

# Phenotypic Plasticity

Beyond Nature and Nurture

MASSIMO PIGLIUCCI

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## Foreword

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Research on phenotypic plasticity has been at the forefront of evolutionary thinking for the last two decades or so. Diversity generated by the ability of any particular genotype to adjust its development and, therefore, phenotype in response to the environment can be dramatic. However, few books on this subject have appeared, which makes this offering a most timely one. Without doubt this book demonstrates why phenotypic plasticity has become so fascinating to many biologists, especially to those who share a bent toward multidisciplinary approaches. Like-minded researchers are most excited by those topics that reflect intersecting areas of biology. In my opinion these are precisely where the opportunities to achieve the most innovative and important insights lie. Phenotypic plasticity must be one of the more striking phenomena in need of integration across different areas of biology. As such it represents both a formidable challenge and an exciting opportunity for research. To study plasticity effectively one needs to be a biologist of many colors: a geneticist, a physiologist, a developmental biologist, an ecologist, and an evolutionary biologist. I think the challenging nature of the topic is also evident in a healthy level of controversy, especially with regard to the nature of genes for plasticity. This book rises admirably to the challenge.

Historically, attempts to integrate ecology and genetics have sought to study the genetic basis of phenotypic variation in natural populations and the ways in which such variability is influenced by natural selection. It can, however, be very difficult to identify the specific targets of selection. Some examples of plasticity can prove excellent tools for exploring natural selection in the wild and addressing the question of to what extent plasticity is the result of adaptive evolution. The other side of the coin—that plasticity can reflect constraints on the ability of organisms to develop optimal phenotypes across environments—is also receiving avid attention.

The ways in which genes map onto phenotypes in natural populations have represented something of a black box in the history of evolutionary ecology. Once again, phenotypic plasticity can provide wonderful material for opening this box. How are developmental pathways within an individual organism modulated to produce the alternative phenotypes? The present opportunities for identifying genes to match up with the developmental and physiological mechanisms are endless. To do this in the context of phenotypes of evolutionary significance in natural populations is an exciting goal indeed. Functional genomics will only provide yet more tools and technologies for further exploration of the developmental and physiological mechanisms underlying the ability to express phenotypic plasticity.

The environment of an individual of a given genotype not only is critical in shaping how it is influenced by natural selection but also may profoundly affect the phenotype it will produce during development. Again the different levels of interaction between genotype, environment, and phenotype are at the heart of thinking about the evolution of phenotypic plasticity, and such complexity is part of its challenge. Those interactions between genotype and environment that are the basis for the evolution of plasticity should provide a cautionary tale to those applying functional genomics: Gene expression may be highly dependent on both external and internal environment.

At the same time that phenotypic plasticity presents such opportunities to the empiricist to explore fundamental issues in biology, the field as a whole has also benefited greatly from contributions from theoretical biology. These have provided both extremely useful frameworks for the empiricists as well as unique insights into how organisms can adapt to spatial or temporal heterogeneity in their environments.

All these issues and many more are explored in this timely and wide-ranging book. It shows what has been achieved but also sets the scene for the many exciting discoveries that the burgeoning molecular world will increasingly open up. Fortunately, the topic of phenotypic plasticity will continue to draw together biologists working with organisms in nature, in the laboratory, and in the test tube.

Paul Brakefield  
Leiden University, The Netherlands