

# Preface

In April 1999, at the Cognitive Neuroscience Meeting in Washington, D.C., MIT Press representative Michael Rutter asked one of us (KH) if it was not about time to publish a second edition of *Brain Asymmetry*, which had been published by MIT Press in 1995. Had not the field progressed since 1995, so that it was now time for an update, or even a new book based on the most recent research in the field of brain asymmetry? On his way home to Bergen, Norway, Kenneth Hugdahl stopped over in Madison, Wisconsin, to meet with Richard Davidson, the other editor of the first book. Davidson agreed that indeed the field had progressed during the years since the first volume; thus a new volume could be an important update of the most recent findings in the field. That was the start of this volume, which is a completely new book on brain asymmetry, with 21 original chapters.

In the preface to the 1995 volume we wrote, “We cannot identify any other construct that forms the focus of such a diverse array of behavioral processes. The study of brain asymmetry continues to attract unique forms of integration in the biobehavioral sciences.” The mysteries of the two hemispheres of the brain, how they differ functionally and structurally, how they communicate, and how they participate in the cortical and subcortical circuitry underlying complex cognition and affect still fascinate and interest young and old neuroscientists. What we wrote in 1995 about the diverse array of behavioral processes being reflected in the asymmetry construct is no less relevant today than it was in 1995. To mention just one example, the development of new neuroimaging techniques—functional magnetic resonance imaging (fMRI), positron emission tomography (PET), and magnetoencephalography (MEG)—have revealed how neuronal activation is asym-

metrically organized and distributed across the hemispheres, providing evidence for how the asymmetry construct becomes ever more refined and detailed. This topic was not included in the 1995 volume but has a part of its own in the present volume. Another topic that has been the focus of much recent research is the use of high-resolution structural MR imaging to reveal subtle morphological differences between the hemispheres. Thus, it has become possible to look for correspondences of structural and functional asymmetries between the hemispheres. Most of the interest has been in the upper posterior parts of the temporal lobe and adjacent areas in the parietal lobe. Both the planum temporale and the planum parietale, in the temporal and parietal lobes, respectively, have attracted much interest, relating structural-functional asymmetries in these areas to such diverse clinical syndromes as dyslexia and schizophrenia. This is covered in several chapters in the present volume.

A goal of the present volume has been to show the international interest in brain asymmetry and related concepts. We hope this is reflected in the various contributions, with authors from the United States, Canada, United Kingdom, Germany, France, and Norway.

Folk psychology statements like "The left hemisphere is specialized, or dominant, for language, and the right hemisphere is specialized, or dominant, for visuospatial functions, or space orientation" obviously tell an incomplete, and sometimes inaccurate, story. First of all, such statements imply that the brain basically is specialized only for two functions, language and the ability to orient in the environment. Second, they imply that half the brain does only language and the other half does only visual processing. This also is obviously wrong. On the contrary, a prevailing aspect of research throughout the history of brain asymmetry is the notion that asymmetries exist at all levels of the nervous system, including also the peripheral and autonomic nervous systems. Another prevailing idea is that asymmetries exist not only for higher cognitive processes, like language and visuospatial processing, but also for emotional processes. A third aspect is that recent advances in methods have made it possible to quantify structural asymmetries with much greater precision and resolution than was available previously. This has resulted in new theories and models of how functional asymmetries may have their structural correlates in brain anatomy. A fourth aspect is the development of the new neuroimaging techniques, both hemodynamic techniques (e.g., PET and fMRI) and

other techniques (ERP [event-related potential], MEG, and transcranial magnetic stimulation [TMS]). A fifth aspect of recent asymmetry research is its application to clinical areas with regard to psychiatric, neurological, and developmental disorders. It is our intention to cover all these ideas and developments as a reflection of the current status of the field, from both a basic research and a clinical perspective.

In selecting the contributors, it was our intention to focus on relatively recent and new topics as well as a few older topics where there have been new developments since 1995. Selecting the contributors therefore meant, as always, that not all prominent researchers in the field could be invited. This would have made the volume unwieldy. We have therefore chosen to present the field through a mixed selection of chapters ranging from basic physiological processes on the neuronal level to major clinical disorders like schizophrenia and depression. When inviting the selected authors, it was our intention to include promising and novel ideas in the field, with potential for possible breakthroughs in the near future. For these reasons the book is divided into seven major parts that include animal models of asymmetry and basic asymmetrical functions (e.g., handedness), neuroimaging studies, visual asymmetry, auditory asymmetry, emotional asymmetry, and applications for neurological and psychiatric disorders. Each part has two or more chapters that are intended to illustrate the range of methods and research topics within each area that is represented.

In part I, on animal models and basic functions, Onur Güntürkün provides a review of studies on the lateralization of the visual system in various species of birds, thus providing an animal model for the understanding of the neuronal substrates of visual asymmetry. This is followed by the chapter by Akaysha Tang, who presents a new theory of asymmetry based on the role played by left and right nuclei complexes in the hippocampus, taking a bottom-up approach to asymmetry and laterality. In the third chapter, Craig Berridge and coworkers show how stress and coping are related to the asymmetry of the dopamine system within the prefrontal cortex. The final chapter in part I, by Alan Beaton, provides an updated and comprehensive review of handedness effects in research on brain asymmetry.

Part II, which deals with brain imaging and brain stimulation, starts with a chapter by Karl Friston on experimental design and statistical analysis of functional brain imaging studies, focusing on issues related to asymmetry and lateralization in functional brain architecture. Next,

Lutz Jäncke and Helmut Steinmetz review their extensive research on anatomical brain asymmetry, particularly research on the role of the planum temporale area in the upper posterior temporal lobe. This is followed by a chapter by Alvaro Pascual-Leone and Vincent Walsh on the new transcranial magnetic stimulation (TMS) technique and what this method will contribute to an enhanced understanding of the functions of the cerebral hemispheres.

Part III is devoted to studies on visual asymmetry and laterality, starting with the contribution by Marie Banich on hemispheric interactions, and implications for theories of information processing and processing capacity in the brain and in the left and right hemispheres. Bruno Laeng and collaborators review studies on asymmetries in encoding of spatial relations, providing evidence for different kinds of spatial encoding properties in the left and right hemispheres. Next, Clifford Saron and coworkers present an extensive review of ERP work with visual half-field stimulus presentations, focusing on the complexities of interhemispheric communication.

Part IV consists of three chapters, are devoted to auditory laterality. Robert Zatorre reviews work related to hemispheric asymmetries in the processing of tonal stimuli, including asymmetries for musical stimuli and music. Kenneth Hugdahl presents an update on dichotic listening studies with speech sounds, including a new database containing dichotic listening performances from more than 1000 subjects. Finally, Daniel O'Leary shows the effects of attention on the asymmetry for speech and nonspeech sounds, with applications to schizophrenia.

Part V, on emotional laterality, opens with a chapter by Diego Pizzagalli, Alexander J. Shackman, and Richard Davidson on how the two hemispheres of the brain differ in their contributions to emotions and emotional behavior, focusing on functional neuroimaging data. Next, Wendy Heller and collaborators present a model of anxiety and emotional functioning with a focus on the asymmetrical contributions of the left and right hemispheres to the understanding of the neural implementation of emotions and emotional disorders. James Coan and John Allen close the part with a comprehensive review of studies of frontal EEG asymmetry as a measure of state and trait indices of positive and negative emotions, and the interactions with the functioning of the left and right cerebral hemispheres.

Part VI deals with studies of asymmetry in relation to neurological disorders. Maryse Lassonde and Hannelore Sauerwein present their

work on patients with agenesis of the corpus callosum and implications for understanding the nature of both specialization and integration of the hemispheres. Next, Mark Eckert and Christiana Leonard review data and theories of dyslexia, one of the most common developmental disorders, and its neurobiological substrates from the perspective of brain asymmetry. This is followed by a chapter by Michel Habib and Fabrice Robichon, who also focus on the brain mechanisms of dyslexia, presenting evidence for the importance of structures outside of those brain regions traditionally believed to be important for the understanding of dyslexia.

In part VII, on psychiatric disorders, Gerard Bruder presents behavioral, electrophysiological, and hemodynamic brain imaging data showing functional asymmetries in depression and depressive disorders, and how this relates to, for example, clinical features. In the final chapter, Michael Green and coworkers present an overview of theoretical models of and empirical evidence for a view of schizophrenia as being related to impaired asymmetry and laterality, and possibly having neuroanatomical substrates as well.

It is our sincere hope that this volume will contribute to a continued interest in one of the most fascinating aspects of the mammalian brain, its division into left and right halves along the neuroaxis. We further hope that it will contribute to better integration of the neurosciences, with different subdisciplines—psychology, psychiatry, neurophysiology, neurology, and neurosurgery, to mention a few examples—working together to unravel the great mystery of the brain.

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