

Preface

Behavior genetics is an interdisciplinary area combining the behavioral sciences and genetics. The study of behavior genetics has become increasingly important as we see growth spurts in finding genes involved in complex behaviors following on advances in molecular genetic techniques. This domain has been growing rapidly since the 1970s and increasingly receives attention from many different disciplines. It has now become a vast common ground for scientists from very diverse fields including psychology, psychiatry, neurology, endocrinology, biochemistry, neuroimaging, and genetics.

When I was invited to organize this book by Springer, I was preparing for a new course, *Behavior Genetics*, at the University of Georgia in fall, 2005. Only a few textbooks were available at that time, but I could not find good references for graduate students and scientists. I thought that we needed to offer research guides to the studies of genetic and environmental influences on a variety of complex behaviors in humans and animals. I had little idea about the proper scope for such a book. I contacted senior colleagues of the Behavior Genetics Association and they gave me excellent advice. I initially invited contributors who were largely members of the Behavior Genetics Association and the handbook was outlined with 14 chapters. As the Handbook developed, it became clear that the first draft was not sufficient to cover all important domains in behavior genetics. In the second meeting with contributors during the BGA meeting in Hollywood, CA, we discussed expanding the handbook to other related domains, such as evolutionary psychology, health behavior, and neurosciences. I invited additional contributors from other disciplines, and added chapters on the history of behavior genetics, quantitative methods and models, as well as more studies of animal models. Now the handbook stands with 34 chapters and integrates many of the basic issues in behavior genetics. *In each chapter, current research and issues on the selected topics are intensively reviewed and directions for future research on these topics are highlighted: new research designs, analytic methods, and their implications are addressed.* It is anticipated that the handbook will contribute to our understanding of behavior genetics and future research endeavors in the 21st century.

Chapter 1 addresses a history of behavior genetics going back to some of Plato's ideas and discusses the nature–nurture controversies on behavior in the modern era which sometimes brought about uproar in our community. In Part I, we address designs and methods in behavior genetic research. Chapters 2 and 4 introduce statistical models and analyses, i.e., biometrical models and multivariate genetic analyses, which explain genetic and environmental causes of covariation between quantitative traits and comorbidity between disorders. In Chapter 3, quantitative trait locus (QTL) analysis is introduced and methods of linkage and association mapping of continuous traits are discussed. Results of the QTL analyses in several quantitative traits are presented throughout this volume. Chapter 5 addresses the importance of animals as models of human behaviors – cognition, personality, and pathology are presented in this volume.

Part II addresses the genetics of cognition in humans and animals with nine selected topics. Chapter 6 discusses genetic and environmental influences on general intelligence using

twin studies, followed by new twin research designs, analytic methods, findings, and their implications. In Chapter 7, behavioral genetic research on cognitive aging is reviewed: genetic and environmental contributions to age-related changes in cognitive abilities; contributions of genes and lifestyle variables to dementia, and to the terminal decline in cognitive functioning; and quantitative methods for investigating cognitive aging are presented. Chapter 8 addresses behavioral genetic research on reading, and the genetic and environmental etiologies of reading ability and disability are discussed. Chapter 9 explores behavioral and molecular genetic studies elucidating the role of the genome in the development and manifestation of disorders of speech and language. The human brain continues to show dynamic changes from childhood into adulthood. Genetic and environmental influences in brain volumes are addressed in Chapter 10. Using quantitative magnetic resonance imaging (MRI), brain structures in patients with a clear genetic etiology are reviewed. Genetic approaches to the search for genes associated with brain volume are discussed. Cognitive abilities in animals as models of human behavior are presented in Chapters 11, 12, 13, and 14. Quantitative and molecular genetic approaches to cognition research in rodents are presented in Chapter 11. Cognitive deficits affected by genetic manipulations and mouse models for human cognitive disabilities are discussed. Specifically, Chapter 12 reviews human cognitive impairment associated with chromosomal abnormalities, and mouse models of trisomy 21 are discussed addressing the relationships among genes, brain, and cognitive function. *Drosophila* (fruit fly) models of Alzheimer's disease are introduced in Chapter 13. Pathological roles of A β peptides in fly brains, memory defects, and locomotor dysfunctions are discussed. Chapter 14 addresses *Drosophila* courtship songs which are utilized for intersexual selection and species recognition in nature. Quantitative and molecular genetic studies on the phylogenetic patterns of song evolution in different species groups are reviewed.

In Part III, the genetics of personality in humans and animals is addressed with 10 selected topics. Personality is influenced by both genes and environment during development. Chapter 15 explores genotype–environment correlation through a review of the behavioral genetic literature on genetic and environmental influences on family relationships. It is very important that behavioral genetic models that measure behaviors of interest reflect the content of the domains. Chapter 16 reviews behavioral genetic methods and models for personality research and theory, and addresses some methodological issues. Chapter 17 addresses the roles of specific genes, i.e., DRD4 and 5-HTTLPR genes, contributing to the multifaceted dimensions of human personality, including altruism. Temperament, developing early in life and possibly forming the basis for later personality and psychopathology, is explored in Chapter 18 in which quantitative and molecular genetic findings, as well as endophenotypic approaches, are discussed. Sexual orientation is a controversial issue in our communities. A growing body of evidence suggests that familial and genetic factors affect human sexual orientation. Quantitative and molecular genetic studies on sexual orientation are reviewed in Chapter 19. Three chapters introduce animal models of personality and aggression. Chapter 20 explores personality differences in rats widely used in laboratories and discusses anatomical and neurochemical analyses in this endeavor. Behavioral and genetic research on offensive aggression in mice is reviewed and comparative genetic studies of aggression across species are addressed in Chapter 21. Chapter 22 discusses aggressive behavior in fruit flies from the ecological, genetic, neurological, and evolutionary perspectives. Approximately 10% of the population are left-handers. The history, determination, and etiology of handedness are addressed in Chapter 23. Chapter 24 introduces exercise behavior as a new discipline in behavior genetics. A large proportion of adults in the world do not regularly engage in exercise, although benefits of exercise are well documented. Genetic determinants of variability in exercise behavior are discussed.

In Part IV the genetics of psychopathology is represented with nine selected topics. Some psychiatric disorders like ADHD are only diagnosed by questionnaires or psychiatric interviews, rather than by clinical tests, and consequently the genetic studies of the disorders can vary as a function of applied assessment methods and informants. Chapter 25 addresses such behavioral measure issues concerning ADHD. Depression and anxiety have their origins

in childhood and arise from genetic and shared environmental effects. Epidemiological and behavior genetic research on childhood depression and anxiety are discussed in Chapter 26. Autism is familial and, thus, relatives of probands with autism are at high risk for depression, anxiety, and personality attributes. Chapter 27 reviews current findings in the genetic epidemiology of autism and its etiological issues concerning the definition of autism phenotypes are discussed. Two chapters address substance abuse behaviors, that is, smoking, drugs, and drinking. Smoking behaviors aggregate in families and in peer networks due to genetic dispositions and common environmental influences. Chapter 28 reviews behavioral genetic research on smoking behavior and nicotine dependence, using Finnish sample studies, and its comorbidities with other substance use, depression, and schizophrenia are discussed. Behavioral and molecular genetic research on the use and abuse of both alcohol and drugs is reviewed in Chapter 29. Substance abuse and substance use disorder co-occur with conduct disorder and antisocial behavior. Chapter 30 gives results of a meta-analysis of twin and adoption studies examining genetic and environmental influences on conduct disorder and antisocial behavior. Association and linkage studies for genes influencing antisocial behavior are discussed. Chapter 31 explores the behavioral and molecular genetic approaches to the origins of two major psychoses: schizophrenia and bipolar mood disorder. The concept of endophenotypes, which are measured intermediate traits or states between genotypes (genetic liability) and phenotypes (disorders), is discussed. Chapter 32 discusses indepth longitudinal "high-risk" studies that intend to identify endophenotypes in the first-degree relatives of schizophrenic probands and to offer putative behavioral predictors of future schizophrenia spectrum disorders. Mouse models of cognitive dysfunctions in schizophrenia are explored in Chapter 33 where the role of dopamine in attention and working memory is discussed. Finally, in Chapter 34, future directions for behavior genetics are addressed.

It is not surprising that, at the final publication date of a book like the *Handbook of Behavior Genetics*, research has moved on. In 2008 we saw the publication of genome wide association studies for Bipolar disorder (Ferreira et al., 2008), for five dimensions of personality (Terracciano et al., 2008), ADHD (Neale et al., 2008) and major depressive disorder (Sullivan et al., 2008). Many more GWA studies of complex behavioral and psychiatric phenotypes are expected in the next few years. The landscape of behavior genetics has changed remarkably in a relatively short space of time. The field continues to progress from comparatively small studies to consortia-based efforts that target the inherited components of complex diseases and behaviors and which typically involve thousands of participants (Orr & Chanock, 2008).

References

- Ferreira, M. A., O'Donovan, M. C., Meng, Y. A., Jones, I. R., Ruderfer, D. M., Jones, L., et al. (2008). Collaborative genome-wide association analysis supports a role for ANK3 and CACNA1C in bipolar disorder. *Nature Genetics*, 40, 1056–1058.
- Neale, B. M., Lasky-Su, J., Anney, R., Franke, B., Zhou, K., Maller, J. B., et al. (2008). Genome-wide association scan of attention deficit hyperactivity disorder. *American Journal of Medical Genetics B Neuropsychiatric Genetics*, 147B, 1337–1344.
- Orr, N., & Chanock, S. (2008). Common genetic variation and human disease. *Advances in Genetics*, 62, 1–32.
- Sullivan, P. F., de Geus, E. J. C., Willemsen, G., James, M. R., Smit, J. H., Zandbelt, T., et al. (2008). Genome-wide association for major depressive disorder: a possible role for the presynaptic protein piccolo. *Molecular Psychiatry*, 1–17.
- Terracciano, A., Sanna, S., Uda, M., Deiana, B., Usala, G., Busonero, F., et al. (2008). Genome-wide association scan for five major depressions of personality. *Molecular Psychiatry* (in press).