Divided Brains

The Biology and Behaviour of Brain Asymmetries

Asymmetry of the brain and behaviour (lateralization) has traditionally been considered to be unique to humans. However, research has shown that this phenomenon is widespread throughout the vertebrate kingdom and is found even in some invertebrate species. A similar basic plan of organization exists across vertebrates.

Summarizing the evidence and highlighting research from the past 20 years, the authors discuss lateralization from four perspectives – function, evolution, development and causation – covering a wide range of animals, including humans. The evolution of lateralization is traced from our earliest ancestors, through fish and reptiles to birds and mammals. The benefits of having a divided brain are discussed, as well as the influence of experience on its development. A final chapter discusses outstanding problems and areas for further investigation.

Experts in this field, the authors present the latest scientific knowledge clearly and engagingly, making this book a valuable tool for anyone interested in the biology and behaviour of brain asymmetries.

Lesley J. Rogers is Emeritus Professor at the Centre for Neuroscience and Animal Behaviour, University of New England, Armidale, Australia. A Fellow of the Australian Academy of Science, she has made outstanding contributions to understanding brain development and behaviour, including the discovery of lateralization in the chick forebrain at a time when lateralization was thought to be unique to humans.

Giorgio Vallortigara is Professor of Neuroscience at, and Director of, the Centre for Mind/Brain Sciences, University of Trento, Rovereto, Italy. His research includes the study of spatial cognition in the avian brain, number and object cognition in animals and lateralization of cognition. He discovered functional brain asymmetry in the so-called 'lower' vertebrate species.

Richard J. Andrew is Emeritus Professor at the School of Life Sciences, University of Sussex, Brighton, UK. He has worked extensively on lateralized processes in memory formation in chicks, and on behavioural transitions during early development. At present he uses zebrafish to explore the role of brain asymmetries in the generation of lateralized behaviour.

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CAMBRIDGE
UNIVERSITY PRESS

Shaftesbury Road, Cambridge CB2 8EA, 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 Cambridge University Press & Assessment, a department of the University of Cambridge.

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www.cambridge.org
Information on this title: www.cambridge.org/9781107005358

First published 2013

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

Library of Congress Cataloging-in-Publication data
Rogers, Lesley J.
Divided brains : the biology and behaviour of brain asymmetries / Lesley J. Rogers, Giorgio Vallortigara, Richard J. Andrew.
p. cm.
ISBN 978-1-107-00535-8 (hardback)
1. Cerebral dominance. 2. Brain – Duality. 3. Brain – Anatomy. I. Vallortigara, Giorgio, 1959– II. Andrew, Richard John, 1932– III. Title.
QP385.5.R64 2013
612.8´2–dc23

2012023177

ISBN 978-1-107-00535-8 Hardback
ISBN 978-0-521-18304-8 Paperback

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Illustrations

Advance praise for *Divided Brains*

"This fascinating book has been written by three experts in the field. The different roles played by the two sides of the brain were thought to be a uniquely human characteristic, but the authors show that such lateralisation has ancient origins in biological evolution. They have written a superb book which I shall use as an invaluable source for years to come."

Professor Sir Patrick Bateson, University of Cambridge, co-author of *Plasticity, Robustness, Development and Evolution* (Cambridge, 2011)

"Birds do it, bees do it – and so, it seems, do species of every taxa: They show cerebral and behavioral asymmetries that belie the seeming bilateral symmetry of the body, and even the brain itself. Until quite recently such asymmetries, especially in the form of right-handedness and left-brain dominance, were held to be uniquely human, and even to define our species. This anthropocentric view is here comprehensively buried. The book is more than simply a compendium of asymmetries across different species. Rogers, Vallortigara and Andrew cover evolutionary, development and genetic aspects of asymmetry, asking why and how asymmetries evolved in a world that is indifferent to left and right. This is the most in-depth analysis to date, by the three foremost authorities on animal asymmetries, of a phenomenon that has fascinated scientists and philosophers through the centuries."

Professor Michael C. Corballis, University of Auckland

"A timely addition to our understanding of hemisphere difference, this book is a vital and accessible source of information about laterality in fish, reptiles, birds, mammals, and even insects. It does not content itself with merely marshalling information, though it does that very well, but addresses the 'how' and 'why' of the asymmetrical world of all living things."

Dr Iain McGilchrist, author of *The Master and his Emissary: The Divided Brain and the Making of the Western World*

"In the last 30 years it has become clearer and clearer that there are functional differences between the two sides of the brain in vertebrates and even in invertebrates, and that these differences sometimes reveal deep phylogenetic trends. It is unlikely that any other group of authors could have done such a remarkable synthesis of the current state of evidence on this topic."

Professor Peter F. MacNeilage, Department of Psychology, University of Texas at Austin

Preface

Research on lateralization of brain and behaviour in animals has expanded rapidly over the past two decades and continues to grow exponentially. The same is true of studies on lateralization in humans, and the evidence from these two sources is integrated in this book in a way not previously attempted. We were motivated to write this book because of the widening interest in the subject and a perceived need to make the most up-to-date information available in a form that, we hope, is stimulating and easy to read. Since there are many general texts on cerebral specialization in humans, our chief focus was on left–right differences in brain and behaviour in non-human animals, with the aim of bringing together recent striking advances arising from study of lateralization in these species and the state of knowledge of lateralization in humans.

We approached the topic of lateralization from the perspective of Tinbergen's four questions (function, evolution, development, causation), to each of which we have devoted one chapter.