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Volume 37

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Lorenzo Magnani

# The Abductive Structure of Scientific Creativity

An Essay on the Ecology of Cognition



Springer

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*Of the three Universes of Experience familiar to us all, the first comprises all mere Ideas, those airy nothings to which the mind of poet, pure mathematician, or another might give local habitation and a name within that mind. Their very airy-nothingness, the fact that their Being consists in mere capability of getting thought, not in anybody's Actually thinking them, saves their Reality.*

Charles Sanders Peirce, A Neglected  
Argument for the Reality of God, 1908

*To my students*

# Preface

The book addresses a new approach to epistemology I call “eco-cognitive”, which stresses the attention to the question of hypothesis generation and choice, that is to abduction, partially disregarded in the tradition of philosophy of science. I think the intellectual and didactic virtues of this approach resort to the conviction that dynamically seeing at the scientific enterprise in the light of the process of hypotheses generation and withdrawal can provide a unified perspective on various epistemological interdisciplinary aspects, which would otherwise remain fragmented and dispersed.

The book aims at stressing that updated analysis of scientific creativity must take into account:

- The *distributed* and *embodied* nature of scientific cognition, ultimately related to the idea of the importance of the external cognitive tools and mediators in cognition;
- The central role of the dynamics of the production and of the rational handling of hypotheses, by referring to the various *multimodal* aspects of abduction, visual/diagrammatic, verbal-propositional, emotional, and manipulative;
- The fact that science is characterized by a *maximization of abducibility*, performed thanks to specific constraints.

These topics are analyzed in terms of what I consider the main tenets of an eco-cognitive approach to the epistemology of scientific creativity<sup>1</sup>:

1. Chapter 1. Abduction (ἀπαγωγή, in ancient Greek, often translated as “leading away” or “reduction”) is a procedure in which something that lacks classical explanatory epistemic virtue can be accepted because it has virtue of another kind: Gabbay and Woods contend that abduction presents an *ignorance-preserving* or (ignorance-mitigating) character. From this perspective abductive

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<sup>1</sup>A considerable part of the recent academic literature—for example in social epistemology—refers the word epistemology to the whole area of cognitive reasoned activities. In this book I basically adopt its classical intended meaning, which is only referred to scientific cognition.

reasoning is a *response* to an ignorance-problem; through abduction the basic ignorance—that does not have to be considered a total “ignorance”—is neither solved nor left intact. Abductive reasoning is an ignorance-preserving accommodation of the problem at hand. My question will be: is abduction really ignorance-preserving? The answer I propose is that abduction can occasionally be *knowledge-enhancing*, as I will further illustrate in Chap. 3, dealing with the role of models in science. To better examine these topics and to introduce new important epistemological considerations I will describe my *eco-cognitive model* (EC-Model) of abduction.

2. Chapter 2. In science we do not have to confuse the process of abducting models with the process of abducting *fictions*. Scientific models play fundamental “rational” knowledge-enhancing roles: in a static perspective (for example when inserted in a textbook) scientific models can appear fictional to the epistemologist, but their fictional character disappears if a dynamic perspective is adopted and their possible “constitutive” character (of new knowledge) is admitted.
3. Chapter 3. Also in science, as in religion, in morality, in the arts, and in common sense reasoning, knowledge can be enhanced, even when a postulated or discovered hypothesis is not characterized by the need of an empirical evaluation phase, or an inductive phase, as Peirce called it. Hence, abduction can occasionally be *knowledge-enhancing*: in science model-based reasoning often represents one of the most relevant examples of knowledge-enhancing abduction.
4. Chapter 4. Scientific modeling activity can be better described taking advantage of the concept of *epistemic warfare*, which sees scientific enterprise as a complicated struggle for rational knowledge in which it is crucial to distinguish epistemic (for example scientific models) from non epistemic (for example fictions, falsities, propaganda) weapons.
5. Chapter 5. To further deepen the eco-cognitive character of abduction and hypothetical cognition in science a simple genealogy of logic is provided. Aristotle clearly states that in syllogistic theory local/environmental cognitive factors—external to that peculiar inferential process, for example regarding users/reasoners, are given up. At the same time in chapter B25 of the *Prior Analytics* Aristotle presents a seminal perspective on abduction: I contend that some of the current well-known distinctive characters of abductive cognition, and of abductive cognition in science, are already expressed, which are in tune with my EC-Model. By referring to the role of the method of analysis and of the middle terms in Plato’s dialectic argumentation, considered as related to the diorismic/poristic process in ancient geometry, Aristotle is still pointing to the fundamental inferential and “distributed” role in reasoning of those externalities that substantiate the process of “leading away” (and expression which also translates what Aristotle calls ἀπαγωγή, that is “abduction”).
6. Chapter 6. When dealing with the so-called “inferential problem”, which affects current research in logic and epistemology, I will opt for the more general



concepts of input and output instead of those of premisses and conclusions. From this perspective abductive inferences can be first of all seen as related to logical processes in which input and output fail to hold each other in an expected relation, with the solution involving the modification of inputs, not that of outputs. The chance of finding an abductive solution still appears to depend on the Aristotelian concept of “leading away” (*ἀπαγωγή*), that is, on the starting of the application of a supplementary logic implementing an appropriate formal inference engine. In this perspective—and given the fact science produces and “maximizes” cognition through a process in which affirming truths implies negating truths—the most important consequence for epistemology I can clearly derive is that irrelevance and implausibility are not always offensive to reason. We cannot be sure, more broadly, that our guessed hypotheses are plausible (even if we know that looking—in advance—for plausibility is a human good and wise heuristic), indeed an implausible hypothesis can later on result plausible.

7. Chapter 7. The analysis of abductive processes illustrated in the previous chapters in terms of the effort to naturalize the logic of its special consequence relation, leads us to the emphasis on the importance of the following main aspects: “optimization of eco-cognitive situatedness”, “maximization of changeability” of both input and output, and high “information-sensitiveness”. Furthermore, a naturalized logic of abduction must acknowledge the importance of keeping record of the “past life” of abductive inferential praxes, contrarily to the fact that traditional demonstrative ideal systems are prototypically characterized by what I call “maximization of memorylessness”. In this perspective I will provide an analysis of the importance of the *maximization of abducibility*, which is typical of science, together with a discussion of the relevance of the various aspects above for epistemology.
8. Chapter 8. In this chapter I will analyze some important aspects of the organization of research and development (R&D) in the case of biopharmaceutical companies, which represent a prototypical situation of what I call impoverished epistemic niches. At least in this case we clearly see a challenge to the epistemic integrity of modern science. Taking advantage of the logical and cognitive studies illustrated in the previous chapters, which emphasize the crucial role played in abductive cognition by the so-called “optimization of eco-cognitive openness and situatedness”, this chapter first of all aims at illustrating the importance of *knowledge in motion*—in multidisciplinary, interdisciplinary, and transdisciplinary scientific research. Various subsections also introduce the hot problem of the current emergence of disparate kinds of “*epistemic irresponsibility*”. Interesting cases related to the commodification and commercialization of science, marketing of technoscientific products, impoverishment of the so-called epistemological niches are illustrated, which show that human fruitful abductive cognition in science is increasingly assaulted and jeopardized, and at

the same time human creativity seriously endangered. The challenges against human abduction and epistemic rigor on the part of what I call computational invasive “subcultures” and unwelcome effects of selective ignorance are finally illustrated.

As an appendix, the reader may find a *Lexicon of Abductive Cognition in Science*, in which I summarize the main aspects of abduction illustrated in the present book.

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Lorenzo Magnani

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