

FUNDAMENTALS OF COGNITIVE
NEUROSCIENCE

FUNDAMENTALS OF COGNITIVE NEUROSCIENCE

A BEGINNER'S GUIDE

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Preface

Scientific revolutions are exciting, but they make it hard to keep up. That goes doubly for faculty who want to stay up to date and *also* teach the latest “mind-brain” science to students in psychology, education, economics, political science, sociology, and biology. Popular sources are not always reliable, and specialized journals seem to speak their own languages.

This is our effort to present the fundamentals as clearly and simply as possible. It is based on our upper-division textbook, *Cognition, Brain, and Consciousness: An Introduction to Cognitive Neuroscience*, by Bernard J. Baars and Nicole M. Gage (2010) (Elsevier/Academic Press).

Human beings have thought about the mind and its brain (or vice versa) for many centuries. Scientific psychology emerged from roots in the natural sciences, philosophy, medicine, and the wisdom traditions before 1900. Brain science has its own history. The first accurate anatomy was published by Vesalius in the late Renaissance. Brain anatomy has been studied ever since that time with increasingly fine-grained tools.

Brain functions were much harder to determine—mainly in neurologic patients, followed by postmortem dissection. The living human brain could not be studied directly. That made it hard to find out how the “psyche” and the “brain” relate to each other. The brain is complex and flexible, so it is constantly learning and adapting. Brain damage is not a static thing but a tissue insult that the brain tries to heal, to work around, and to isolate. Postmortem evidence is

therefore important, but it does not necessarily reveal the healthy brain before the injury.

In 1929, Hans Berger was able to detect the tiny (microvolt) electrical field of the human brain for the first time. Berger discovered alpha waves when his subjects were asked to close their eyes. Other basic discoveries followed. Today electroencephalography (EEG) is an indispensable medical tool, but electrically the brain is much like a bowl of gelatin, making it hard to find out *what, where, when, and why*.

Psychological science matured separately from brain science. It was hard to build solid bridges between them. Only in the last decade or so have new and much improved “brain scopes” really taken off. We can now observe the living brain in detail when humans perceive, act, learn, remember, feel, speak, listen, and interact with one another. The effect is much like Galileo’s first view through a telescope: It revolutionized the physics and astronomy of his time. Those sciences used the early telescopes, but they also started to build new and better ones, a process that continues today. The early telescope was still crude, but it had a huge impact.

While our current understanding is far from complete, scientists no longer believe in exploring memory, attention, or the senses from just one point of view. We now want to study those topics from both brain and mind perspectives. The result is not one side “losing” and the other one “winning,” but rather a win-win for both. We are seeing a new synthesis emerging. The whole is greater than, or at least different from, the sum of its parts.

Many practical applications are emerging in medicine, education, and even in the arts. The resulting field is taught under many different course titles. We believe the content is the most important. *Cognitive neuroscience* is our current term of art, but *biopsychology*, *psychophysiology*, and the like can make a claim to the new mind-brain science.

College curricula increasingly demand excellent, up-to-date, and “user-friendly” teaching materials in cognitive neuroscience. The book you now hold in your hands is our attempt to meet that demand. We would be delighted to hear from you and your students.

We have many people to thank for their guidance, assistance, and support throughout the process of preparing this new book. We thank our editor, Mica Haley, for her constant support and guidance throughout this process. Her enthusiasm and friendship were an extra benefit for us! April Graham, our editorial project manager, guided us through the complex and sometimes difficult process of transforming our written words into a printed book, and we thank her for her patience and wisdom during the process. Vanessa McNeill was our godsend during the book preparation. Her organizational and gentle editing truly made the process a pleasure.

Bernard Baars also owes a debt of gratitude to Gerald M. Edelman and many colleagues at the Neurosciences Institute in San Diego for a first-rate education in the

biology of brains—human, virtual, and squid. Nicole Gage wishes to thank Greg Hickok and David Poeppel for their mentoring and friendship as she began her journey to understand the mind and brain.

Most of all, we thank our families and friends for their patience while we created this textbook! Nicole Gage in particular wants to thank her husband Kim for his insight and love.

Bernard J. Baars and Nicole M. Gage

POSTSCRIPT

Our hardcover text, *Cognition, Brain, and Consciousness*, 2nd Edition, has been praised for its accessible approach for students and instructors.

“A powerful pedagogical achievement and a boon for both the novice and the advanced student.”

Patricia Smith Churchland, chair, President’s Professor of Philosophy, University of California, San Diego

“Though intended as a text for students of psychology, biology, education, and medicine, Cognition, Brain, and Consciousness has much to offer the intelligent layperson and even experts in cognitive neuroscience. It’s clearly and entertainingly written, abundantly illustrated, and content rich, making this complex, but fascinating, field accessible to all.”

Stan Franklin, Ph.D., W. Harry Feinstone Professor of Interdisciplinary Research, director, Institute for Intelligent Systems, The University of Memphis, Tennessee