



NATIONAL
BESTSELLER

How the Mind Works

"Marks out the territory on which the coming century's debate about human nature will be held." —Oliver Morton, *The New Yorker*

STEVEN PINKER

AUTHOR OF *THE LANGUAGE INSTINCT*

HOW THE MIND WORKS

Steven Pinker



W. W. Norton & Company
New York • London

FOR ILAVENIL

Copyright © 1997 by Steven Pinker

All rights reserved

Printed in the United States of America

First published as a Norton paperback 1999

Since this page cannot legibly accommodate all the copyright notices, page 626 constitutes an extension of the copyright page.

For information about permission to reproduce selections from this book, write to
Permissions, W. W. Norton & Company, Inc., 500 Fifth Avenue,
New York, NY 10110.

The text of this book is composed in Fairfield Light
with the display set in Castellar
Desktop composition by Gina Webster
Manufacturing by The Maple Vail Book Manufacturing Group
Book design by Chris Welch

Library of Congress Cataloging-in-Publication Data
Pinker, Steven, 1954–

How the mind works / Steven Pinker.

p. cm.

Includes bibliographical references and index.

ISBN 0-393-04535-8

1. Cognitive neuroscience. 2. Neuropsychology. 3. Natural selection.
4. Human evolution. 5. Psychology. I. Title.

QP360.5.P56 1997

153—DC21

97—1855

CIP

ISBN 0-393-31848-6 pbk.

W. W. Norton & Company, Inc.
500 Fifth Avenue, New York, N.Y. 10110
www.wwnorton.com

W. W. Norton & Company Ltd.
Castle House, 75/76 Wells Street, London W1T 3QT

Praise for HOW THE MIND WORKS

"Steven Pinker hasn't explained everything in his compelling new book . . . but he explains a great deal. . . . As lengthy as it is, it will produce a book in the reader's head that is even longer. For it alters completely the way one thinks about thinking, and its unforeseen consequences probably can't be contained by a book."

—Christopher Lehmann-Haupt, *New York Times*

"Answers to dozens of questions [about the mind], along with more laughs than one would have thought possible in so illuminating a book, await readers. The vast . . . intellectual enterprise we come to know by spending [time with this book] is simply thrilling in its intricacy, subtlety, and scope."

—George Scialabba, *Boston Sunday Globe*

"With clever examples and buoyant prose, he floats the argument that the mind is a killer collection of 'software modules.' . . . A remarkable synthesis whose rhetorical shimmer alone may help transform 'evolutionary psychology' . . . from a politically and scientifically suspect upstart into a dominant paradigm. . . . [Pinker] is a popularizer in the best sense of the word: He makes complex ideas comprehensible, even compelling, without dumbing them down. And his writerly charm helps to neutralize the acid that is Darwinism."

—John Horgan, *Lingua Franca*

"Pinker is in the tradition of Bertrand Russell as a popularizer of science and a debunker of myths. . . . An ideal introduction to a new view of human nature, one that is likely to gain in influence over time; it's an important book even for those who don't share Pinker's conclusions."

—Adam Kirsch, *Boston Phoenix*

"How does the mind work? Steven Pinker offers more plausible answers to this fundamental question than have ever appeared in a single-authored volume. . . . Pinker is a thoughtful and engagingly witty scientist [and has tackled a problem that] bridges traditional disciplines in an unconventional, challenging, and important way. Those who take the challenge seriously will find stimulating insights throughout the book."

—Steven Gaulin, *Evolution and Human Behavior*

“Pinker has a knack for making the profound seem obvious. . . . A fascinating bag of evolutionary insights.”
—*The Economist*

“Learned, instructive, clever, and charming. . . . It gives you all sorts of things to think about. It makes you think about them in ways that would never have occurred to you. And it makes work for the mind feel like play.”
—Christopher Dornan, *Montreal Gazette*

“[Pinker] has a gift for exposition, for witty analogies, for apposite quotation from his vast knowledge of culture, high and low. And he knows when to skip the details of difficult technicalities. He uses all these skills in his current book. It is erudite [and] light in touch.”

—Phillip Johnson-Laird, *Nature*

“Large, wide-ranging, attractively written, and generally well-argued. . . . May be the most convincing general theory of mind currently on offer. . . . [He] explains all this with exemplary clarity and breadth.”

—Colin McGinn, *New Republic*

“As well as offering an effortless mastery of some extremely difficult theoretical writing, Pinker is witty, lucid, and ultimately enthralling. If you’re interested in the mind, this is both indispensable and truly authoritative.”

—Robert McCrum, *Observer*

“A wonderful overview. . . . Writing with exceptional clarity combined with a healthy dose of humor, he is delightfully provocative.”

—Cyrus Taylor, *Cleveland Plain Dealer*

“Masterful . . . clearly written. He has a gift for making enormously complicated mechanisms—and human foibles—accessible, and he offers a truly comprehensive vision of how number crunching allowed the seeing, hearing, and feeling human parts to evolve within a wondrous, modularized, and goal-directed whole.”

—*Publishers Weekly*

“The theory . . . is presented with extraordinary lucidity, cogency, and panache. . . . To have read [the book] is to have consulted a first draft of the structural plan of the human psyche. . . . A glittering tour de force.”

—Hugh Lawson-Tancred, *Spectator*

"Pinker has a remarkable capacity to explain difficult ideas and he writes with the comic verve of Martin Amis or Woody Allen. . . . Inspire[s] a conceptual breakthrough as unsettling and exciting as seeing the figures in an autostereogram. . . . *How the Mind Works* will change the way your mind works."

—Elaine Showalter, *Times* (London)

"Beautifully written, engaging at every turn, hilariously funny, and devilishly clever. This book is to be read, reread, studied and discussed. The deceptive ease with which it can be enjoyed masks the depths of the message it communicates."

—Michael Gazzaniga, *Trends in Cognitive Science*

"No one tells this story with greater authority or panache. . . . Pinker eschews the usual ponderous academic obfuscations, and his light sense of humor makes one almost forgive his intimidating erudition. . . . Most of [his conclusions] are like shafts of light illuminating what is usually a dark domain."

—Mihaly Csikszentmihalyi, *Washington Post*

OTHER BOOKS BY STEVEN PINKER

Language Learnability and Language Development

Visual Cognition (ed.)

Connections and Symbols (ed., with Jacques Mehler)

Learnability and Cognition

Lexical and Conceptual Semantics (ed., with Beth Levin)

The Language Instinct

PREFACE

Any book called *How the Mind Works* had better begin on a note of humility, and I will begin with two.

First, we don't understand how the mind works—not nearly as well as we understand how the body works, and certainly not well enough to design utopia or to cure unhappiness. Then why the audacious title? The linguist Noam Chomsky once suggested that our ignorance can be divided into *problems* and *mysteries*. When we face a problem, we may not know its solution, but we have insight, increasing knowledge, and an inkling of what we are looking for. When we face a mystery, however, we can only stare in wonder and bewilderment, not knowing what an explanation would even look like. I wrote this book because dozens of mysteries of the mind, from mental images to romantic love, have recently been upgraded to problems (though there are still some mysteries, too!). Every idea in the book may turn out to be wrong, but that would be progress, because our old ideas were too vapid to be wrong.

Second, I have not discovered what we do know about how the mind works. Few of the ideas in the pages to follow are mine. I have selected, from many disciplines, theories that strike me as offering a special insight into our thoughts and feelings, that fit the facts and predict new ones, and that are consistent in their content and in their style of explanation. My goal was to weave the ideas into a cohesive picture using two even bigger ideas that are not mine: the computational theory of mind and the theory of the natural selection of replicators.

The opening chapter presents the big picture: that the mind is a system of organs of computation designed by natural selection to solve the problems faced by our evolutionary ancestors in their foraging way of life. Each of the two big ideas—computation and evolution—then gets a chapter. I dissect the major faculties of the mind in chapters on perception, reasoning, emotion, and social relations (family, lovers, rivals, friends, acquaintances, allies, enemies). A final chapter discusses our higher callings: art, music, literature, humor, religion, and philosophy. There is no chapter on language; my previous book *The Language Instinct* covers the topic in a complementary way.

This book is intended for anyone who is curious about how the mind works. I didn't write it only for professors and students, but I also didn't write it only to "popularize science." I am hoping that scholars and general readers both might profit from a bird's-eye view of the mind and how it enters into human affairs. At this high altitude there is little difference between a specialist and a thoughtful layperson because nowadays we specialists cannot be more than laypeople in most of our own disciplines, let alone neighboring ones. I have not given comprehensive literature reviews or an airing of all sides to every debate, because they would have made the book unreadable, indeed, unliftable. My conclusions come from assessments of the convergence of evidence from different fields and methods, and I have provided detailed citations so readers can follow them up.

I have intellectual debts to many teachers, students, and colleagues, but most of all to John Tooby and Leda Cosmides. They forged the synthesis between evolution and psychology that made this book possible, and thought up many of the theories I present (and many of the better jokes). By inviting me to spend a year as a Fellow of the Center for Evolutionary Psychology at the University of California, Santa Barbara, they provided an ideal environment for thinking and writing and immeasurable friendship and advice.

I am deeply grateful to Michael Gazzaniga, Marc Hauser, David Kemmerer, Gary Marcus, John Tooby, and Margo Wilson for their reading of the entire manuscript and their invaluable criticism and encouragement. Other colleagues generously commented on chapters in their areas of expertise: Edward Adelson, Barton Anderson, Simon Baron-Cohen, Ned Block, Paul Bloom, David Brainard, David Buss, John Constable, Leda Cosmides, Helena Cronin, Dan Dennett, David Epstein, Alan Fridlund, Gerd Gigerenzer, Judith Harris, Richard Held, Ray Jackendoff, Alex Kacelnik, Stephen Kosslyn, Jack Loomis, Charles Oman, Bernard Sher-

man, Paul Smolensky, Elizabeth Spelke, Frank Sulloway, Donald Symons, and Michael Tarr. Many others answered queries and offered profitable suggestions, including Robert Boyd, Donald Brown, Napoleon Chagnon, Martin Daly, Richard Dawkins, Robert Hadley, James Hillenbrand, Don Hoffman, Kelly Olguin Jaakola, Timothy Ketelaar, Robert Kurzban, Dan Montello, Alex Pentland, Roslyn Pinker, Robert Provine, Whitman Richards, Daniel Schacter, Devendra Singh, Pawan Sinha, Christopher Tyler, Jeremy Wolfe, and Robert Wright.

This book is a product of the stimulating environments at two institutions, the Massachusetts Institute of Technology and the University of California, Santa Barbara. Special thanks go to Emilio Bizzi of the Department of Brain and Cognitive Sciences at MIT for enabling me to take a sabbatical leave, and to Loy Lytle and Aaron Ettenberg of the Department of Psychology and to Patricia Clancy and Marianne Mithun of the Department of Linguistics at UCSB for inviting me to be a Visiting Scholar in their departments.

Patricia Claffey of MIT's Teuber Library knows everything, or at least knows where to find it, which is just as good. I am grateful for her indefatigable efforts to track down the obscurest material with swiftness and good humor. My secretary, the well-named Eleanor Bonsaint, offered professional, cheerful help in countless matters. Thanks go also to Marianne Teuber and to Sabrina Detmar and Jennifer Riddell of MIT's List Visual Arts Center for advice on the jacket art.

My editors, Drake McFeely (Norton), Howard Boyer (now at the University of California Press), Stefan McGrath (Penguin), and Ravi Mirchandani (now at Orion), offered fine advice and care throughout. I am also grateful to my agents, John Brockman and Katinka Matson, for their efforts on my behalf and their dedication to science writing. Special appreciation goes to Katya Rice, who has now worked with me on four books over fourteen years. Her analytical eye and masterly touch have improved the books and have taught me much about clarity and style.

My heartfelt gratitude goes to my family for their encouragement and suggestions: to Harry, Roslyn, Robert, and Susan Pinker, Martin, Eva, Carl, and Eric Boodman, Saroja Subbiah, and Stan Adams. Thanks, too, to Windsor, Wilfred, and Fiona.

Greatest thanks of all go to my wife, Ilavenil Subbiah, who designed the figures, provided invaluable comments on the manuscript, offered constant advice, support, and kindness, and shared in the adventure. This book is dedicated to her, with love and gratitude.



My research on mind and language has been supported by the National Institutes of Health (grant HD 18381), the National Science Foundation (grants 82-09540, 85-18774, and 91-09766), and the McDonnell-Pew Center for Cognitive Neuroscience at MIT.

CONTENTS

Preface ix

- 1 Standard Equipment 3
- 2 Thinking Machines 59
- 3 Revenge of the Nerds 149
- 4 The Mind's Eye 211
- 5 Good Ideas 299
- 6 Hotheads 363
- 7 Family Values 425
- 8 The Meaning of Life 521

Notes 567

References 589

Index 627

HOW
THE MIND
WORKS

STANDARD EQUIPMENT

Why are there so many robots in fiction, but none in real life? I would pay a lot for a robot that could put away the dishes or run simple errands. But I will not have the opportunity in this century, and probably not in the next one either. There are, of course, robots that weld or spray-paint on assembly lines and that roll through laboratory hallways; my question is about the machines that walk, talk, see, and think, often better than their human masters. Since 1920, when Karel Čapek coined the word *robot* in his play *R.U.R.*, dramatists have freely conjured them up: Speedy, Cutie, and Dave in Isaac Asimov's *I, Robot*, Robbie in *Forbidden Planet*, the flailing canister in *Lost in Space*, the daleks in *Dr. Who*, Rosie the Maid in *The Jetsons*, Nomad in *Star Trek*, Hymie in *Get Smart*, the vacant butlers and bickering haberdashers in *Sleeper*, R2D2 and C3PO in *Star Wars*, the Terminator in *The Terminator*, Lieutenant Commander Data in *Star Trek: The Next Generation*, and the wisecracking film critics in *Mystery Science Theater 3000*.

This book is not about robots; it is about the human mind. I will try to explain what the mind is, where it came from, and how it lets us see, think, feel, interact, and pursue higher callings like art, religion, and philosophy. On the way I will try to throw light on distinctively human quirks. Why do memories fade? How does makeup change the look of a face? Where do ethnic stereotypes come from, and when are they irrational? Why do people lose their tempers? What makes children bratty? Why do fools fall in love? What makes us laugh? And why do people believe in ghosts and spirits?

But the gap between robots in imagination and in reality is my starting point, for it shows the first step we must take in knowing ourselves: appreciating the fantastically complex design behind feats of mental life we take for granted. The reason there are no humanlike robots is not that the very idea of a mechanical mind is misguided. It is that the engineering problems that we humans solve as we see and walk and plan and make it through the day are far more challenging than landing on the moon or sequencing the human genome. Nature, once again, has found ingenious solutions that human engineers cannot yet duplicate. When Hamlet says, “What a piece of work is a man! how noble in reason! how infinite in faculty! in form and moving how express and admirable!” we should direct our awe not at Shakespeare or Mozart or Einstein or Kareem Abdul-Jabbar but at a four-year old carrying out a request to put a toy on a shelf.

In a well-designed system, the components are black boxes that perform their functions as if by magic. That is no less true of the mind. The faculty with which we ponder the world has no ability to peer inside itself or our other faculties to see what makes them tick. That makes us the victims of an illusion: that our own psychology comes from some divine force or mysterious essence or almighty principle. In the Jewish legend of the Golem, a clay figure was animated when it was fed an inscription of the name of God. The archetype is echoed in many robot stories. The statue of Galatea was brought to life by Venus’ answer to Pygmalion’s prayers; Pinocchio was vivified by the Blue Fairy. Modern versions of the Golem archetype appear in some of the less fanciful stories of science. All of human psychology is said to be explained by a single, omnipotent cause: a large brain, culture, language, socialization, learning, complexity, self-organization, neural-network dynamics.

I want to convince you that our minds are not animated by some godly vapor or single wonder principle. The mind, like the Apollo spacecraft, is designed to solve many engineering problems, and thus is packed with high-tech systems each contrived to overcome its own obstacles. I begin by laying out these problems, which are both design specs for a robot and the subject matter of psychology. For I believe that the discovery by cognitive science and artificial intelligence of the technical challenges overcome by our mundane mental activity is one of the great revelations of science, an awakening of the imagination comparable to learning that the universe is made up of billions of galaxies or that a drop of pond water teems with microscopic life.

THE ROBOT CHALLENGE

What does it take to build a robot? Let's put aside superhuman abilities like calculating planetary orbits and begin with the simple human ones: seeing, walking, grasping, thinking about objects and people, and planning how to act.

In movies we are often shown a scene from a robot's-eye view, with the help of cinematic conventions like fish-eye distortion or crosshairs. That is fine for us, the audience, who already have functioning eyes and brains. But it is no help to the robot's innards. The robot does not house an audience of little people—homunculi—gazing at the picture and telling the robot what they are seeing. If you could see the world through a robot's eyes, it would look not like a movie picture decorated with crosshairs but something like this:

```

225 221 216 219 219 214 207 218 219 220 207 155 136 135
213 206 213 223 208 217 223 221 223 216 195 156 141 130
206 217 210 216 224 223 228 230 234 216 207 157 136 132
211 213 221 223 220 222 237 216 219 220 176 149 137 132
221 229 218 230 228 214 213 209 198 224 161 140 133 127
220 219 224 220 219 215 215 206 206 221 159 143 133 131
221 215 211 214 220 218 221 212 218 204 148 141 131 130
214 211 211 218 214 220 226 216 223 209 143 141 141 124
211 208 223 213 216 226 231 230 241 199 153 141 136 125
200 224 219 215 217 224 232 241 240 211 150 139 128 132
204 206 208 205 233 241 241 252 242 192 151 141 133 130
200 205 201 216 232 248 255 246 231 210 149 141 132 126
191 194 209 238 245 255 249 235 238 197 146 139 130 132
189 199 200 227 239 237 235 236 247 192 145 142 124 133
198 196 209 211 210 215 236 240 232 177 142 137 135 124
198 203 205 208 211 224 226 240 210 160 139 132 129 130
216 209 214 220 210 231 245 219 169 143 148 129 128 136
211 210 217 218 214 227 244 221 162 140 139 129 133 131
215 210 216 216 209 220 248 200 156 139 131 129 139 128
219 220 211 208 205 209 240 217 154 141 127 130 124 142
229 224 212 214 220 229 234 208 151 145 128 128 142 122
252 224 222 224 233 244 228 213 143 141 135 128 131 129
255 235 230 249 253 240 228 193 147 139 132 128 136 125
250 245 238 245 246 235 235 190 139 136 134 135 126 130
240 238 233 232 235 255 246 168 156 144 129 127 136 134

```