

A GROUNDBREAKING COLLABORATION  
BETWEEN NEUROSCIENCE AND BUDDHISM

*Train Your*  
**MIND**  
*Change Your*  
**BRAIN**

HOW A NEW SCIENCE REVEALS  
OUR EXTRAORDINARY POTENTIAL  
TO TRANSFORM OURSELVES

**SHARON BEGLEY**

**FOREWORD BY THE DALAI LAMA**

**PREFACE BY DANIEL GOLEMAN,**  
*author of Emotional Intelligence and Social Intelligence*

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**I**s it really possible to change the structure and function of the brain, and in so doing alter how we think and feel? The answer is a resounding yes. In late 2004, leading Western scientists joined the Dalai Lama at his home in Dharamsala, India, to address this very question—and in the process brought about a revolution in our understanding of the human mind. In this fascinating and far-reaching book, *Wall Street Journal* science writer Sharon Begley reports on how cutting-edge science and the ancient wisdom of Buddhism have come together to show how we all have the power to literally change our brains by changing our minds. These findings hold exciting implications for personal transformation.

For decades, the conventional wisdom of neuroscience held that the hardware of the brain is fixed and immutable—that we are stuck with what we were born with. As Begley shows, however, recent pioneering experiments in neuroplasticity, a new science that investigates whether and how the brain can undergo wholesale change, reveal that the brain is capable not only of altering its structure but also of generating new neurons, even into old age. The brain can adapt, heal, renew itself after trauma, and compensate for disability.

Begley documents how this fundamental paradigm shift is transforming both our understanding of the human mind and our approach to deep-seated emotional, cognitive, and behavioral problems. These breakthroughs show that it is possible to reset our happiness meter, regain the use of limbs disabled by stroke, train the mind to break cycles of depression and OCD, and reverse age-related changes in the brain. They also suggest that it is possible to teach and learn compassion, a key step in the Dalai Lama's quest for a more peaceful world. But as we learn from studies performed on Buddhist monks, an important component in changing the brain is to tap the power of mind and, in particular, focused attention. This is the classic Buddhist practice of mindfulness, a technique that has become popular in the West and that is immediately available to everyone.

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With her extraordinary gift for making science accessible, meaningful, and compelling, Sharon Begley illuminates a profound shift in our understanding of how the brain and the mind interact. This tremendously hopeful book takes us to the leading edge of a revolution in what it means to be human.



**SHARON BEGLEY**, science columnist for *The Wall Street Journal*, inaugurated the paper's "Science Journal" in 2002. She was previously the senior science writer at *Newsweek*, covering neuroscience, genetics, physics, astronomy, and anthropology. The co-author of *The Mind and the Brain*, she has won many awards for her articles. She is a frequent guest on radio and television, including *The Charlie Rose Show*, *Today Weekend*, CBS's *The Early Show*, and *Imus in the Morning*. She lives in New Jersey.

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## A Child Shall Lead Them

### *The Neuroplasticity of Young Brains*

Esref Armagan has never seen a ray of light, a shadow, or a mountain. To him, color is a property that, people have told him, objects have, and perspective something he has learned from the casual conversations of friends. When he was born in a poor neighborhood of Istanbul in 1951, one of his eyes remained undeveloped and the other was damaged, with the result that he has always been functionally blind. Armagan received no formal education, and although he tried to play with the other street kids, his blindness set him apart, leaving him to find his own amusements. When he was little more than a toddler, he began scratching lines in the dirt and, by six, was sketching with pencil and paper. As a young man, he took up oils and eventually became a professional artist. Armagan's canvases are not abstract swirls and shapes, not stark geometrics or flat primitives. They show windmills and flying dragons, vibrant landscapes with shadows and three-point perspective. The sort of images you would think possible only with vision.

But Armagan has developed a unique compensation for his handicap. Using a special rubberized stylus, he draws lines that he can feel as tiny bumps and creases, so as one hand sketches a scene, the fingers of the other





ation) were located in a primary sensory area," the primary visual cortex. It seems that the functional hierarchy of the brain, he added, "is not carved in stone." To the contrary. The visual cortex "is recruited to be part of the network involved in a high-level cognitive function, processing speech and remembering words," said Leo Cohen. That a usually low-level region such as the visual cortex can handle such a sophisticated task was as astounding as finding a granite worker leaving the quarry and sculpting pietàs instead.

### Painting Blind

But what about the blind Turkish painter? Esref Armagan never learned Braille. He is illiterate, he told Amedi and Pascual-Leone when they invited him to Boston so they could study his brain, and has poor verbal memory. Ironically for someone who lives in perpetual darkness, his is a purely visual world, not a verbal one. The life he led was strikingly different from that of the well-educated, Braille-fluent blind Americans whose visual cortex felt, heard, and generated language. Would Armagan's visual cortex be different, too? To find out, the Harvard scientists had him perform various tasks while fMRI detected regions of heightened activity in his brain. He sketched coffee mugs and cats and hammers. He listened intently to a list of words. He heard those words again as well as words he had not heard before.

When the scientists analyzed the fMRI scans, they were brought up short. Armagan's visual cortex was alight with activity when he drew. Scientists have known for several years that when people conjure up a mental image in their mind's eye, the visual cortex is active just as it is when people see something in the real world. But the activity is much quieter when you imagine seeing something than when you actually see it. In Armagan's case, activity in his visual cortex when he conjured an image in order to draw it was as intense as when a sighted person sees, and anyone looking at the fMRI would conclude that it showed someone with normal vision gazing out at the world. Amedi said, "It suggests that by becoming so expert, he was able to recruit visual cortex for the mental imagery he needs to recall the shapes of objects and how perspective and shadows look."

But when Armagan tried to recall words, his visual cortex was mostly quiet. "This was unlike every other blind person we tested," Amedi said.

"They all showed visual cortex activity during verbal memory. This suggests that environmental influences determine what a blind person's brain recruits the visual cortex to do. Mr. Armagan uses his visual cortex for the mental imagery he needs to create his paintings. He never learned Braille. It may be that learning Braille creates an association between touch and language and that that is a prerequisite for recruiting visual cortex for verbal memory." But when a person puts no such demand on his or her visual cortex, there is opportunity for the visual cortex to choose another career. Many of the blind people who so graciously volunteer to be zapped and scanned and tested by neuroscientists are well-educated, functioning participants in American society. And that means they are highly verbal as well as proficient in Braille. These are the demands they place on a visual cortex that would otherwise go to waste, and it rises to the challenge. But Armagan places different demands on his visual cortex, ones of visual imagery. And his, too, responds to those demands.

The bottom line is that, in the blind, the seeing part of the brain is no longer seeing. As Sadato puts it, the primary visual cortex becomes "unbound from visual perception." When it does, it turns to the processing of other senses, notably the sense of touch, as well as nonsensory tasks such as language. Just as the mind is, as they say, a terrible thing to waste, so is the brain. And the brain is not going to let a little thing such as the lack of the expected visual signals keep the visual cortex—which, as mentioned above, accounts for an impressive 35 percent of the brain's space—from being gainfully employed. Neuroplasticity sees to that.

### Rewiring Dyslexia

One of Neville's strongest messages to the Dalai Lama was that there are, as she put it, "two sides to neuroplasticity." Systems and structures that display the greatest plasticity are those under the weakest genetic control and most subject to the whims of experience and the environment. That can be beneficial, allowing the otherwise out-of-work visual cortex in the blind to enhance the ability to localize sounds in space. But it is also a risky way to make a brain. "The same systems that display the greatest plasticity and are enhanced in the deaf are more vulnerable in development and will display

the greatest deficit says. Specifically, "I than people with r really fast, the neu They're really good fast staccato sounds bility go hand in ha circuits that proces It is no coincidence, are very bad at fast :

By the mid-1990s, plasticity in the brains apply the findings to a relatively obscure had piped sounds th cortex has what is matosensory cortex with dinner-plate lip map, clumps of neuropitch. You can probably the monkey processed that frequencies shrank. Add sou:

Around this time, specific language impairment reading and writing despite normal intelligence is dyslexia, and accounts for educators had blamed the stereotype, a dyslexic

Paula Tallal of Rutgers expected that many cases of dyslexia were due to the appearances of letters but not their sounds. In particular, she found that certain speech sounds



"There are two great things about this book. One is that it shows us how nothing about our brain is set in stone. The other is that it is written by Sharon Begley, one of the best science writers around. Begley is superb at framing the latest facts within the larger context of the field. She also gives us the back stories that reveal how human the process of science research is.

This is a terrific book."

—ROBERT M. SAPOLSKY, author of *Why Zebras Don't Get Ulcers*

"Reading this book is like opening doors in the mind. Sharon Begley brings the reader right to the intersection of scientific and meditative understanding, a place of exciting potential for personal and global transformation. And she does it so skillfully as to seem effortless."

—SHARON SALZBERG, author of *Faith: Trusting Your Own Deepest Experience*

"It is very seldom that a science in its infancy is so skillfully unpacked that it reads like a detective novel. The fact that this science includes the collaborative efforts of neuroscientists, psychologists, contemplatives, and philosophers and the full engagement of the genius of the Dalai Lama is not only fascinating but uplifting and inspiring. This book lets you know that how you pay attention to your experience can change your entire way of being."

—JON KABAT-ZINN, author of *Coming to Our Senses*

"I have meditated for forty years and have long felt that the potential of mind training to improve our emotional, physical, and spiritual well-being has barely been tapped. Thanks to Sharon Begley's fascinating book, though, that is about to change. As human beings, we really do have inner powers that can make a world of difference, particularly if our goal is not merely to advance our own agendas but to cultivate compassion for the benefit of all living beings."

—JOHN ROBBINS, author of *Healthy at 100* and *Diet for a New America*

"This is a truly illuminating and eminently readable book on the revolutionary new insights in mind sciences. I recommend it highly to anyone interested in understanding human potential."

—JACK KORNFELD, author of *A Path with Heart*

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