

Preface

Behaviors are the ultimate expression of the nervous system. They manifest themselves as spontaneous activities or as appropriate responses to events that take place in our environment, actions that occur after integrating sensory input, physical needs, and social constraints, within the context of our individual personalities and based on previous experience. Truly, our behaviors reflect our humanity. In a much broader context it is clear that, in the animal kingdom, behaviors are essential for survival and procreation. Thus, behaviors provide the stage on which natural selection can act, and represent a vehicle for evolution. Behaviors depend on the developmental history of the individual, its genetic composition, the connectivity of its nervous system, its physiological state, its physical and social environment, and, at the molecular level, ultimately the carefully-orchestrated interplay of a host of biochemical reactions. Indeed, one might fairly say that behavior provides a window through which we can view much of biology.

During most of the twentieth century, studies on behavior were almost entirely descriptive. Understanding the complexity of behavior from molecular detail to organismal integration was considered a daunting, virtually intractable challenge. This changed with rapid advances in neuroscience during the last quarter of the century and the subsequent genomic revolution, which provided scientists with unprecedented opportunities to study the “genes–brain–behavior” axis, which is the underlying genetic principle that enables the nervous system to express behaviors. Neuroscience has led the way in this endeavor, and a variety of excellent textbooks on behavioral neuroscience have become available. Comprehensive textbooks on the genetics of behavior, however, are far and few between, although the pioneering text of 1974 by McClearn and DeFries deserves mention, as does the 2000 edition of *Behavioral Genetics* by Plomin et al., which focuses especially on human cognition.

Here, we have attempted to define the field of behavioral genetics as a comprehensive discipline that encompasses both studies on model organisms and people, with emphasis on unifying principles whenever possible. Whereas this book treats the study of behavior deliberately from a genetics viewpoint, we recognized that neurobiological and ecological aspects could not be ignored, but had to be integrated with the text. Furthermore, behavioral genetics cannot be discussed without touching on evolutionary genetics and gene flow in populations.

Behaviors are complex traits that result from the coordinated action of multiple segregating genes that are sensitive

to environmental conditions. Thus, behavioral genetics falls into the realm of quantitative genetics, and a basic understanding of quantitative genetic principles is essential if one is to understand how the genome enables the expression of behavior. Genes that contribute to behavior fall into two classes, those that contribute to the *manifestation* of behavior, and a subset of these genes that give rise to *variation* in behavior. The former can be studied through mutagenesis; the latter requires classical quantitative genetic approaches.

In the first half of the book, we present an introductory chapter that describes the history of the fledgling field of behavioral genetics, followed by chapters that describe the essentials of the function and organization of the nervous system, and chapters that are designed to provide the reader with a basic understanding of quantitative genetic principles. The second part of the book focuses on a range of commonly-studied behaviors, including social behaviors, chemoreception, learning and memory, locomotion, circadian activity and sleep, and addiction. Each chapter has an overview that describes the material to be covered, and a summary that reiterates the major principles. Text boxes with ancillary information are provided throughout, along with study questions that will help the student master the material, and a list of recommended reading of classical and contemporary papers. A glossary of terminology is included for the reader's convenience.

Draft chapters of this book have been used to teach a course on Principles of Behavioral Genetics at North Carolina State University in the fall of 2008. We received valuable feedback, both from students and postdoctoral trainees, which was greatly appreciated. We would like to thank especially Elaine Smith and Susan Harbison for valuable and perceptive comments on Chapter 14 and Chapter 11, respectively. Our colleagues at North Carolina State University John Godwin, Robert Grossfeld, Christina Grozinger, and Jane Lubischer also provided valuable input on several of the chapters. Special thanks are due to Mariana Wolfner from Cornell University for critical reading and detailed editing of many of the chapters, and to Hans Hofmann from the University of Texas at Austin for critical reading of Chapter 16. Numerous colleagues have provided us with reprints or preprints of manuscripts to help in the preparation of this book. They are John Carlson (Yale University), Joshua Dubnau (Cold Spring Harbor Laboratories), Howard Edenberg (Indiana University School of Medicine), Hopi Hoekstra (Harvard

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For instructors, you will also find assessment questions with recommended answers for your convenience.