

Love, A.C. (2006) “Looking Beyond Gene Concepts”, (A Review of *What Genes Can't Do* by Lenny Moss, [2004]), *Philosophy of Science* **73**: 247–250.

Lenny Moss, *What Genes Can't Do*, Cambridge, MA: The MIT Press, 2002, 228pp, \$34.95 (hbk), ISBN 026213411X.

Many philosophers of science will have encountered the core distinction between two different gene concepts found in *What Genes Can't Do*. Moss argues that contemporary uses of the term ‘gene’ that denote an information bearing entity result from the conflation of two concepts (‘Gene-P’ and ‘Gene-D’). These concepts arise out of distinct trajectories in the history of biology (preformation and epigenesis, respectively) but are glued together by the rhetoric of linguistic and textual metaphors (e.g. blueprints and programs). Gene-P picks out an instrumentalist use of ‘gene’ as phenotypic indicator or predictor, whereas Gene-D refers to DNA sequences as developmental template resources for RNA and protein products that play variegated cellular roles in the production of many, distinct phenotypes. A number of critical responses to the distinction are now extant in the literature but my aim is to answer a different question. Why should philosophers of science who have not yet read the book be interested in it (besides the fact that it is now available in paperback)? The answer is found at the level of methodology and is relevant to criticisms of Moss’s distinction.

First and foremost, the Gene-P/Gene-D distinction is not the main point of the book. Moss’s thesis is that genes are not the sole source of biological information in the sense of being ‘order’ generating entities. This explains why he devotes considerable time to reconstructing Schrödinger’s argument for a solid-state aperiodic crystal being the basis of biological information. The structure of the book accentuates this. Chapter one traces the historical lineages of Gene-P and Gene-D out of pre-genetic lines of research dichotomized as preformation and epigenesis. Chapter two focuses on the gene-as-text metaphor, engaging both

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history and rhetoric. Chapter three is an extended argument that order is distributed throughout biological systems, reliably passed along via a variety of mechanisms, and not preferentially contained in any particular molecule type. Chapter four sketches the historical development of cancer research using the framework from earlier chapters, which leads to an argument that alternate conceptualizations of carcinogenesis become visible once certain (empirically flawed) commitments to a genetic viewpoint are abandoned. The concluding chapter sketches a methodological and philosophical future for the life sciences conditioned on this analysis.

Three aspects of Moss’s methodology are critical to understanding the nature and significance of his argument. First, the distinction between Gene-P and Gene-D is arrived at *historically*. Tracing the lineages of concepts in the context of research communities with very distinct epistemic commitments is the main strategy for differentiating Genes-P versus Genes-D (and demonstrating their current conflation). Each emerges from opposing viewpoints in the history of biology that are concerned with explaining the origin of form: preformation (order is preexistent and emerges via growth mechanisms) and epigenesis (order is constructed every generation via interactive causal processes). Preformation gained a new lease on life at the turn of the nineteenth century when biologists were willing to shift explanations of form from individual ontogeny to its historical origins in phylogeny. An instrumental gene was the transmission entity that facilitated this shift. Recurring philosophical themes in Moss’s discussion include the conditions for the introduction of theoretical terms and their semantic instability over time in the face of new empirical discoveries. To only argue against his core distinction without addressing the historical methodology and larger argument in which it fits is a deficient philosophical strategy that misses the substance of Moss’s claims. Some philosophers

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of science have recognized this and concentrated explicitly on the historical issues (e.g. Waters 2004).

Second, Moss overtly utilizes metaphor alongside discordant rhetoric. Some readers have found the book mired in jargon and metaphors that leave one continually slipping without semantic *terra firma*. I take this as an intentional component of the analysis because the present tenacity of the Gene-P/Gene-D conflation (according to Moss) is rhetorical glue founded on linguistic metaphors improperly applied to biological materials. Destabilization of metaphorical ‘stickiness’ through the introduction of new metaphors is an argumentative strategy in and of itself. Its effectiveness is another matter, and there are certainly places where the metaphors warrant further discussion. However, the strategy prevents one from returning too quickly to one’s preferred metaphorical grounding. This is not a common style of argument used by philosophers of biology, even those attempting to deflate claims about genes similar to those attacked by Moss. Philosophical style can certainly come in for criticism but it should be recognized as such.

The third methodological feature to flag is the choice of cancer as an exemplar. Cancer biology has not been central to philosophical discussions but it is one of the largest areas of contemporary life science. It highlights the significance of Moss’s argument over and above the distinction between Gene-P and Gene-D since it concerns biological *disorder*. A recent poster advertisement for a textbook on cancer shows a single cell with hundreds of internal components (e.g. proteins associated with particular ‘genes’) in order to illustrate *the* ‘pathways’ to cancer. Moss argues that research has repeatedly pointed toward cancer origination as a *multi*-cellular phenomenon that is not reducible to intracellular dynamics (e.g. mutations in oncogenes) because the ‘order’ lost is not solely located in ‘genes’. The argument subtly draws one back into issues

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surrounding reductionism in biology without lumbering through overworked cases. An additional benefit of using cancer as an exemplar is that it connects philosophy of medicine with the growing prospects and promises of biomedical research.

Given these methodological features, those who have found the Gene-P/Gene-D distinction wanting should reflect on how the distinction was achieved and the context of its use in the entire book. Moss approached his topic motivated by the recognition that there are 'high stakes' involved. Conceptualizations of 'genes' feed into bioethical judgments and interpretations of normalcy, deviancy, and pathology. The target of this book's argument is not just other philosophers or even biologists but a 'powerful social-technical trend' in our culture. Persuasion, not merely positional articulation, is Moss's goal. No wonder then that rhetoric and metaphor are central tactics.

Once methodology is front and center, different criticisms become pertinent. Instead of asking whether the Gene-P/Gene-D distinction illuminates the conceptual practices of biologists, the historical basis for it can be called into question. Moss's historical tale is built around a few touchstone works by historians of biology rather than primary sources. That he leans on these sources does not mean Moss idly reiterates their conclusions; he contributes serious conceptual reconstructions of historical episodes. But returning to the primary sources might yield problematic turns in a historically based argument. Another difficulty related to the main argument concerns the truncated final chapter. After devoting large chunks of time to history, rhetoric, information, and cancer, chapter five ('After the gene') gives only an outline of where to move constructively. As I have suggested, Moss is attempting to push you toward a conceptualization of biological order independent of genes and information. The reader is left wanting much more of this tantalizing alternative.

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This book should be read not only for the distinction between Gene-P and Gene-D but also because the methodology used to formulate it is an unresolved part of philosophy of science; namely, the role of history in philosophical analysis. Once this is recognized, those who have worried about Moss’s distinction might turn their attention to whether his philosophical style combining history, rhetoric, and metaphor is compelling. Or maybe attention will be drawn to his unexplicated use of ‘concept’. What is involved in calling something a ‘gene’ *concept*? How are concepts individuated (Machery 2005)? Now we are no longer just talking about the Gene-P/Gene-D distinction but issues at the foundations of philosophy of science.

Machery, E. (2005), “Concepts Are Not a Natural Kind”, *Philosophy of Science* 72: 444-467.

Waters, C.K. (2004), “What was classical genetics?” *Studies in the History and Philosophy of Science* 35: 783-809.

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