

---

# The Cognitive Neuroscience of Mind

A Tribute to Michael S. Gazzaniga

edited by Patricia A. Reuter-Lorenz, Kathleen Baynes,  
George R. Mangun, and Elizabeth A. Phelps

A Bradford Book  
The MIT Press  
Cambridge, Massachusetts  
London, England

© 2010 Massachusetts Institute of Technology

All rights reserved. No part of this book may be reproduced in any form by any electronic or mechanical means (including photocopying, recording, or information storage and retrieval) without permission in writing from the publisher.

For information about special quantity discounts, please email [special\\_sales@mitpress.mit.edu](mailto:special_sales@mitpress.mit.edu)

This book was set in Sabon by Toppan Best-set Premedia Limited. Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data

The cognitive neuroscience of mind : a tribute to Michael S. Gazzaniga / edited by Patricia A. Reuter-Lorenz ... [et al.].

p. cm.

“A Bradford book.”

Includes bibliographical references and index.

ISBN 978-0-262-01401-4 (hardcover : alk. paper)

1. Cognitive neuroscience—Congresses. 2. Gazzaniga, Michael S.—Congresses.

I. Gazzaniga, Michael S. II. Reuter-Lorenz, Patricia Ann, 1958–

[DNLM: 1. Gazzaniga, Michael S. 2. Cognition—Festschrift.

3. Neurosciences—Festschrift. BF 311 C676346 2010]

QP360.5.C3694 2010

612.8'233—dc22

2009034514

10 9 8 7 6 5 4 3 2 1

---

# Index

- Allen, Woody, 229–230  
Amygdala, 95–96, 127, 180  
Anosognosia, 113  
Anterior cingulate cortex (ACC),  
127–129, 181–183  
Aphasia, right hemisphere and, 63–69  
Attardi, Domenica “Nica,” 6–7  
Attentional mechanism, disconnected  
hemispheres sharing a common,  
100, 102–103  
solution to the paradox, 103–106  
Attentional orienting, bottom-up *vs.*  
top-down, 104–106  
Attentional resources possessed only  
by split-brain patients, 101–103  
Attention Network Test (ANT), 132–  
133  
Attention research, 99, 101  
  
Bartlett, Frederic, 139  
Beadle, George, 4  
Behavioral neurology and cognitive  
neuroscience, 204  
Berlucchi, Giovanni  
remembrance of Gazzaniga, 8–10  
*Bisected Brain, The* (Gazzaniga), 90–  
91, 93  
Bisected brain, updating the, 90–91  
Bogen, Joe, 7  
Bonner, James, 5  
Brain and behavior  
ethics and, 223–232  
methods used to study the  
relationship between, 206–207  
Brain-as-PDA theory, 224, 225  
Brecha, Nick, 90  
Broca, Paul, 204  
Buckley, William F., 94  
  
Cabeza, Roberto, 107, 109  
California Institute of Technology  
(Cal Tech), 3–10, 25, 94  
Biology Department, 4–5  
Gazzaniga at, 3–10  
Nobel Prizes awarded to professors  
at, 4  
Callosotomy. *See* Corpus callosotomy  
Categorical spatial relations, 41–43.  
*See also* Spatial relations  
representations  
Chatterjee, Anjan, 217  
Chemoaffinity hypotheses, 198  
Cloning, therapeutic, 224  
Cognitive dissonance and emotion,  
96  
Cognitive neuroscience, 223. *See also*  
*specific topics*  
meanings of the term, 204, 205  
politics of and fears affecting, 223–  
229  
Cognitive neuroscience methods,  
203–206, 209–215, 217–219. *See*  
*also specific methods*  
general considerations regarding,  
207–209  
impact, 215, 216f, 217  
temporal and spatial resolution of  
various, 210f

- “Cognitive Neurosciences, The” (Gazzaniga), 205
- Cognitive Neuroscience Society, 205 meetings, 203–204, 207
- Cognitive subtraction, 213–214
- Collective memory, 140, 151. *See also* Forgetting; Social contagion defined, 140
- effect of speaker on listener, 143–144
- effect of speaker on speaker, 142–143
- formation, 140–142
- intentions of speaker and, 150–151
- resistance to misinformation and, 144, 149–150
- Commissurotomy patients, 60
- Connectivity between brain areas, 128–130. *See also specific topics*
- Conscious experience, subjective unity of, 34–36. *See also* Self-awareness
- Cooney, J., 177
- Coordinate spatial relations, 42–44. *See also* Spatial relations representations
- Corbalis, Paul, 74–75
- Corpus callosotomy, 111–112. *See also* Epilepsy
- awareness of deficits following, 112–114
- memory following, 115–119
- Corpus callosum
- constructing functional maps in, 16–19
- cortical excitation and inhibition by, 13–15
- evolutionary significance, 35–36
- functions, 35
- recent research on, 10–19
- Witelson’s proposed division of, 16
- Corpus callosum connections, formation of, 198–199
- Corpus projection neurons, 11–13
- Cuc, A., 148
- Determinism, fear of, 225, 227–228
- Diffusion tensor imaging (DTI), 17, 18, 128
- Disconnection syndromes, 112. *See also* Corpus callosotomy; Split-brain performance
- Gazzaniga’s review paper on, 95
- Dopamine D4 receptor (DRD4) gene, 132–134
- Dorsal anterior cingulate cortex (dACC), 181
- Dorsal lateral geniculate nucleus (dLGN), 194, 196–197
- Dreher, Bogdan, 195
- Emotion, 95–97
- Schachter-Singer cognitive theory of, 96–97
- Emotional brain, 89, 97
- Emotional Brain, The* (LeDoux), 97
- Emotional reactivity, 126–128. *See also* Temperament
- Emotional regulation. *See* Self-regulation
- Epilepsy, callosotomy treatment of, 7, 9, 17, 91–92, 101. *See also* J.W. *Ethical Brain, The* (Gazzaniga), 225
- Ethics and the ethical brain, 223–232
- Eye, Retina, and Visual System of the Mouse* (Chalupa & Williams), 194–195
- Fellows, Lesley, 215
- Festinger, Leon, 94
- Fitzpatrick, Susan, ix
- Forebrain and spatial attention, 33
- Forgetting, induced, 143–144, 146–149
- Forward inference, 214–215
- Frontal cortex, left inferior, 67
- Functional magnetic resonance imaging (fMRI), 15, 174, 206
- Functional neuroimaging, 173–174, 206–208, 213–215
- as correlative method, 208
- Functional neuroimaging studies, number of published, 216f, 217

- Gazzaniga, Michael S., ix  
 account of consciousness, 118  
 attentional network (*see* Attention research)  
 on brain as PDA, 225  
 at Cal Tech, 3, 7–10, 25  
 cerebral hemispheres and, 26–27, 28f, 34–36, 112–114, 177, 198, 229  
 on changes in brain/mind research, 218–219  
 citation for APA Distinguished Scientific Award to, 223  
 coining the phrase “cognitive neuroscience,” 204  
 on consciousness and conscious experience, 114–115  
 corpus callosum and, 35–36, 198  
 at Dartmouth College, 3  
 on emotional brain, 89  
 on evolution, 35–36  
 on the “interpreter,” 114, 177  
 Leon Festinger and, 94  
 lessons regarding studying the mind, 173–174  
 on “memory impairments,” 116  
 opening doors for colleagues, 107, 109  
 people with whom he surrounded himself, 73  
 personality, 9, 10, 73, 89, 90, 91, 94–95, 109, 111, 191–192  
 professional achievements, 3, 35, 191, 205–206, 223, 225, 231  
 remembrances of  
 Alan Kingstone’s, 99–100, 107  
 Elisabetta Lådavas’s, 155–156  
 Giovanni Berlucchi’s, 8–10  
 Joseph LeDoux’s, 89–97  
 Kathleen Baynes’s, 59, 60  
 Leo Chalupa’s, 191–192  
 Margaret Funnell’s, 73–74  
 Michael Miller and Scott Guerin’s, 111  
 Mitch Glickstein’s, 3, 7–8  
 Stephen Kosslyn’s, 39–40  
 Steven Hillyard’s, 25  
 Todd Heatherton’s, 173–174, 185
- social psychology and, 94–95  
 split-brain research, 35, 39, 217–218  
 on split-brain research, 35f  
 twin research, 226  
 writings, 26, 191  
*The Bisected Brain*, 90–91, 93  
 on disconnection syndromes, 95  
 “Does the corpus callosum enable the human condition?,” 35–36  
*The Ethical Brain*, 225  
*Human: The Science Behind What Makes Us Unique*, 125, 191, 192, 225, 226  
*The Integrated Mind*, 93–94, 184  
*Mind Matters*, 94  
*The Mind’s Past*, 229, 230  
*Nature’s Mind*, 226  
*The Social Brain*, 94, 125, 140, 174, 184  
 “The Cognitive Neurosciences,” 205
- Genetic contribution to structure and function of neural networks, 132–134
- Geschwind, Norm, 95
- Glickstein, Mitchell, 9  
 remembrance of Gazzaniga, 3, 7–8
- Group inclusion. *See* In-group, out-group, and detection of threat
- Hamilton, Chuck, 6, 9, 25–26
- Hemispherectomy patients, 60–61
- Hemispheres  
 communication link between, 92  
 and evolution of cognition, 35  
 confusion caused by information presented to both, 101–102  
 exerting control over each other, 107 (*see also* Attentional mechanism)  
 interaction between surgically separated, 26–27, 30–31, 33–34, 33f
- Hemispheric differences in function  
 methodologies to study, 76–77  
 perceptual differences, 75  
 visuospatial processing and, 74–85

- Hemispheric encoding/retrieval asymmetry (HERA) model, 116–117, 119
- Hippocampus and memory, 116, 118–119, 208–209
- Hirst, William, 147
- Holtzman, Jeffrey D., 100–102
- Horwitz, H. Robert, 193
- Human: The Science Behind What Makes Us Unique* (Gazzaniga), 125, 191, 192, 225, 226
- Imperfectibility, fear of, 225–227
- Inequality, fear of, 225–226
- In-group, out-group, and detection of threat, 179–182
- Innocenti, Giorgio, 199
- Integrated Mind, The* (Gazzaniga), 93–94, 184
- Intention and memory, 150–151
- Interpreter, left-hemisphere, 134–135, 184–185  
 corpus callosum and, 35  
 experience of self and, 177–178  
 Gazzaniga on, 34–35, 92–94, 114, 125, 134, 155, 174, 177, 184  
 language and, 75, 76, 84  
 right-hemisphere interpreter and, 75, 84–85
- Interpretive capacity of left-hemisphere, 76–77
- Journal of Cognitive Neuroscience*, 191, 205, 218
- J.W. (callosotomy patient), 31f, 39, 62, 66, 74, 77  
 ability to speak responses to LVF stimuli, 62  
 drawings of words presented to left and right visual field, 108f  
 Gazzaniga and, 39, 59, 60, 74  
 independent perceptual and mnemonic capabilities of separated hemispheres, 27, 29f, 30  
 relational category tasks and, 77–82, 79f
- visual search experiment with, 101–102, 106
- Karten, Harvey, 89
- Killackey, Herb, 199
- Kingstone, Alan, 104, 105
- Kinsbourne, M., 63
- Klein, Ray, 99
- Kosslyn, Stephen M., 44, 45
- Language. *See also* Verb generation  
 left-hemisphere interpreter and, 75, 76, 84  
 in split-brain patients, 101
- Lashley, Karl Spencer, 5
- Lateral geniculate nucleus. *See* Dorsal lateral geniculate nucleus
- LeDoux, Joseph, 115–116
- Left-brain “interpreter.” *See* Interpreter
- Left inferior frontal cortex (LIFC), 67
- Left visual field (LVF) stimuli, verbal responses to, 62
- Lesion-overlap approach, 210–212
- Lesion studies, 210–213, 215, 216f, 217
- Listening. *See* Collective memory
- Loftus, Elizabeth F., 144
- Magnetic resonance imaging (MRI), 173–174
- Mangun, George R., 100
- Medial region of prefrontal cortex (MPFC), 176, 177, 179
- Memory, 139–140, 151, 208–209.  
*See also* Collective memory  
 after corpus callosotomy, 115–119
- Mental images  
 constructed a part at a time, 49  
 ways of generating, 49
- Miller, Michael B., 107, 109, 117
- Miller, Tara, ix
- Mind Matters* (Gazzaniga), 94
- Mind’s Past, The* (Gazzaniga), 229, 230

- Mingazzini, G., 16  
 Mishkin, Mort, 95–96  
 Myers, Ronald, 6
- Nakamura, Richard, 91  
*Nature's Mind* (Gazzaniga), 226  
 Navigation, 43–44  
 Neuroimaging. *See* Functional neuroimaging; *specific techniques*  
*Neurological Foundations of Cognitive Neuroscience* (D'Esposito), 203–204, 206  
 “Neuroscience,” Gazzaniga’s coining the term, 204  
 Nihilism, fear of, 228–229
- Orienting. *See* Attentional orienting
- Phelps, Elizabeth A., 116  
 Posner, Michael I., 99, 130  
 Posner cued spatial orienting paradigm, 30, 31f  
 Prefrontal cortex, 183. *See also* Medial region of prefrontal cortex  
 Premack, David, 94  
 Pure insertion, 213–214
- Rakic, Pasko, 196  
 Reaching, 43–44  
 Reactivity. *See* Emotional reactivity  
 Relational category/relation-matching tasks, 77–82, 78f, 79f  
 Religion and science, 224  
 Resistance to misleading information, 144, 149–150  
 Retinal decussation patterns, 195–196  
 Retinotopic errors, 198  
 Retrieval-induced forgetting. *See also* Forgetting  
 socially shared *vs.* within-individual, 148  
 Reuter-Lorenz, Patricia A., 100, 103–105  
 Reverse inference, 215  
 Right hemisphere (RH), 61. *See also* *specific topics*  
 Right-hemisphere interpreter. *See* Interpreter  
 Rothbart, Mary K., 130
- Saying-is-believing effect, 142–143  
 Schachter, Dan, 139–140  
 Schachter, Stanley, 96  
 Search, “smart” *vs.* standard, 104  
 Seizure disorder, 60  
 Self-awareness, 175–178, 229  
 Self-knowledge, 175. *See also* Self-awareness  
 Self-regulation, 175, 182–184  
 development of, 130–132  
 Self-regulatory networks, 128  
 Semantic relations and semantic priming, 65–68  
 Sensory integration (SI), 157, 158f  
 Shared memories. *See* Collective memory  
 Similarity between self and other, 163, 164f, 165–167  
 Singer, Jerome, 96  
 Singer, Peter, 227  
 “Smart search,” 104  
 Snowball effect, 52–53  
 Social brain, 134–135  
 building the, 174–175, 184  
 components of, 175–184  
*Social Brain, The* (Gazzaniga), 94, 125, 140, 174, 184  
 Social contagion, 143–146, 149  
 Social inclusion *vs.* rejection. *See* In-group, out-group, and detection of threat  
 Socially shared retrieval-induced forgetting, 148, 149. *See also* Forgetting  
 Spatial attention and forebrain, 33  
 Spatial orientation, 30  
 Spatial relations representations, 39, 54–55  
 categorical *vs.* coordinate, 40–55  
 computational modeling of, 51  
 bases of lateralization, 52–53  
 incompatible mappings, 51–52  
 new predictions, 53–54

- Spatial relations representations (cont.)  
 divided-visual-field studies, 45–46, 49–50  
 lateralization, 42–44, 52–53  
 neuroimaging studies, 46–47, 50–51  
 in visual mental imagery, 48–49  
 in visual perception, 44–48  
 brain damage and, 47–48
- Speakers and listeners. *See* Collective memory
- Speech production, 43
- Sperry, Roger W., 3, 5–9  
 background, 5, 6  
 at Cal Tech, 6–8, 25  
 chemoaffinity hypotheses, 198  
 Gazzaniga and, 10, 25  
 Gazzaniga on, 218–219  
 on memory impairment, 112, 115  
 personality, 8, 10  
 psychobiology class taught by, 25  
 split-brain research, 10, 25, 26, 112, 115
- Spirituality and science, 224
- Splenium, 16–19
- Split-brain performance, 101–102.  
*See also specific topics*  
 a general principle of, 106–107
- Stem-cell research, 224
- Strategic search, 104
- Summer Institute for Cognitive Neuroscience, 205
- Tactile processing. *See* Touch
- Temperament, 125, 126. *See also* Emotional reactivity
- Theory of mind (ToM), 175, 178–179
- Thompson, Robert, 89–90
- Threat, detection of, 175, 179–182
- Touch. *See also* Visual enhancement of touch  
 visual remapping of, 160–161, 162f, 163, 164f, 165–168
- Tulving, Endel, 116–117
- Ventral anterior cingulate cortex (vACC), 181, 182
- Verb generation, 67–68, 68f
- Visual enhancement of touch (VET), 156–157, 168  
 model for brain mechanism underlying, 158f, 159
- Visual images, constructed a segment at a time, 48–49
- Visual remapping of touch, 160–161, 162f, 163, 164f, 165–168
- Visual search experiment with J.W., 101–102, 106
- Visual system development, species differences in, 195–200
- Visual system organization, differs among species, 193–195
- Visuospatial processing. *See* Hemispheric differences in function; Spatial relations representations
- Wernicke's aphasia, 65
- Williams, R. W., 191
- Witelson, S. F., 16–18
- Within-individual retrieval-induced forgetting, 148. *See also* Forgetting
- Working memory, 208, 209
- Year in Cognitive Neuroscience, The* (journal), 109