

SCIENTIFIC
AMERICAN™

SCIENTIFIC AMERICAN
MIND
BEHAVIOR • BRAIN SCIENCE • INSIGHTS

The Scientific American BOOK OF LOVE, SEX, AND THE BRAIN

THE NEUROSCIENCE
OF HOW, WHEN, WHY,
AND WHO WE LOVE

JUDITH HORSTMAN

**SCIENTIFIC
AMERICAN™**

SCIENTIFIC AMERICAN
MIND
BEHAVIOR • BRAIN SCIENCE • INSIGHTS

The **SCIENTIFIC AMERICAN**
BOOK OF LOVE, SEX,
AND THE BRAIN

The Neuroscience of How, When, Why,
and Who We Love

Judith Horstman



J **JOSSEY-BASS**
A Wiley Imprint
www.josseybass.com



Copyright © 2012 by John Wiley & Sons, Inc., and Scientific American, a division of Nature America, Inc. All rights reserved.

Published by Jossey-Bass
A Wiley Imprint
989 Market Street, San Francisco, CA 94103-1741—www.josseybass.com

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400, fax 978-646-8600, or on the Web at www.copyright.com. Requests to the publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, 201-748-6011, fax 201-748-6008, or online at www.wiley.com/go/permissions.

The contents of this work are intended to further general scientific research, understanding, and discussion only and are not intended and should not be relied upon as recommending or promoting a specific method, diagnosis, or treatment by physicians for any particular patient. The publisher and the author make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation any implied warranties of fitness for a particular purpose. In view of ongoing research, equipment modifications, changes in governmental regulations, and the constant flow of information relating to the use of medicines, equipment, and devices, the reader is urged to review and evaluate the information provided in the package insert or instructions for each medicine, equipment, or device for, among other things, any changes in the instructions or indication of usage and for added warnings and precautions. Readers should consult with a specialist where appropriate. The fact that an organization or Web site is referred to in this work as a citation and/or a potential source of further information does not mean that the author or the publisher endorses the information that the organization or Web site may provide or recommendations it may make. Further, readers should be aware that Internet Web sites listed in this work may have changed or disappeared between when this work was written and when it is read. No warranty may be created or extended by any promotional statements for this work. Neither the publisher nor the author shall be liable for any damages arising herefrom.

Jossey-Bass books and products are available through most bookstores. To contact Jossey-Bass directly call our Customer Care Department within the U.S. at 800-956-7739, outside the U.S. at 317-572-3986, or fax 317-572-4002.

Wiley also publishes its books in a variety of electronic formats and by print-on-demand. Not all content that is available in standard print versions of this book may appear or be packaged in all book formats. If you have purchased a version of this book that did not include media that is referenced by or accompanies a standard print version, you may request this media by visiting <http://booksupport.wiley.com>. For more information about Wiley products, visit us www.wiley.com.

Library of Congress Cataloging-in-Publication Data

Horstman, Judith.

The Scientific American book of love, sex, and the brain : the neuroscience of how, when, why, and who we love / Judith Horstman. – 1st ed.

p. cm. – (Scientific American ; 3)

Includes bibliographical references and index.

ISBN 978-0-470-64778-3 (cloth); ISBN 978-1-118-10951-9 (ebk.); ISBN 978-1-118-10952-6 (ebk.);

ISBN 978-1-118-10953-3 (ebk.)

1. Love. 2. Sex (Psychology) 3. Sex (Biology) 4. Neurosciences. I. Scientific American, inc. II. Title.
III. Title: Book of love, sex, and the brain.

BF575.L8H663 2012

155.3–dc23

2011029321

Printed in the United States of America

FIRST EDITION

HB Printing 10 9 8 7 6 5 4 3 2

The SCIENTIFIC AMERICAN
BOOK OF LOVE, SEX,
AND THE BRAIN

Previous Books in the Scientific American Brain Series

The Scientific American Brave New Brain

The Scientific American Day in the Life of Your Brain

*To my family, my friends, and my Tribe,
who taught me the meaning of love*

ACKNOWLEDGMENTS

My thanks to the wonderful writers and editors of *Scientific American* and *Scientific American Mind* for the excellent articles on which so much of this book is based (they and their work are acknowledged in detail in the Sources) and to scientists everywhere for their deep and keen interest in sex and, more important, in how and why we love.

The creative and hard-working team at Jossey-Bass, who has worked on three brain books with me, are much appreciated. Special thanks to executive editor emeritus Alan Rinzler, who contributed much to the shaping and creation of this book; to senior editorial assistant extraordinaire Nana Twumasi, who ushered it through its final edits and revisions; my new editor, Margie McAneny; Carol Hartland, production genius; Bev Miller, much more than a copyeditor; Paula Goldstein, who designed the book's interior; and all the marketing people who put my book in your hands, including Jennifer Wenzel, P. J. Campbell, Karen Warner. Ace freelance researcher Brianna Smith and Harvard University neuroscientist Kelly Dakin were invaluable. At *Scientific American*, Diane McGarvey and Karin Tucker were responsible for finding and approving years of archived material. Thank you.

Writing is a lonely activity. My family, good friends, and fellow writers supported me with company and cheer and had much to say on the subject of love. Many thanks to you all, in particular to first readers Judith Auberjonois, Ann Crew, Ferris Buck Kelley, J. T. Long, and the wonderfully productive and generous writing community of Sacramento, especially the Writers Who Wine.

PREFACE: WHO DO YOU LOVE?

Who do we love? Who loves us? And why? Why does some love die while other love lasts? Is it really a mystery—or can science (specifically neuroscience) shed some light on how, why, and who our brains love? Probably it can.

We've been learning more about sex every day, especially since Alfred Kinsey began asking Americans exactly what we were doing sexually, where, and with whom, and since William H. Masters and Virginia E. Johnson began scrutinizing and categorizing what our genitals were doing while our brains were having sex.

Recently researchers have been studying what in our brains makes our hearts go pitter-patter with lust and with lasting love—with the whole smorgasbord of emotions, including the love of parent and child, the affectionate love of companionship, the role that the love of animals can play in our lives, and the love of God.

Scientists have learned that the brain in love and sex uses an entire pharmacy of chemicals and chemical actions and reactions, calling forth a tsunami of neurotransmitters and hormones. And now we are able to actually look at a brain that's in love, lust, or both. New imaging technology allows scientists to peer inside our brains, our

primary sex and love organ, to see what's happening in there. Brain scans, especially the functional magnetic resonance imaging scans, allow scientists to see brain activity in real time in a live, thinking, feeling, loving (or sexually excited) brain. They allow scientists to watch as our brain experiences romance, sex, love, and loss, and several emotions in between.

This book is structured around the way your brain encounters and experiences various kinds of love, beginning with prenatal influences and continuing through parental love, friendship, sex, romance, marriage, religious love, and beyond. It is based on the indisputable evidence that we are hardwired to connect to one another. Love is who we are.

CONTENTS

Acknowledgments xi

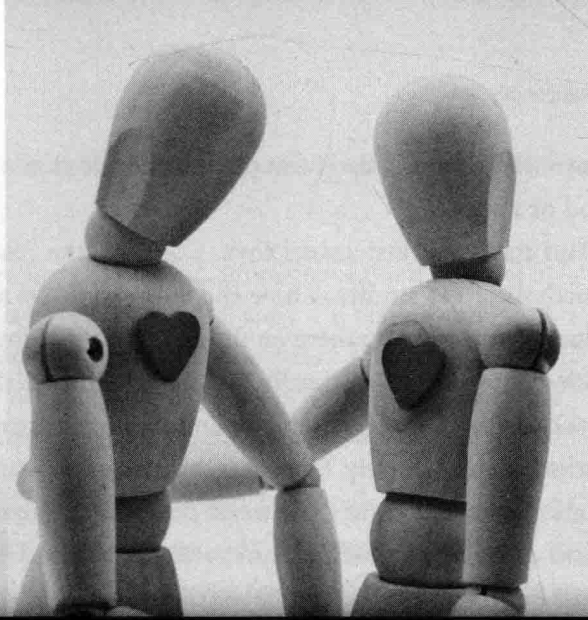
Preface: Who Do You Love? xiii

- Introduction: What Is This Thing Called Love?** 1
- So What Is Love? 2
- Love Is a Many Splendored Thing—and the Greeks Had a Word for
All of the Types 4
- The Basics of Your Brain in Love and Sex 6
- I've Got You Under My Skull: Love in Your Brain 7
- You Make Me Feel So Good: The Pleasure Center 8
- The Very Thought of You 9
- How Scientists Research Love and Sex in Your Brain 10
- 1 Born to Love: Why People Need People** 15
- Do You See What I See? How Mirror Neurons Connect Us 17
- The Dangers of Involuntary Mind Merging 22
- The Chemistry of Love 23
- Love Is Everywhere: Where Love Grows in the Brain 26
- A Brain Unable to Love: Inside the Brain of a Psychopath 27
- Baby Face, You've Got the Cutest Little Baby Face 33
- 2 Learning to Love** 35
- How Your Parents Affect Your Love Life 36
- Love at First Sight: The Earliest Lessons in Love 39
- If You Could Read My Mind: Moms Do 42

A Mother's Everlasting Love	43
How Parenting Primes Your Brain for Love	45
Parenting Rewires the Daddy Brain as Well	46
How Father Love Feeds Both Brains	47
Postpartum Depression: Misery for Mom and Baby	50
Loving the One Who Hurts You: Why Children Cling to Abusers	51
What If Things Went Wrong with That First Love?	52
In the End: Do Parents Matter?	54
3 His Brain, Her Brain, Gay Brain, and Other Brains	57
How Real Are the Differences?	58
The Five Genders of the Brain	60
His Brain, Her Brain: The Geography	61
So What Does This Have to Do with Love?	63
Our Changeable Brains	66
Some Myths About Male and Female Brains: True or False?	68
Toujours Gay: The Gay Brain Is Born That Way	72
Can Animals Be Gay? Better to Call It Bisexual	74
I Am What I Am	76
The Third Gender: When Gender and Sex Do Not Align	79
Are There Asexuals Among Us? On the Possibility of a Fourth Sexual Orientation	81
4 That Old Black Magic: Your Brain in Love	85
How Love and Sex Are Good for Your Brain	88
When Love Occupies Your Brain	90
Who Do You Love? And Who Loves Ya, Baby?	91
You've Got That Lovin' Feelin', But What Turns You On?	96
You Go to My Nose: The Power of Smell over Sex	96
A Kiss Is (More Than) Just a Kiss	102
You Light Up My Brain	104
What's Love Got to Do with It? Plenty It Turns Out—for Women	108
Need Some Love Potion? Try a Bit of Oxytocin Spray	109

- I'll Have What She's Having: What Makes a Better Female
Orgasm? 110
- Does the Penis Have a Brain of Its Own? 112
- When Things Go Wrong: A Fine Romance 115
- 5 Friendship, Such a Perfect Blendship: Or, with a
Little Help from My Friends 121**
- Is Friendship Declining? 123
- Are You Lonesome Tonight? 60 Million Other
Americans Are 125
- You've Got a Friend—or You Should! 126
- Widening the Social Circle 129
- Imaginary Friends: TV Characters Can Ease Your Pain 130
- Until the Real Thing Comes Along: Your Brain on Facebook 133
- Work, the "Other Love" in Your Life 135
- Can Animals Love? Yes, and More 136
- How to Make Friends 139
- 6 Only You Can Make My Dreams Come True: Let's Get
Married 143**
- Grow Old Along with Me: The Marriage Benefits 144
- You Make Me Feel So Good: Romance Lowers Stress 145
- Finding That Special Someone: Looking for Love in All the
Wrong Places? 146
- Falling and Staying in Love 148
- I've Grown Accustomed to Your Face 150
- My One and Only Love: Are We Monogamous? 151
- Granny's Got to Have It 153
- Your Hormones May Drive You Apart: A Tough Pill to
Swallow 155
- Making Love Last: I Get a Kick out of You 156
- Can Pornography Help Your Love Life? 158
- Love Will Keep Us Together: Lasting Romance Is Embossed
in the Brain 159
- Will You Still Need Me When I'm 64? 161

7	You've Lost That Lovin' Feelin': When Love Dies	165
	Breaking Up Is Hard to Do: How Rejection Affects Your Brain	166
	The Jilted Brain	167
	After the Love Is Gone—You Ache and Ache	169
	Can't Live If Living Is Without You: The Widowhood Effect	171
	Achy Breaky Heart: Can You Die of a Broken Heart?	172
	Ain't No Cure for Love—But Acetaminophen Could Help	172
	Every Time You Say Good-Bye, I Die a Little: Why It Hurts to Leave Your Lover	174
	Broken Promises: Can the Brain Predict Betrayal?	176
	Coping with a Breaking Heart	178
8	For the Love of God	181
	Searching for God in Your Brain	182
	Epilepsy, the Temporal Lobe, and God	182
	Strokes of Insight: Brain Changes and Spiritual Awakening	184
	Religious Ecstasy Is Like Romantic Love—in the Brain at Least	186
	God on the Brain: What Brain Scans Show	188
	Could Religion Shrink Your Brain?	190
	The Evolutionary Roots of God Thought	191
	God Neurons May Be Everywhere	192
9	Technology, Science, and the Future of Sex	195
	The Wonderful World of Cybersex	196
	Sex in Bits and Bytes: The Future of Virtual Sex Is Here	199
10	How Can Love Survive?	201
	But What of Love?	204
	<i>Glossary</i>	207
	<i>Sources</i>	215
	<i>Illustration Credits</i>	229
	<i>About the Author</i>	231
	<i>Index</i>	233



Introduction: What Is This Thing Called Love?

Much is written of the mysteries of love, but there is no mystery about our need for it. We crave the comfort of others, especially those who have become special to us. People will kill, die, starve, and commit crimes for love. They have faced torture and prison, defending their rights to love the god or person of their choice. Children and spouses cling to abusers out of the need for their love. People go mad in solitary confinement, or even, studies show, die of loneliness or the emotional blow of a “broken heart.”

Love is so vital to the human condition that it is beyond mere emotion. Indeed, many researchers have described love as a drive, an urge, and even a hunger. A multistudy analysis confirms that the powerful rush we feel when we are madly, deeply, passionately in love is not really an emotion. It’s a reward produced by ancient brain

pathways that similarly motivate our most basic needs such as those for food or sleep.

And that's not just sexual love. Consider the results of a 2010 meta analysis of 148 studies of how and why people die and the causes. Loneliness ranks right up there on the top. The study found that a lack of relationships can be as deadly as well-established risk factors for death such as smoking and alcohol, and it is even greater than other risk factors such as obesity. Shunning, abandonment, and forced solitary confinement are among the worst punishments, considered to be cruel and excessive, or even torture, and the rejected brain is a very wretched brain.

So What Is Love?

Everyone in every culture knows what love is, in all its many guises, as both a noun and a verb. It is tender, sweet, protective, passionate, lustful, jealous, trustful, and sometimes mad. But just try to get a good, clear, take-to-the-bank definition, and you will be stymied. Google alone yields 6,730,000,000 hits for the simple word *love*.

The poets say it in verse, as Shakespeare did in his Sonnet 116:

Love is not love
 Which alters when it alteration finds,
 Or Bends with the remover to remove.
 O, no! It is an ever-fixed mark,
 That looks on tempests and is never shaken.

—WILLIAM SHAKESPEARE

Kahlil Gibran in *The Prophet* describes love thus:

Love has no desire but to fulfill itself. To melt and be like a running brook that sings its melody to the night. . . . To wake at dawn with a winged heart and give thanks for another day of loving.

The New Testament offers the well-quoted passage from 1 Corinthians 13:47:

Love is patient, love is kind. It does not envy, it does not boast, it is not proud. It is not rude, it is not self-seeking, it is not easily angered, it keeps no record of wrongs. Love does not delight in evil but rejoices with the truth. It always protects, always trusts, always hopes, always perseveres.

And, of course (and anonymously), “God is love.”

Philosophers don't sound very philosophical when it comes to love. Sophocles wrote, “One word frees us of all the weight and pain of life: That word is love.” Plato wrote, “At the touch of love everyone becomes a poet,” and later added, “Love is a serious mental disease.”

Scientists reduce love to its basics, exemplified by these definitions from Stephanie Ortigue and associates:

Love is the existence of a complex rewarding emotional state involving chemical, cognitive, and goal-directed behavioral components.

Romantic love is a mammalian brain system for mate choice.

And this basic truth is from the twentieth-century psychoanalyst Eric Fromm:

Love is the only sane and satisfactory answer to the problem of human existence.

Even fictional characters have an opinion. The character Hawkeye from the TV show *M*A*S*H** said on one episode in 1973, “Without love, what are we worth? Eighty-nine cents! Eighty-nine cents worth of chemicals walking around lonely.”

We all have our own definitions when it comes to being in love, but most of us would agree, “I know it when I see it” (which just happens to also be the way Supreme Court Justice Potter Stewart famously defined pornography).