

Foundations of Behavior Genetics

Foundations of Behavior Genetics provides a forward-looking introduction to this fascinating field. Written by an experienced teacher and researcher, this text focuses on concepts, methods, and findings that inform our understanding of heredity–behavior relations.

The book’s neuroscience perspective asks students to think about potential neural mechanisms involved in pathways from genes to behavior. While the text is primarily focused on human behavior genetics, it also emphasizes the importance of non-human animal models in experimental studies, as well as their evolutionary connections to humans.

Part I covers the history of behavior genetics and the basics of non-molecular genetics; Part II discusses molecular genetics and neurogenetics; Part III addresses various behavioral disorders; and Part IV explores health, social behavior, and ethical implications.

The text includes detailed chapter summaries, several “Check-up” questions after major sections that test student understanding, and recommended readings. Instructors are provided with a test bank of multiple-choice items and hi-res JPEGs of the many illustrations created for the book.

Professor Scott F. Stoltenberg has taught and conducted research at the University of Nebraska since 2009. He has previously taught at Black Hills State University and done research at the University of Michigan. He earned his BS from Saint John’s University (MN) and his Ph.D. in Psychology from the University of Illinois at Urbana-Champaign. He has conducted behavior genetic research for more than three decades, first with fruit flies and then with human participants. He teaches courses in behavior genetics, addiction, and neuroscience.

Foundations of Behavior Genetics

SCOTT F. STOLTENBERG

University of Nebraska–Lincoln



CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE
UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of the University of Cambridge. It furthers the University's mission by disseminating knowledge in the pursuit of education, learning, and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/highereducation/isbn/9781108487979

DOI: 10.1017/9781108768412

© Scott F. Stoltenberg 2023

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2023

Printed in the United Kingdom by TJ Books Limited, Padstow Cornwall 2023

A catalogue record for this publication is available from the British Library.

Library of Congress Cataloging-in-Publication Data

Names: Stoltenberg, Scott F. author.

Title: Foundations of behavior genetics / Scott F. Stoltenberg.

Description: New York, NY : Cambridge University Press, 2023. | Includes bibliographical references and index.

Identifiers: LCCN 2021035044 (print) | LCCN 2021035045 (ebook) | ISBN 9781108487979 (hardback) | ISBN 9781108768412 (epub)

Subjects: MESH: Genetics, Behavioral | Genetic Variation | Mental Disorders—genetics

Classification: LCC QH443 (print) | LCC QH443 (ebook) | NLM QU 450 | DDC 572.8/77—dc23

LC record available at <https://lcn.loc.gov/2021035044>

LC ebook record available at <https://lcn.loc.gov/2021035045>

ISBN 978-1-108-48797-9 Hardback

Additional resources for this publication at www.cambridge.org/stoltenberg

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

**To Jerry Hirsch, for giving me an opportunity, providing unwavering support,
and for leading by example.**

Brief Contents

List of Figures	xiv
List of Tables	xviii
List of Boxes	xix
Preface	xxi
Acknowledgments	xxiii

Part I Fundamentals

1 Introduction to Behavior Genetics	3
2 Mendelian Genetics	25
3 Heritability	46

Part II Molecules and Cells

4 Genes	73
5 Genetic Variation	94
6 Neurogenetics	117

Part III Behaviors and Behavioral Disorders

7 Serious Mental Illness	145
8 Learning and Memory	169
9 Emotion and Depressive Disorders	194
10 Fear and Anxiety	222
11 Addiction	248

viii **Brief Contents**

Part IV Health, Social Behavior, and Implications

12 Eating and Exercising	279
13 Social Behavior	306
14 Behavior Genetics in Real Life	331
15 Eugenics	351
Glossary	372
Index	394

Contents

List of Figures	xiv
List of Tables	xviii
List of Boxes	xix
Preface	xxi
Acknowledgments	xxiii

Part I Fundamentals

1 Introduction to Behavior Genetics	3
1.1 A Brief History of Behavior Genetics	3
1.2 Behavior Genetics Focuses on Understanding Individual Differences in Behavior	10
1.3 Pathways from Genes to Behaviors Cross Levels of Analysis	13
1.4 Non-Human Animal Models Are Essential in Behavior Genetics	16
1.5 Ethical Oversight of Behavior Genetic Research Is Necessary	20
1.6 Summary	22
Recommended Reading	22
References	23
2 Mendelian Genetics	25
2.1 Developments in Science, Agriculture, and Medicine Set the Stage for Understanding Heredity	25
2.2 Early Thinking about Generation	26
2.3 Gregor Mendel: Early Depression and Failures	29
2.4 Experimental Hybridization Was the Key	30
2.5 Mendel's Law of Segregation Describes Inheritance of a Single Locus	32
2.6 Mendel's Law of Independent Assortment Describes Inheritance of Multiple Loci	35
2.7 Mendel's Laws Are Used to Map Relative Positions of Genes on Chromosomes	36
2.8 Mendelian Disorders in Humans Are Caused by Variants in Single Genes	42
2.9 Summary	44
Recommended Reading	45
References	45

x Contents

3 Heritability	46
3.1 Genetic Factors That Affect Quantitative Traits Are Inherited in Mendelian Fashion	46
3.2 Phenotypic Variation in a Population May Be Due to Genetic and Environmental Sources	48
3.3 Genetic Variance May Be Due to Polygenes, Dominance, and Epistatic Interactions	52
3.4 There Are Many Sources of Environmental Variance	53
3.5 Heritability Indexes Degree of Phenotypic Variance Due to Genetic Effects	58
3.6 Beware of the Potential for Misunderstanding and Bias	66
3.7 Summary	67
Recommended Reading	68
References	68

Part II Molecules and Cells

4 Genes	73
4.1 Chromosomes Carry Hereditary Material	73
4.2 The Structure of DNA Determines Its Functions	77
4.3 DNA Replication Involves Making Copies	80
4.4 DNA Sequence Specifies Amino Acid Sequence in Proteins	81
4.5 Epigenetic Processes Regulate Gene Expression	85
4.6 What Is a Gene?	89
4.7 Summary	92
Recommended Reading	93
References	93
5 Genetic Variation	94
5.1 There Are Different Types of Genetic Variation	94
5.2 How Genetic Differences Play a Role in Phenotype Differences	99
5.3 Assessing Genetic Variation	102
5.4 Non-Experimental Methods: Testing Associations between Genetic Variants and Behavior	107
5.5 Experimental Methods: Generating Genetic Variation	110
5.6 The Human Genome Project Changed Biomedical Science	113
5.7 Summary	115
Recommended Reading	115
References	116

6 Neurogenetics	117
6.1 Neurons Are Cells Specialized for Communication	117
6.2 Genetic Variation for Neural Components Is Common	122
6.3 Formation and Maintenance of Synapses and Circuits Depends on Genes	126
6.4 Genetic Variation Affects Neural Activation Patterns	131
6.5 Genetic Variation Can Moderate the Impact of Drugs on Neural Activity	136
6.6 Summary	140
Recommended Reading	140
References	141
Part III Behaviors and Behavioral Disorders	
7 Serious Mental Illness	145
7.1 Mental Illness and Its Impact	145
7.2 Risk for Developing Mental Illness	147
7.3 How Should Behavior Genetics Researchers Think About Mental Illness?	149
7.4 Schizophrenia Signs, Symptoms, and Diagnostic Criteria	154
7.5 Neurobiology of Schizophrenia	155
7.6 Schizophrenia Genetics: Heritability	157
7.7 Schizophrenia Genetics: Molecular Genetics	159
7.8 Schizophrenia Genetics: Non-Human Animal Models	163
7.9 Summary	165
Recommended Reading	165
References	166
8 Learning and Memory	169
8.1 Intelligence Is Indexed by IQ Tests	169
8.2 Intellectual Disability Is a Developmental Disorder with Multiple Causes	171
8.3 Learning Disorders Are Not Considered Intellectual Disabilities	177
8.4 Memory Is a Crucial Aspect of Cognitive Ability	179
8.5 Alzheimer Disease Is a Common Cause of Neurocognitive Disorder	184
8.6 Summary	189
Recommended Reading	190
References	190
9 Emotion and Depressive Disorders	194
9.1 Emotions Prepare for Action and Communicate	194
9.2 There Are Many Ways to Measure Emotion	196
9.3 Emotion Regulation Difficulties May Lead to Psychopathology	199
9.4 Mood Disorders Are Common, and Symptomatically Heterogeneous	201

xii Contents

9.5	Prevalence and Symptoms of Depressive Disorders	204
9.6	The Genetic Epidemiology of Depressive Disorders	206
9.7	Efforts to Characterize Genetic Mechanisms of Depressive Disorders Are Ongoing	208
9.8	Genetic Evidence from Non-Human Animal Models	212
9.9	Summary	216
	Recommended Reading	217
	References	218
10	Fear and Anxiety	222
10.1	Fear and Anxiety Are Defensive Responses to Threats	222
10.2	The Genetics of Fear and Anxiety in Mice	225
10.3	Anxiety-Related Personality Traits as Phenotypes for Genetic Analysis	229
10.4	Anxiety Disorders Are Common	231
10.5	Anxiety Disorders Run in Families and Are Polygenic	234
10.6	Obsessive-Compulsive and Related Disorders	237
10.7	Trauma- and Stressor-Related Disorders	240
10.8	Summary	243
	Recommended Reading	244
	References	244
11	Addiction	248
11.1	Addiction Is Characterized by Impaired Control Over Substance Use, Tolerance, and Withdrawal	248
11.2	The Neurobiology of Addiction	254
11.3	Non-Human Animal Models of Alcohol Use Disorder Genetics	257
11.4	Alcohol-Related Traits and Alcohol Use Disorder Run in Families	262
11.5	Alcohol Metabolism Genes Affect Risk for Alcohol Use Disorder	265
11.6	There Are Many Genes That Contribute to Risk for Alcohol Use Disorder	269
11.7	Summary	273
	Recommended Reading	273
	References	273
Part IV Health, Social Behavior, and Implications		
12	Eating and Exercising	279
12.1	Eating and Exercising in Context	279
12.2	Genetic Variation Partially Explains Risk for Obesity	284
12.3	Genetic Variation Partially Explains Risk for Eating Disorders	289
12.4	Exercise Motivation and Benefits Show Genetic Influence	296

12.5 Summary	301
Recommended Reading	302
References	302
13 Social Behavior	306
13.1 Individual Differences in Social Behavior Are an Important Part of Life	306
13.2 The Neurobiology of Social Behavior	309
13.3 Individual Differences in Social Cognition and Sociability	311
13.4 Affiliation and Attachment	314
13.5 Sexual Behavior Circuits	320
13.6 Aggression: Harming Someone Else	324
13.7 Summary	326
Recommended Reading	327
References	327
14 Behavior Genetics in Real Life	331
14.1 Direct-to-Consumer Genetic Testing	331
14.2 Precision Medicine for Mental Illness	337
14.3 Behavior Genetics and the Justice System	340
14.4 Designer Babies	343
14.5 What Use Is Behavior Genetics?	345
14.6 Summary	348
Recommended Reading	349
References	349
15 Eugenics	351
15.1 Social Darwinism	351
15.2 Galton's Theory and Its Reception	354
15.3 The Eugenics Records Office in the United States	356
15.4 Involuntary Sterilization Laws and Immigration Policies	359
15.5 America Exports Eugenics to Nazi Germany	364
15.6 Race and Its Place in Behavior Genetics	366
15.7 Summary	369
Recommended Reading	370
References	370
Glossary	372
Index	394

Figures

1.1	Familial resemblance	4
1.2	Locke and Darwin	4
1.3	Francis Galton	6
1.4	Morphological variation in dog breeds	7
1.5	Thomas Hunt Morgan	8
1.6	Logo of the Second International Congress of Eugenics, 1921	9
1.7	Three commonly used behavioral measures	11
1.8	Levels of analysis	14
1.9	Three main questions in behavior genetic research	15
1.10	Key model organisms in behavior genetics	18
2.1	Breeds of sheep	26
2.2	Homunculus	27
2.3	Qualitative and quantitative traits	27
2.4	Bakewell's New Leicester sheep	28
2.5	Gregor Mendel	30
2.6	Traits of the garden pea	31
2.7	Monohybrid cross of pea shape	32
2.8	Theoretical model of a monohybrid cross of pea color	33
2.9	Punnett squares for a monohybrid cross of pea shape	34
2.10	Dihybrid cross	35
2.11	Sex-linked white eye mutation	38
2.12	Dihybrid cross with mutants for sepia eye and vestigial wings	38
2.13	Backcrossing vestigial wings and black body mutants	39
2.14	No recombinant types produced when male F_1 generation males are backcrossed to parental line females	40
2.15	Crossing over and map distance	40
2.16	Hypothetical pedigrees showing different inheritance patterns	43
3.1	Height is normally distributed in populations	47
3.2	Polygenic inheritance can approximate the normal distribution	48
3.3	Partitioning phenotypic variance	49
3.4	Variance partitioning in a hypothetical study of depression-like behavior	50
3.5	A laboratory mouse and a standard cage	51
3.6	Dominance and epistasis	52
3.7	Patterns of $G \times E$ interaction	55
3.8	Genotype–environment correlations	57
3.9	Pedigree indicating genetic relatedness to a proband	59
3.10	Heritability estimates of temperament traits in cattle	60
3.11	Types of twins	61
3.12	Selection for depression-like behavior in rats	65
4.1	Human karyotype	74
4.2	Meiosis	75
4.3	Mitosis	76
4.4	Watson and Crick's double helix model of DNA	78

4.5	Genetic information is contained in the nucleotide bases of the DNA double helix	79
4.6	Semiconservative DNA replication	80
4.7	Transcribing DNA into mRNA	82
4.8	Alternative splicing and translation of mRNA into proteins	83
4.9	Translating mRNA sequence into a protein	84
4.10	The genetic code	85
4.11	Epigenetic regulation of gene expression	86
4.12	Maternal care impacts stress responsivity in adult offspring	88
4.13	What is a gene?	91
5.1	The Great Pyramid of Giza	95
5.2	Types of DNA sequence variation	96
5.3	The Genome Data Viewer	98
5.4	Examples of DNA sequence variations and their impact on mRNA and amino acid sequence	100
5.5	Thermalcycler	103
5.6	Gel electrophoresis	104
5.7	Polymerase chain reaction	106
5.8	Genotyping bead array	107
5.9	Population stratification	109
5.10	CRISPR-Cas9	112
5.11	Cost of sequencing	114
6.1	Cell membrane and organelles	118
6.2	Basic structure of a neuron	120
6.3	Synaptic activity	122
6.4	Serotonergic pathway in the brain	123
6.5	Pathway of serotonin synthesis and metabolism	124
6.6	Neurexins and neuroligins	127
6.7	Structure of the 5-HT1B receptor	129
6.8	Structure of the serotonin transporter	130
6.9	Magnetic resonance imaging	134
6.10	Potential impact of drugs on neural activation	137
6.11	The 5-HTTLPR polymorphism of the serotonin transporter gene	139
7.1	Share of population with mental health and substance use disorders, 2017	146
7.2	Mental and substance use disorders as a share of total disease burden, 2017	147
7.3	Models for understanding genetic and environmental risk	148
7.4	Levels of analysis	150
7.5	Qualitative diagnoses as a function of endophenotypes	152
7.6	Research Domain Criteria	153
7.7	Enlarged ventricles associated with schizophrenia diagnosis	156
7.8	Hypofrontality associated with schizophrenia diagnosis	156
7.9	Risk for developing schizophrenia-related psychoses	157
7.10	Microcephaly in 3q29 microdeletion	160
7.11	Schizophrenia endophenotypes	161
7.12	Synaptic plasticity and neural circuitry genes harboring private damaging mutations	162
8.1	Standardized IQ score distribution	170
8.2	<i>FMRI</i>	173
8.3	Trisomy 21 karyotype	175
8.4	Synteny of human chromosome 21 and three mouse chromosomes	176
8.5	<i>In utero</i> RNAi affects response of auditory cortex neurons to speech sounds in rats	179

xvi **List of Figures**

8.6	KIBRA protein regulates dendritic growth in hippocampus	181
8.7	Olfactory conditioning in fruit flies	182
8.8	Mutations that affect learning and memory	184
8.9	Alzheimer disease pathology	186
8.10	Mechanism of amyloid plaque production	186
8.11	Genes associated with early onset Alzheimer disease	188
8.12	APOE genotypes	188
9.1	Emotion in dogs and cats	195
9.2	Amygdala activation in response to facial expressions of threat	197
9.3	The process model of emotion regulation	200
9.4	Genetic correlations across psychiatric disorders	203
9.5	Prevalence of an episode of depressive disorder around the world as well as sex and age differences	205
9.6	The top 20 leading causes of DALYs worldwide	206
9.7	Heritability estimates for depressive disorder	207
9.8	Candidate gene association studies for depression 1991–2016	209
9.9	Action of selective serotonin reuptake inhibitors	211
9.10	Depression-like behavior paradigms	213
9.11	Hypothalamic-Pituitary-Adrenal Axis	215
10.1	Public-speaking anxiety	222
10.2	Rodent assays for fear- and anxiety-like behavior	224
10.3	Two mouse strains that differ on anxiety-like behaviors	226
10.4	Diazepam modulates GABA _A receptors	227
10.5	Silver fox domestication study	229
10.6	Self-report items from the Big Five Inventory	230
10.7	Prevalence of anxiety disorders around the world as well as sex and age differences	233
10.8	Anxiety score distribution for European American and African American veterans	236
10.9	Obsessive-compulsive disorder runs in families	238
10.10	Self-destructive grooming behavior of <i>Sapap3</i> knockouts	240
10.11	Witnessing trauma	242
11.1	Past month substance use in the US	249
11.2	Alcohol use	250
11.3	Alcohol or drug use disorders	252
11.4	Reward pathway	255
11.5	Alcohol preference in two inbred lines of mice	258
11.6	Mating scheme to develop recombinant inbred lines	260
11.7	Heritability estimates for addictive disorders	264
11.8	Ethanol metabolism	265
11.9	Genotype frequency of rs671	268
11.10	Voluntary alcohol consumption in rats with different <i>Aldh2</i> genotypes	269
11.11	Genes most studied for association with alcoholism	270
11.12	Manhattan plot of GWAS findings for alcohol dependence	272
12.1	Food availability worldwide	280
12.2	Nutrition transition	281
12.3	Obese mice	282
12.4	Appetite control circuits	283
12.5	Body mass index chart	285
12.6	Worldwide obesity rates	286
12.7	Twenty-five genes associated with BMI	289

12.8	Number of females and males with anorexia nervosa or bulimia nervosa from 1990 to 2017	290
12.9	Manhattan plot of anorexia nervosa GWAS	295
12.10	Rates of insufficient physical activity across the globe for men and women	298
12.11	Twenty-five genes associated with physical activity	299
12.12	Endocannabinoid system	301
13.1	Relations among genes, brains, and social behavior	307
13.2	Agonistic behavior	309
13.3	Social interaction dynamics	310
13.4	Brain circuits for social behavior in mice	311
13.5	Williams syndrome critical region on chromosome 7	313
13.6	Non-allelic homologous recombination	313
13.7	Oxytocin receptor	315
13.8	Autism spectrum disorder	318
13.9	Autism spectrum disorder risk genes	320
13.10	Female Satin Bowerbird inspects bower	321
13.11	Courtship behavior in <i>D. melanogaster</i>	322
13.12	Aggression in other non-human animal models	325
14.1	Direct-to-consumer genetic testing kit	332
14.2	23andMe genetic weight report	335
14.3	Precision Medicine Initiative	337
14.4	Precision medicine in psychiatry	338
14.5	Selective serotonin reuptake inhibitors	339
14.6	Genetic genealogy	341
14.7	Views on human genetic engineering	343
14.8	CCR5 receptor and the HIV replication cycle	345
14.9	Three main questions in behavior genetic research revisited	346
14.10	Weak and strong genetic explanations	347
15.1	Thomas Malthus	352
15.2	Herbert Spencer	353
15.3	Karl Pearson and Francis Galton	355
15.4	Kallikak's pedigree	357
15.5	Carnegie Library, Luverne, MN	358
15.6	Field worker training at the ERO	359
15.7	<i>Buck v. Bell</i>	361
15.8	Army mental tests	363
15.9	Nazi extermination camps	365
15.10	Lebensborn Program	366
15.11	Scientific racism in the 1960s	368

Tables

3.1 Realized heritability after one generation of divergent selection for depressive-like behavior	64
5.1 Genomes of species important in behavior genetics	95
5.2 Median autosomal variant sites per genome	96
6.1 Serotonin receptor genetics	125
7.1 Endophenotype criteria	151
11.1 <i>ADH1B</i> single nucleotide polymorphisms and relative reaction rates of three genotypes	266
11.2 <i>ADH1C</i> single nucleotide polymorphisms and relative reaction rates of two genotypes	266

Boxes

1.1 Critical Concept: Measuring Behavior	10
1.2 Critical Concept: Model Organisms	17
2.1 Sheep Breeders Make Their Mark on Genetics	28
2.2 Bloomington Drosophila Stock Center	41
3.1 Species Spotlight: <i>Mus musculus</i>	51
3.2 Critical Concept: Twinning	61
4.1 Critical Concept: <i>Homo sapiens</i> Chromosomes	74
4.2 Critical Concept: Transgenerational Epigenetic Inheritance	88
5.1 NCBI Genome Data Viewer	97
5.2 Critical Concept: CRISPR-Cas9	111
6.1 Critical Concept: Neurotransmitter Systems	122
6.2 Critical Concept: Neuroimaging Genetics	133
7.1 Critical Concept: Research Diagnostic Criteria (RDoC)	152
7.2 ICD-11 Diagnosis: Schizophrenia	154
7.3 Environmental Risk Factors for Schizophrenia	158
8.1 ICD-11 Diagnosis: Disorders of Intellectual Development	171
8.2 Mouse Models of Trisomy 21	175
8.3 ICD-11 Diagnosis: Developmental Learning Disorder	177
8.4 Species Spotlight: Dissecting Learning and Memory in Fruit Flies	182
8.5 ICD-11 Diagnosis: Dementia Due to Alzheimer Disease	185
9.1 Genetic Differences in Amygdala Activation in Response to Facial Expressions of Threat	197
9.2 ICD-11 Diagnosis: Mood Disorders	201
9.3 ICD-11 Diagnosis: Bipolar Type I Disorder, Current Episode Manic, without Psychotic Symptoms	202
9.4 ICD-11 Depressive Disorders	204
9.5 Non-Human Animal Models for Investigating Depression-Like Behaviors	212
10.1 Selection for Tameness in Silver Foxes	228
10.2 ICD-11 Diagnosis: Anxiety or Fear-Related Disorders	232
10.3 ICD-11 Diagnosis: Obsessive-Compulsive or Related Disorders	237
10.4 ICD-11 Diagnosis: Disorders Specifically Associated with Stress	240
11.1 ICD-11 Diagnosis: Alcohol Dependence	253
11.2 Recombinant Inbred Lines	259
11.3 Alcohol Dehydrogenase (ADH)	266
12.1 Appetite Control Circuits	283
12.2 ICD-11 Diagnosis: Feeding and Eating Disorders	290
12.3 ICD-11 Diagnosis: Anorexia Nervosa and Bulimia Nervosa	292
12.4 The Role of Puberty in Disordered Eating	293
13.1 Non-Allelic Homologous Recombination	313
13.2 ICD-11 Diagnosis: Autism Spectrum Disorder	319
13.3 Measuring Aggressive Behavior in Non-Human Animal Models	325
14.1 ClinVar	332
14.2 5-HTTLPR Genotype and SSRI Treatment Response	339
15.1 The Kallikak Family	356
15.2 Army Mental Tests	362

Preface

Behavior genetics addresses one of the most complex questions in science: What causes behavior? Specifically, researchers in behavior genetics seek to understand the role of *genetic differences* in *individual differences* in behavior. The complexity of this problem cannot be overstated, especially when the most informative experimental approaches may be ethically off-limits.

In this book I focus on the basic concepts and methods in behavior genetics, warts and all, and try not to oversell the findings. In the last thirty years we have seen unprecedented advances in biotechnology and computing that have been put to good use in behavior genetics. Such technological advances seem to generate recurring cycles of optimism and disappointment as new avenues of inquiry reveal unexpected complexity. We tend to extol the virtues of the new approaches, sometimes bash the old approaches, and hope to learn from our mistakes. It is important to recognize that the details of some of today's most exciting findings will likely fall short under future scrutiny. That is how science progresses. Students must learn to appreciate how science works in a way that strengthens their confidence in the process. This book focuses on concepts and methods that have been historically important and will hopefully engender some humility when considering how much we know about one of the most complex problems in science.

We live in an era when editing the human genome is not only possible but has been accomplished. We also live in a time when survivors of state-sponsored forced sterilizations still walk among us. We cannot permit the same scientific hubris concerning heredity–behavior relations that justified wholesale human rights abuses to permeate the next generation of scientists and citizens. It seems that the time is ripe for a book in behavior genetics to embrace the twenty-first century without ignoring the twentieth.

I have conducted behavior genetic research since the late 1980s and have been teaching it for nearly as long. In graduate school my research focused on geotaxis in fruit flies. As a postdoctoral fellow, in the mid-1990s, I began conducting candidate gene association studies in humans. This book covers methods used in both animal and human behavior genetic studies and emphasizes the crucial role of *convergent evidence* throughout.

This book contains:

- Boldfaced key terms (defined in glossary)
- Interim review questions (i.e., “Check-ups”) for each main section
- Boxes with additional detail in each chapter
- A list of recommended readings in each chapter
- Bulleted summaries of each chapter

The perspective of this book is that while it is important to describe statistical associations between heredity and behavior, it is imperative that we consider the biological mechanisms through which those associations are manifest. Accordingly, this book relies more on neuroscience than on advanced statistical models for understanding pathways from genes to behavior.

xxii Preface

The chapter lineup in *Foundations of Behavior Genetics* covers four major themes. The first three chapters (Fundamentals) cover the history of behavior genetics and the basics of non-molecular genetics. The next three chapters (Molecules and Cells) discuss molecular genetics, and neurogenetics. The next five chapters (Behaviors and Behavioral Disorders) discuss topics such as schizophrenia, learning and cognition, emotion, depression, anxiety, and substance use disorders. The final four chapters (Health, Social Behavior, and Implications) discuss topics such as obesity, social behavior, behavior genetics in real life, and eugenics. The material in the first six chapters should be covered in sequence before moving on to material in the final nine chapters. However, the final nine chapters could be covered in whatever order suits the reader.

The intended audience for this book is advanced undergraduate psychology majors. Courses such as Introduction to Psychology, Research Methods & Statistics, and Biopsychology, or their equivalents should be considered prerequisites to a Behavior Genetics course taught with this book. Other courses such as Developmental Psychology, Social Psychology, and Abnormal Psychology would be desirable, but should not be considered prerequisite.

Supplementary material included in the Instructor's Package includes a Test Bank with at least twenty multiple choice items per chapter, and all artwork as JPEGs or PNGs (many in color) for use in lectures.

Acknowledgments

This book would not exist if not for the mentoring that I have received from Doug Bernstein over several decades. His enthusiasm and support for effective teaching has always been an inspiration. His experience in and knowledge about writing textbooks coupled with his readiness to help have been invaluable to me.

A debt of gratitude is owed to my colleagues who served as reviewers. Their thoughtful perspectives were critical in the organization, tone, and contents of the book. Although I did not always take their advice, I always appreciated it, fully considered it, and found it valuable. Any mistakes or awkward sentences in the book are my responsibility.

A similar debt is owed to my students, who have helped me across the semesters to think more clearly about behavior genetics. Their enthusiasm for the topic keeps me motivated.

Thanks to the editorial staff at Cambridge. Stephen Acerra has been and continues to be a champion of the book. Maggie Jeffers and Nicola Chapman kept me on task and moved things along. Thanks for being so easy to work with.

Finally, thanks to my life-partner, Shelley Jennifer Creeger Stoltenberg. None of this would have been possible without you by my side. Here's to the future!

Cheers,

Scott F. Stoltenberg

