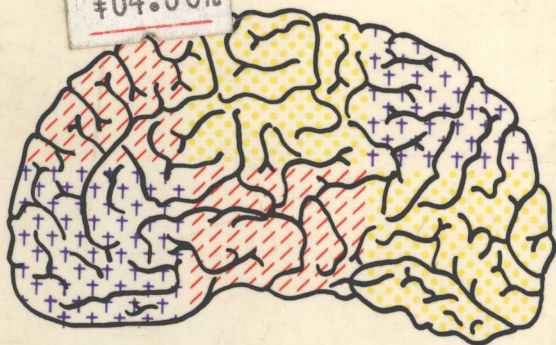


THE

SOCIAL BRAIN

DISCOVERING
THE NETWORKS OF
THE MIND

¥04.00π



MICHAEL S. GAZZANIGA

THE SOCIAL BRAIN

Discovering the Networks
of the Mind

MICHAEL S. GAZZANIGA

Basic Books, Inc., Publishers

New York

"Hymn to Zeus" from George Boas, *The History of Ideas*. Copyright © 1969 Charles Scribner's Sons. Reprinted with permission of Charles Scribner's Sons.

Library of Congress Cataloging-in-Publication Data

Gazzaniga, Michael S.

The social brain.

Includes index.

1. Brain—Localization of functions. 2. Split brain. 3. Belief and doubt. 4. Neuropsychology.
I. Title. [DNLM: 1. Brain—physiology—popular works. 2. Neuropsychology—popular works. 3. Social Values—popular works. WL 103 G289s]

QP385.G394 1985 612'.825 85-47563

ISBN 0-465-07850-8 (cloth)

ISBN 0-465-07851-6 (paper)

Copyright © 1985 by Basic Books, Inc.

Printed in the United States of America

Designed by Vincent Torre

87 88 89 90 MPC 9 8 7 6 5 4 3 2 1

PREFACE

THIS IS A STORY about a scientific discovery, about its evolution and ultimately its effect on my personal understanding of social process.

Looking back over the last twenty-five years, I see how little we can foretell our future. From personal habits to scientific pursuits, our year-to-year endeavors change in ways that are totally unpredictable. What do not change are initial unanswered questions and, for me, those centered on how brain science might address problems of personal consciousness and through those a wider understanding of social processes. Some highly intelligent people can marvel over the elucidation of a phenomenon and are quite happy to leave it hanging in a factual capsule. Others are plagued with the secondary question of how a fact relates to a value, or to a personal understanding of life. While most scientific facts do not directly relate to broader social realities, some do. I think I have come across such connections, which is one reason for my writing this book.

In this book I recount how my experience in brain and psychological research has led to a mechanistic understanding of the way our brains are organized to generate our cognitions and, ultimately, our beliefs. Personal beliefs are what we are all about. We live and die by our commitments to particular views of life. What is it about the human brain that finds the formation of beliefs so central to its operation? Is there an identifiable logic to human brain organization that predicts which phenomena relate to belief formation? I address these and many other questions, but only after what I hope is an enlightening and

Preface

even entertaining account of my brain research activities over the last twenty-five years.

I tell the story chronologically, as it happened. My first draft, however, was not written that way. There I fell into the usual scientific posture of describing and explaining an idea formally, in an order that implied that the theoretical construction argued was preformed in the mind, that substantiating experiments were carried out, and the results were presented to the world as an inexorable product of cold logic. Of course, precious few pieces of human knowledge ever emerge in that way, although most descriptions of scientific odysseys lead the reader to believe that research always progresses logically.

The story is now presented in three parts. First I relate how my understanding of the basic principles of brain organization, as learned from studying unique populations of neurologically impaired patients, argues for a particular view of brain function that I call the modular view. The data suggest that our mental lives amount to a reconstruction of the independent activities of the many brain systems we all possess. A confederation of mental systems resides within us. Metaphorically, we humans are more of a sociological entity than a single unified psychological entity. We have a social brain.

I then consider the implications of these ideas from the perspective of archaeology as well as from an interpretation of historical records related to the formation of religious beliefs. (It will become obvious later why I make these connections.) And finally, in the last chapter, I argue that my basic findings in brain research lead to a particular view of culture. It is not a chapter for the timid. Understanding human biologic and psychologic relations is still a most primitive enterprise. As our understanding of these processes deepens, so too will our understanding of social process. Yet, what I hope this chapter will suggest is that the ultimate and proper task of scientists is to work on these problems in an attempt to achieve such a synthesis.

I am accustomed to writing in a scientific style that requires references for everything. The wrath of one's colleagues when they think their ideas are not properly cited can scarcely be imagined. Since, however, this book is as much a personal narrative as a scientific study, I have compromised by providing source notes only for direct quotes and other specific references.

Thanks are due to the many people and institutions who helped me carry out this exercise.

I am most indebted to Jeffrey Holtzman, to whom this book is dedicated. He encouraged me and humored me throughout my work. His criticisms were unrelenting but always constructive. His tragic death from Wegener's disease in the spring of 1985 has created an emptiness in my life that will not soon be filled. He was the stuff of science, of life. He was unique.

I am indebted to Stephen Kosslyn, Nisson Schechter, Ira Black, and Michael Posner for their close readings of an early version of the manuscript, and for their many helpful suggestions. Thanks also go to Edgar Zurif, Gary Lynch, Ofer Bar-Yosef, and Robert Sommerville for their criticisms. I am also indebted to many of the principals in my intellectual life, including Leon Festinger, David Premack, and George Miller. All gave help and suggestions. At a practical level, my secretary, Christine Black, worked tirelessly as she always does, and Kitty Miller made a valiant effort to turn my prose into English. Most important, I thank all of the wonderful patients who made this work possible.

General support came from the Sloan Foundation, the McKnight Foundation, and the U.S. Public Health Service. I was able to write this particular book as the result of a generous fellowship from the John Solomon Guggenheim Memorial Foundation. Finally, my profound thanks to the staff at Basic Books, and especially to Jo Ann Miller, my editor. She made it all work.

Other Books by Michael S. Gazzaniga

THE BISECTED BRAIN (1970)

FUNDAMENTALS OF PSYCHOLOGY (1973)

THE INTEGRATED MIND, with Joseph LeDoux (1978)

PSYCHOLOGY (1980)

**FUNDAMENTALS OF NEUROSCIENCE,
with Bruce T. Volpe and Diana Steen (1980)**

To the memory of Jeffrey David Holtzman

Scientist, Friend, Companion

CONTENTS

PREFACE		ix
CHAPTER 1.	The Interpretive Brain	3
CHAPTER 2.	Basic Brain Principles	9
CHAPTER 3.	Split-Brain Studies: The Early Years	27
CHAPTER 4.	Left-Brain, Right-Brain Mania: A Debunking	47
CHAPTER 5.	Brain Mechanisms and Belief Formation	60
CHAPTER 6.	The Search for Modularity	81
CHAPTER 7.	Modularity and Memory	100
CHAPTER 8.	Brain Modules and the Unconscious	117
CHAPTER 9.	Psychological Aspects of Modularity	136
CHAPTER 10.	Setting the Human Context: Notes from Prehistory	147
CHAPTER 11.	On the Inevitability of Religious Beliefs	165
CHAPTER 12.	After Hours	182
NOTES		205
INDEX		213

The Social Brain



"It's finally happening, Helen. The hemispheres of my brain are drifting apart."

Drawing by Lorenz; ©1980 The New Yorker Magazine, Inc.

CHAPTER 1

The Interpretive Brain

BELIEVING is what we humans do best—we may believe that there is a God, or that the ACLU does or does not do good work—and we are in fact the only species to do so. What is there about the human brain or mind that endows us with this unique capacity? And, more important, in what ways does this remarkable ability relate to how we create and order the world around us? In this book I propose to demonstrate a new and vital link between the way our brains are organized and the way we construct beliefs—a link that I hope will help us gain a greater understanding of human culture in general and of the important connection between biological processes and critical issues in human behavior.

Beliefs stand at the end point of much of our cognitive activity. They are measurable properties of our mental life and they are, needless to say, powerful in determining much of what we accept as true about the world. Beliefs are central to the human experience, yet until recently the topic of how beliefs are formed and why we are so committed to them has been a topic more for philosophers and novelists than for laboratory scientists.

THE SOCIAL BRAIN

However, recent advances in our understanding of how the brain and mind are organized are changing this view. In fact, right now we humans have more insight into why we behave the way we do than we have ever had before. And it is this knowledge, gained in large part from the careful study of neurologically disordered patients, that opens the door to a new understanding of the fixed characteristics of our species.

We begin by taking a new view of the organization of the brain itself. Many prevalent theories about human thought have argued that problem solving occurs only at the level of conscious experience and that it is the product of the human language system per se. It has been a major assumption of many investigators in psychological research that the elements of our thought processes proceed serially in our "consciousness" for construction into cognitions. I think this notion of linear, unified conscious experience is dead wrong.

In contrast, I argue that the human brain has a modular-type organization. By modularity I mean that the brain is organized into relatively independent functioning units that work in parallel. The mind is not an indivisible whole, operating in a single way to solve all problems. Rather, there are many specific and identifiably different units of the mind dealing with all the information they are exposed to. The vast and rich information impinging on our brains is broken up into parts, and many systems start at once to work on it. These modular activities frequently operate apart from our conscious verbal selves. That does not mean they are "unconscious" or "preconscious" processes and outside our capacity to isolate and understand them. Rather, they are processes going on in parallel to our conscious thought, and contributing to our conscious structure in identifiable ways. At the level of conscious experience, we frequently ask ourselves where particular ideas came from when they appear in our consciousness. For example, when we write, we suddenly think of the exact way to phrase an idea. Where does such an insight come from? We don't seem to know. We seem only to

The Interpretive Brain

have access to the product of these brain modules and not to the process itself.

These relatively independent modular units can actually discharge and produce real behaviors. With regular frequency we find ourselves engaged in activities that seem to come out of nowhere. Everything from eating atypical foods to forming uncommon relationships occurs, and at one level these activities appear to start up from scratch. Through experiments to be reported in this book, we are beginning to learn how this occurrence comes about at a mechanistic level.

The realization that the mind has a modular organization suggests that some of our behavior should be accepted as capricious and that a particular behavior might have no origins in our conscious thought process. For example, we just happen to eat frogs' legs for the first time or we decide to read a different kind of book. But as we shall see, we humans resist the interpretation that such behaviors are capricious because we seem to be endowed with an endless capacity to generate hypotheses as to why we engage in any behavior.

In short, our species has a special brain component I will call the "interpreter." Even though a behavior produced by one of these modules can be expressed at any time during our waking hours, this special interpreter accommodates and instantly constructs a theory to explain why the behavior occurred. While the interpreter does not actually know why there was an impulse to consume frogs' leg it might hypothesize, "Because I want to learn about French food." This special capacity, which is a brain component found in the left dominant hemisphere of right-handed humans, reveals how important the carrying out of behaviors is for the formation of many theories about the self. The dynamics that exist between our mind modules and our left-brain interpreter module are responsible for the generation of human beliefs.

Once one becomes sensitive to how strongly behavior guides our beliefs and how they are formed, one becomes aware of the

THE SOCIAL BRAIN

importance of the overarching social structure. Thus, an environment that conditions some of our mental modules to actions that may not be in the long-term best interests of our general belief systems ought to be avoided. For example, a belief in marital fidelity might be seriously challenged when at a Christmas party you find yourself succumbing to the attractive advances of someone new. That is, possible rewards from the environment could find their mark in one of the modules, which in turn generates a behavior. That behavior, once carried out, must be interpreted, and the new belief about the value of fidelity that results may well be at odds with other values. As we come to appreciate this process we gain a greater understanding of the biological basis of cultural phenomena.

Human brain research urges the view that our brains are organized in such a way that many mental systems coexist in what may be thought of as a confederation. The findings of this research also suggest that identifiable regions of the human brain allow for certain computations that make our species the only one capable of high-order, abstract inference, and that out of this special inference-making capacity comes the unique capacity to interpret our multiple self. These interpretations can actually create beliefs. The possession of beliefs is a mechanism our species uses to free itself from being in a simple reflexlike relation with the rewards and punishments of society. At the same time, when our interpretive brain, which generates our personal sets of beliefs, is overwhelmed by the magnitude and frequency of such rewards, it can fall victim to new beliefs that may form as a result of reflexively having to interpret the elicited behaviors.

Related to these principles of brain operation is the personal perception humans possess that they act of their own free will. Civilized, educated, twentieth-century humans, some even contrary to their working knowledge of modern physics, believe they are freely acting agents. Even habitual behaviors are viewed

The Interpretive Brain

as freely willed. At a psychological level, Albert Einstein felt he was acting freely even though intellectually he was committed to the idea of a mechanistic universe. The belief that we act of our own free will is such a powerful one it must result from a basic feature of human brain organization. I propose that this belief follows from the modular theory of mind that will be explicated here. Since we are continually interpreting behaviors produced by independent brain modules as behaviors that are produced by the self, we come to the conclusion, which is largely illusionary, that we are acting freely. I will argue that it is this inescapable personal perception that finds our beliefs becoming altered the way they do in response to a variety of social forces.

In this book I explore with the reader the scientific evidence that has led me to these views. Much of the story is about the exciting discoveries of mental mechanisms as they have become more generally understood by our studies of the brain. But I hope to go beyond this to place those findings into a larger social context, a context that surely interacts with the physical nature of our species, but is one that is usually not addressed.

Basic cognitive phenomena, such as acquiring and holding social beliefs, are just as much a product of human brain organization as our desires to eat, sleep, and have sex. These special human properties of the mind are the result of brain organization, and as such reveal that many of the surface differences in cultural beliefs are the inevitable product of how the brain interprets the many milieus of this world. We know that the four or so billion people on this earth have the same type of brain and that our species has possessed this type of brain for at least forty thousand years. It is an awesome fact, one that gives me hope that by divining the brain's nature we will become enlightened about the mechanisms of belief formation and consequently more tolerant of the diversity of human beliefs.

Understanding the brain processes that lead to the formation and maintenance of belief systems gives us a foundation for

THE SOCIAL BRAIN

understanding more clearly the basics of human mental life. But in order to accompany me on the journey through my experiences in brain research that lead up to these ideas, it is important for readers to grasp certain basic principles of brain organization, which I turn to now in chapter 2. Once these principles are understood, the larger issues of how the brain actually produces cognition and beliefs become a joy to discover.