Contents

Contributors ix
Preface xi
Acknowledgments xiii

PART I  Introduction ........................................... xv

CHAPTER 1  Psychobiology of Physical Activity:
Integration at Last! .............................................. 1

   Edmund O. Acevedo  •  Panteleimon Ekkekakis

   The Progress of Scientific Investigations  2
   Secondary Ignorance and Dualism  3
   Sport Psychology  5
   Exercise Psychology  6
   The Present Volume  8
   References  10

CHAPTER 2  Physical Activity and the Neurobiology
of Interoception .............................................. 15

   A.D. (Bud) Craig

   Research Methods in the Neurobiology of Interoception  16
   Primary Afferent Sensory Fibers From Muscle and Joint  17
   Second-Order Neurons in Lamina I  17
   Physiological Characteristics of Lamina I Neurons  18
   Selective Response of Lamina I Neurons  19
   Forebrain Projections of Lamina I Neurons  21
   Interoception in Humans  22
   Weaknesses and Limitations in the Literature  24
   Directions for Future Investigation  25
   References  26

CHAPTER 3  Brain Activation During Physical Activity ........ 29

   Jon W. Williamson

   Central Cardiovascular Modulation  30
   Brain Reorganization  35
PART II  Physical Activity and Cognition .............. 43

CHAPTER 4  Aging, Physical Activity, and Neurocognitive Function ................. 45

Arthur F. Kramer  •  Charles H. Hillman

Fitness and Behavioral Indices of Cognition  46
Fitness Effects on Brain Function and Structure  48
Potential Mechanisms  54
Directions for Future Investigation  55
References  55

CHAPTER 5  Exercise, Neurogenesis, and Learning in Rodents ................. 61

Henriette van Praag

Environmental Enrichment and Neurogenesis  63
Exercise and Neurogenesis  65
Other Anatomical Changes Associated With Exercise  65
Exercise Improves Learning and Memory in Rodents  65
Electrophysiological Changes Associated With Exercise  67
Growth Factor Effects on Neurogenesis and Running  68
The Role of Neurotransmitters in Running and Neurogenesis  68
Directions for Future Investigation  69
References  69

PART III  Physical Activity and Emotion .............. 75

CHAPTER 6  Exertion and Pleasure From an Evolutionary Perspective ................. 79

Michel Cabanac

Sensations From Muscular Exertion  80
Hedonicity of Muscular Exertion  81
Hedonicity in Motivational Conflicts  83
Conclusions 87
References 87

CHAPTER 7 Affective Responses to Acute Exercise: Toward a Psychobiological Dose–Response Model 91

Panteleimon Ekkekakis • Edmund O. Acevedo

The Intensity–Affect Relationship 91
The Inverted U As a Dose–Response Model and Its Limitations 92
Previous Dose–Response Findings and Weaknesses in the Literature 92
The “Next-Generation” of Dose–Response Studies 94
The Dual-Mode Theory 96
A Putative Neural Pathway 98
Conclusions 102
Directions for Future Investigation 103
References 104

CHAPTER 8 Physical Activity, Affect, and Electroencephalogram Studies 111

Steven J. Petruzzello • Panteleimon Ekkekakis • Eric E. Hall

EEG Changes As a Result of Acute Exercise 114
A Model for EEG–Exercise–Affect Research 117
Directions for Future Investigation 121
References 124

CHAPTER 9 Physical Activity and Neurotransmitter Release 129

Romain Meeusen

Biosynthesis of Brain Monoamines 129
The Effects of Physical Activity on Anxiety and Depression 130
Exercise and Brain Neurotransmitter Concentrations 131
Central Fatigue 135
Neurotransmission and Overtraining 137
Weaknesses and Limitations in the Microdialysis Literature 137
Conclusions 138
Directions for Future Investigation 138
References 138
PART IV Physical Activity and Psychosomatic Health .......................... 145

CHAPTER 10 The Cross-Stressor Adaptation Hypothesis and Exercise Training ............. 149

Mark S. Sothmann

Evolution of the Cross-Stressor Adaptation Hypothesis 149
Basic Elements of the Stress Response 150
Cross-Stressor Adaptation Hypothesis 152
Psychobiological Testing of the Cross-Stressor Hypothesis in Humans 154
Weaknesses and Limitations in the Literature 156
Directions for Future Investigation 157
Conclusions 158
References 158

CHAPTER 11 Psychobiological Reactivity, Physical Activity, and Cardiovascular Health .......... 161

Stephen H. Boutcher  •  Mark Hamer

A Multifactorial Model of Cardiovascular Reactivity 161
Cardiovascular Reactivity Assessment 165
Reactivity Effects on Health 166
Chronic Aerobic Exercise and Reactivity 168
Acute Aerobic Exercise and Reactivity 170
Directions for Future Investigation 171
Conclusions 172
References 172

CHAPTER 12 Physical Activity and Psychoneuroimmunology . . 177

Suzi Hong  •  Paul J. Mills

The Immune System 177
Exercise As a Model for Psychoneuroimmunology Research 178
Enumerative Responses of the Immune System to Exercise 180
Functional Responses of the Immune System to Exercise 182
Cytokine Responses to Exercise 183
Regular Physical Activity and Psychoneuroimmunology 184
Directions for Future Investigation 184
Conclusions 185
References 185
CHAPTER 13 Central Regulation of Stress Reactivity and Physical Activity . . . . . . . . . . . . . 189

Gregory A. Hand • Kenneth D. Phillips • Marlene A. Wilson

The Physiological Stress Response 189
The Practical Significance of Studying Physical Activity and Stress 190
Measures of Stress Reactivity 190
Neural and Endocrine Systems That Respond to Stressful Stimulation 191
Weaknesses and Limitations in the Literature 198
Directions for Future Investigation 199
References 199

CHAPTER 14 Physical Activity and Pain . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 203

Dane B. Cook

Epidemiology of Musculoskeletal Pain 203
Neurobiology of Muscle Pain 204
Measurement of Muscle Pain 207
Naturally Occurring Muscle Pain 209
Analgesia During and Following Physical Activity 211
Muscle Pain As a Barrier to Physical Activity 211
Physical Activity As a Treatment for Chronic Musculoskeletal Pain 212
Muscle Pain As a Limiting Factor in Sport Performance 212
Directions for Future Investigation 213
References 214

PART V Psychobiology of Human Performance . . . 219

CHAPTER 15 A Cognitive Neuroscience Perspective on Sport Performance . . . . . . . . . . . . . . . . 221

Bradley D. Hatfield • Amy J. Hauffer • Thomas W. Spalding

Regional Cortical Activity in Elite Performers 223
Expert–Novice Contrasts of EEG Power During Psychomotor Performance 230
Effects of Training on Cortical Activation 232
Performance Variation and Cortical Arousal 233
Networking Between Cortical Association and Motor Regions 234
Directions for Future Investigation 236
Conclusions 237
References 237
CHAPTER 16 The Psychophysiology of Biofeedback and Sport Performance .......................... 241

Dave Collins • Alan McPherson

Measuring the Physiological Index 241
Feedback Methods 242
Selecting the Index 244
Weaknesses and Limitations in the Literature 245
Directions for Future Investigation 248
Conclusions 249
References 249

CHAPTER 17 The Psychophysiology of Imagery in Sport ............................................. 251

Paul S. Holmes

Theoretical Concerns 252
Functional Equivalence 252
Influencing Physiological Change 254
Image Generation 254
Imagery Modalities and Perspectives 255
Neuroscientific Implications for Imagery Use by Sport Performers 258
Indirect Evidence for the Mirror Neuron System 258
Direct Evidence for the Mirror Neuron System 259
Weaknesses and Limitations in the Literature 259
Directions for Future Investigation 259
Conclusions 260
References 260

Epilogue: Future Challenges in Understanding Human Behavior .............................. 265

Edmund O. Acevedo • Panteleimon Ekkekakis

Index 269
About the Editors 279