Lifespan Development and the Brain

This book focuses on the developmental analysis of brain-culture-environment dynamics and argues that this dynamic is interactive and reciprocal: brain and culture co-determine each other. As a whole, this book refutes any unidirectional conception of the brain-culture dynamic, as each is influenced by and modifies the other. To capture the ubiquitous reach and significance of the mutually dependent and co-productive brain-culture system, the metaphor of biocultural co-constructivism is invoked. Distinguished researchers from cognitive neuroscience, cognitive psychology, and developmental psychology review the evidence in their respective fields. A special focus of the book is its coverage of the entire human lifespan.

Paul B. Baltes is noted for his theoretical and empirical work in developmental psychology and the interdisciplinary study of human aging. Aside from multiple honorary doctorates and election to academies, he has received numerous awards, including the International Psychology Award of the American Psychological Association, the Lifetime Achievement Award of the German Psychological Society, and the Aristotle Prize of the European Federation of Psychological Associations.

Patricia A. Reuter-Lorenz is known for her research on the neuropsychological mechanisms of attention and working memory, in particular through her work with special patient populations, functional brain imaging, and normal human aging. She is co-founder of the Cognitive Neuroscience Society, has served on its governing board since its inception, and serves on the editorial boards of leading journals in the field.

Frank Rösler is recognized for his research on biological correlates of cognitive processes, in particular memory, learning, imagery, language, and neural plasticity. He has received several awards, including the Max-Planck/Humboldt prize for international cooperation, and he has been elected as full member to two academies of sciences in Germany.
Lifespan Development and the Brain

The Perspective of Biocultural Co-Constructivism

Edited by

PAUL B. BALTES
Max Planck Institute for Human Development, Berlin, Germany

PATRICIA A. REUTER-LORENZ
University of Michigan, Ann Arbor, Michigan

FRANK RÖSLER
Philipps-University, Marburg, Germany
## Contents

**List of Contributors**  
*page ix*

**Preface and Acknowledgments**  
*Paul B. Baltes, Patricia A. Reuter-Lorenz, and Frank Röslер*  
*xiii*

### PART ONE. SETTING THE STAGE ACROSS THE AGES OF THE LIFESPAN

1. Prologue: Biocultural Co-Constructivism as a Theoretical Metascript  
   *Paul B. Baltes, Frank Röslер, and Patricia A. Reuter-Lorenz*  
   *page 3*

2. Biocultural Co-Construction of Lifespan Development  
   *Shu-Chen Li*  
   *page 40*

### PART TWO. NEURONAL PLASTICITY AND BIOCULTURAL CO-CONSTRUCTION: MICROSTRUCTURE MEETS THE EXPERIENTIAL ENVIRONMENT

3. Neurobehavioral Development in the Context of Biocultural Co-Constructivism  
   *Charles A. Nelson*  
   *page 61*

4. Adult Neurogenesis  
   *Gerd Kempermann*  
   *page 82*

### PART THREE. NEURONAL PLASTICITY AND BIOCULTURAL CO-CONSTRUCTION: ATYPICAL BRAIN ARCHITECTURES

5. Sensory Input–Based Adaptation and Brain Architecture  
   *Maurice Ptito and Sébastien Desgent*  
   *page 111*

6. Blindness: A Source and Case of Neuronal Plasticity  
   *Brigitte Röder*  
   *page 134*
### PART FOUR. BIOCULTURAL CO-CONSTRUCTION: SPECIFIC FUNCTIONS AND DOMAINS

7. Language Acquisition: Biological Versus Cultural Implications for Brain Structure
   - 
   - Angela D. Friederici and Shirley-Ann Rüschemeyer

8. Reading, Writing, and Arithmetic in the Brain: Neural Specialization for Acquired Functions
   - 
   - Thad A. Polk and J. Paul Hamilton

9. Emotion, Learning, and the Brain: From Classical Conditioning to Cultural Bias
   - 
   - Elizabeth A. Phelps

10. The Musical Mind: Neural Tuning and the Aesthetic Experience
    - 
    - Oliver Vitouch

### PART FIVE. PLASTICITY AND BIOCULTURAL CO-CONSTRUCTION IN LATER LIFE

11. Influences of Biological and Self-Initiated Factors on Brain and Cognition in Adulthood and Aging
    - 
    - Lars Nyberg and Lars Bäckman

12. The Aging Mind and Brain: Implications of Enduring Plasticity for Behavioral and Cultural Change
    - 
    - Patricia A. Reuter-Lorenz and Joseph A. Mikels

### PART SIX. BIOCULTURAL CO-CONSTRUCTION: FROM MICRO- TO MACROENVIRONMENTS IN LARGER CULTURAL CONTEXTS

13. Characteristics of Illiterate and Literate Cognitive Processing: Implications of Brain–Behavior Co-Constructivism
    - 
    - Karl Magnus Petersson and Alexandra Reis

14. The Influence of Work and Occupation on Brain Development
    - 
    - Neil Charness

15. The Influence of Organized Violence and Terror on Brain and Mind: A Co-Constructive Perspective
    - 
    - Thomas Elbert, Brigitte Rockstroh, Iris-Tatjana Kolassa, Maggie Schauer, and Frank Neuner

16. Co-Constructing Human Engineering Technologies in Old Age: Lifespan Psychology as a Conceptual Foundation
    - 
    - Ulman Lindenberger and Martin Lövdén
Contents

PART SEVEN. EPILOGUE

17. Letters on Nature and Nurture
    Onur Güntürkün

Author Index

Subject Index
Contributors

Paul B. Baltes  Director, Max Planck International Research Network on Aging, Max Planck Institute for Human Development, Berlin, and Distinguished Professor of Psychology, University of Virginia, Charlottesville, USA

Lars Bäckman  Professor of Psychology, Aging Research Center, Karolinska Institute, Stockholm, Sweden

Neil Charness  Professor of Psychology, Department of Psychology and Pepper Institute on Aging and Public Policy, Florida State University, Tallahassee, USA

Sébastien Desgent  Doctoral Candidate in Neurosciences, Department of Physiology and School of Optometry, University of Montreal, Canada

Thomas Elbert  Professor and Chair of Clinical Psychology and Neuropsychology, University of Konstanz, Germany

Angela D. Friederici  Director, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, and Honorary Professor at the Universities of Leipzig (Psychology) and Potsdam (Linguistics) and Charité University Medicine, Berlin, Germany

Onur Güntürkün  Professor of Biopsychology, Institute of Cognitive Neuroscience, Ruhr-University, Bochum, Germany

J. Paul Hamilton  Postdoctoral Fellow, Stanford Mood and Anxiety Disorders Laboratory, Stanford University, Palo Alto, California, USA

Gerd Kempermann  MD, Head of Neuronal Stem Cells Research Group, Max Delbrück Center for Molecular Medicine (MDC), Berlin-Buch, Germany
List of Contributors

Iris-Tatjana Kolassa  Research Scientist, Department of Psychology, University of Konstanz, Germany

Shu-Chen Li  Senior Research Scientist, Center for Lifespan Psychology, Max Planck Institute for Human Development, Berlin, Germany

Ulman Lindenberger  Director, Center for Lifespan Psychology, Max Planck Institute for Human Development, Berlin, and Honorary Professor of Psychology, Free University, Berlin, and Humboldt University, Berlin, and Professor of Psychology, Saarland University, Saarbrücken, Germany

Martin Lövdén  International Research Fellow, Center for Lifespan Psychology, Max Planck Institute for Human Development, Berlin, Germany

Joseph A. Mikels  Postdoctoral Fellow, Department of Psychology, Stanford University, Palo Alto, California, USA

Charles A. Nelson  Professor of Pediatrics, Harvard Medical School, Richard David Scott Chair in Pediatric Developmental Medicine Research, Developmental Medicine Center Laboratory of Cognitive Neuroscience, Boston, Massachusetts, USA

Frank Neuner  Junior Professor of Clinical Psychology and Psychotherapy, University of Konstanz, Germany

Lars Nyberg  Professor of Neuroscience, Umeå University, Sweden

Karl Magnus Petersson  Postdoctoral Fellow, F. C. Donders Centre for Cognitive Neuroimaging, Radboud University Nijmegen, Netherlands

Elizabeth A. Phelps  Professor of Psychology and Neural Science, New York University, USA

Thad A. Polk  Associate Professor of Psychology, University of Michigan, Ann Arbor, USA

Maurice Ptito  Harlan Sanders Professor of Visual Science, School of Optometry, University of Montreal, Canada

Alexandra Reis  Associate Professor of Biological and Behavioral Psychology, Neuropsychology, and Cognitive Psychology, University of Algarve, Faro, Portugal

Patricia A. Reuter-Lorenz  Professor of Psychology, University of Michigan, Ann Arbor, USA

Brigitte Rockstroh  Professor and Chair of Clinical Psychology, University of Konstanz, Germany

Brigitte Röder  Professor of Biological Psychology and Neuropsychology, University of Hamburg, Germany
List of Contributors

Frank Rösler Professor for Experimental and Biological Psychology, Philipps-University, Marburg, Germany

Shirley-Ann Rüschemeyer Postdoctoral Fellow, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Maggie Schauer Director of the Psychological Research Clinic for Refugees, University of Konstanz, Germany

Oliver Vitouch Professor and Chair of Cognitive Psychology, University of Klagenfurt, Austria
Preface and Acknowledgments

As described in Chapter 1, this book is the outgrowth of the desire to generate a theoretical orientation in which simple models of unidirectional determinism in regard to human behavior and human development, whether gene, brain, behavior, or culture driven, are laid to rest. A vibrant counterdose of interactionism seemed especially necessary in light of recent public discussions in Germany, much stimulated by noted neuroscientists, about the unquestionable dominance of the brain in the determination of behavior and individual action. We believed that this seeming movement toward reductionistic determinism, stemming in part from the justifiable excitement associated with new methods of neuroscience, was cause for concern. Of course, there were many important forerunners to our general theoretical orientation. Nonetheless, we judged that strengthening a more dynamic and interactionist conception of the nature of human behavior and the role of culture in co-constructing the brain and behavior was the call of the times.

Our first step was to have discussions among the three editors and a few close colleagues, such as Ulman Lindenberger and Shu-Chen Li. Subsequently, we planned a conference to examine the basic rationale and enrich its conceptual framework. Specifically, the goal was to bring noted scholars together, who, as a collective, would be prepared to activate and orchestrate a position where the various participating elements – the genome, the brain, behavior, the physical environment, and culture – were seen as somewhat independent agents that influence each other in pervasive, deep, and cumulative ways. To counteract the seeming movement toward a stronger dose of brain determinism, we also believed it necessary to compensate by creating a new metaphor: biocultural co-constructivism was the result of these deliberations. The field chosen to illustrate this position was human development across the lifespan. We are grateful to each chapter author, who, through his or her participation in the conference and contribution to this volume, endeavored to reach into the heart of the
biocultural co-constructivism metaphor or metascript and to illustrate its relevance to his or her respective specialization.

Preparation of this book was aided by many who deserve much of the credit but none of the blame. First, there was the generous financial support of the Max Planck Institute for Human Development in Berlin, Germany. Second, there was the outstanding infrastructure of that institute and its longstanding connection to an enticing conference center in Dölln, a city north of Berlin. Then, there were the individuals who bring such activities to life and permit scientists to engage in their intellectual agendas.

Foremost was Dr. Julia Delius, who functioned as conference coordinator, ably assisted by Amy Michele. Dr. Delius was also the editorial assistant who led the book editors through the initial stages of the review process and supervised submission of the final book manuscript. This book owes much to the care and collegial atmosphere she created. In the final steps of the editorial process, Amy Michele rose to the occasion, becoming Dr. Delius’s competent and committed substitute. In addition, Anke Schepers and Annette Brose provided excellent secretarial and technical support. They deserve our heartfelt gratitude.

Our review process included not only outside reviewers, but also the charge that each chapter author participated in commenting on two or three chapters written by his or her colleagues. We are grateful for this special engagement, and we thank the original chapter authors for their willingness to consider the input. Undoubtedly, because of this cooperative spirit, many, if not all, chapters reached new heights of clarity and cogency.

Considering the complexity of the topic, it is not surprising that such a book cannot offer a definite and comprehensive account. Biocultural co-constructivism is in the making, and it is practiced in rather different areas of the bio-, behavioral, and social sciences. Thus, this book is selective. Other lines of scholarship, and perhaps even more advanced models of treating the topic, could have been included.

Despite these limitations, we are hopeful that the book offers new insights, an attractive counteroffer to simple biological determinism, and a good selection of what current biocultural co-constructivism has to offer. May it age well, less on the dusty shelves of libraries or in rarely accessed computer files, but rather on the handy desks and in the lively minds of active scholars.

Paul B. Baltes
Patricia A. Reuter-Lorenz
Frank Rösler
Lifespan Development and the Brain