors should be commended for including the book in the 'Understanding Life' series, most of whose other volumes deal with scientific aspects of biology and

medicine. By putting the observer in the spotlight, the book ties together disparate scientific topics, showing their embedding in a shared sociolinguistic setting. Clear and concise, the book has an immense didactic value and will serve as a precious teaching aid in history and philosophy classes. However, despite being intended as an entry-level text, the book is more than a synthetic introduction to the subject. Beyond the analysis and evaluation of some of the most iconic metaphors in the life sciences, Reynolds provides a unique perspective on their function and use. More specifically, he advocates the idea that metaphors in science function as hypotheses that, like other provisional conjectures, can be proved or disproved as research progresses (164–167). From this vantage point, connotations that metaphors express are assumed to be objectively given and assessable by the tribunal of evidence like other hypotheses and suppositions. Examples include the “lock and key” metaphor of enzyme action, which conceived as a matching fit of an active site of an enzyme and a specific substrate, fails to conform to evidence showing that the interaction is in fact dynamic and flexible, thereby demanding a replacement with a more adequate “induced fit” model (52–53).

For those science critics who believe that metaphors *create* rather than *articulate* antecedent similarities between a metaphor and its referent, the idea of metaphors as testable hypotheses will seem controversial. Assuming that the rawest of data are already embedded in the figurative code of culture, these authors deny that metaphors can be considered in terms of their veracity, emphasizing instead the role of socio-historical zeitgeists and cultural discourses in shaping the metaphorical corpus of science. However, Reynolds’ idea that reliance on metaphors does not undermine the objective status of science will prove attractive to science-oriented philosophers and biomedical researchers, creating opportunities for new horizons of partnership between researchers in the sciences and the humanities. By showing that dominant images of the wider culture creep into the fabric of scientific thinking to guide the transformation of reality, the book is sure to incite interest in thorough systematic studies of scientific language. The main message is clear: Metaphors are unavoidable elements of science’s conceptual system, but if adopted uncritically, may constrain the understanding of life, unabashedly dictating visions sanctified by the mainstream culture. To liberate science from such a dictatorship, it is necessary to diversify the metaphorical apparatus of science, constantly testing its relevance and usefulness in the light of empirical data.

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