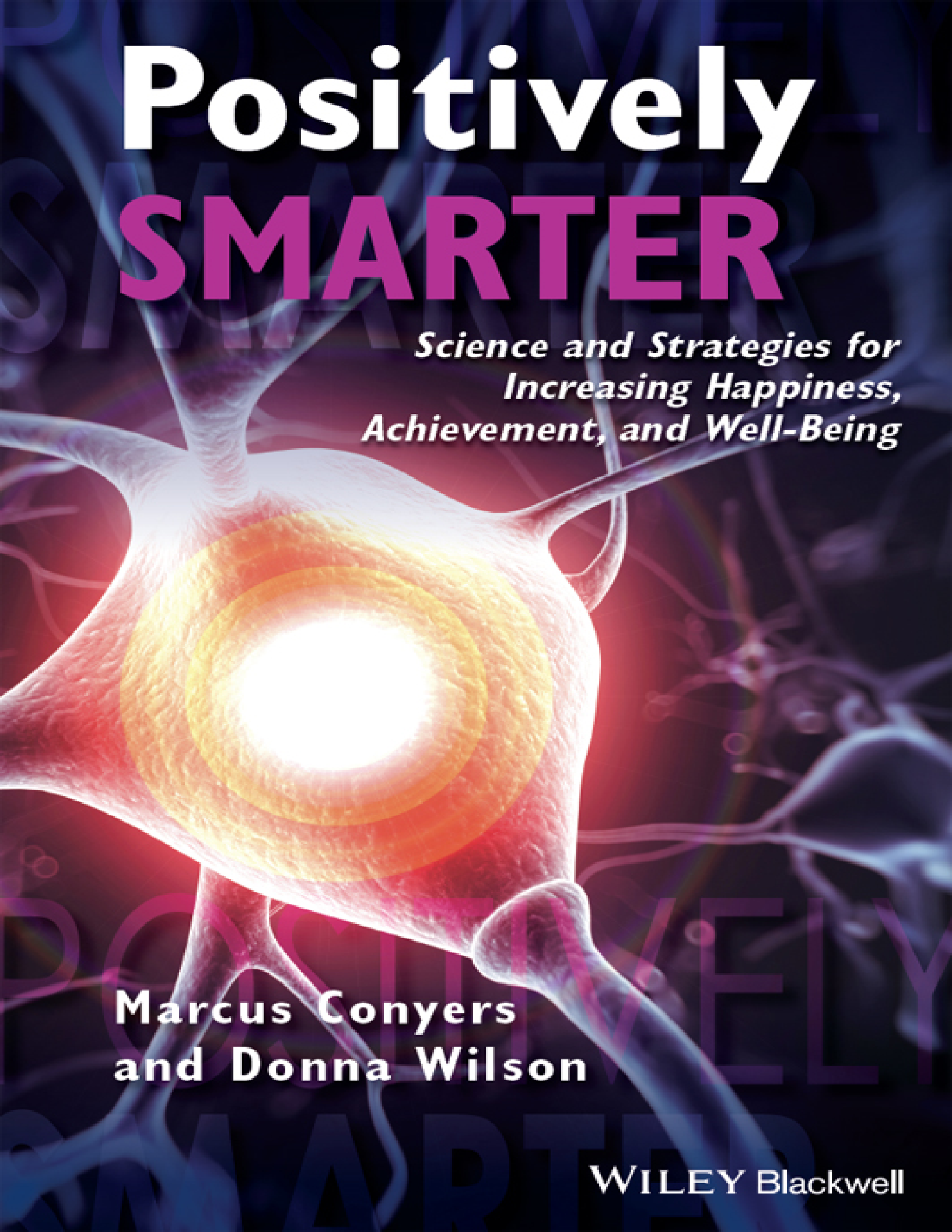
Positively
SMARTER
Science and Strategies for
Increasing Happiness,
Achievement, and Well-Being
Marcus Conyers
and Donna Wilson
WILEY Blackwell

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This book is dedicated to the graduates of the master's and educational specialist degree programs with majors in brain-based teaching and the graduates in the doctoral minor in brain-based leadership at Nova Southeastern University. Thank you for all you are doing to help students, families, colleagues, schools, and communities to become positively smarter.

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Acknowledgments

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We'd also like to acknowledge the tremendous impact of theorists Reuven Feuerstein and Robert Sternberg, whose seminal work has greatly informed our own. Also in these pages, we share what we have learned from Robert Sylwester, who has brought clarity to the field of education in connecting the implications of brain science to classroom practice and who worked with us on our Scholarships for Teachers in Action Research with the Florida Department of Education.

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and makes sure we stay within our deadlines, despite our obsession with adding new research all along the way. Thank you, Lorraine Ortner-Blake, for creating the great illustrations that accompany this text. We had the privilege to work with Acquisitions Editor Jayne Fargnoli, Senior Project Editor Julia Kirk, and other knowledgeable and helpful staff at Wiley Blackwell; we also appreciate the care that Project Manager and Copy Editor Joanna Pyke took with our manuscript.

Finally, we are grateful to have had the opportunity to work with one another in developing this book. It was a rewarding journey, giving us the opportunity to delve deeper into the practical applications of our work. We are pleased that we can share the implications of this work that has so greatly informed and enriched our lives. We have loved living the process described in this book.

Introduction

Redefining Potential as Our Neurocognitive Capacity to Get Better at (Almost) Anything

> *"The brain is a complex biological organ of great computational capability that constructs our sensory experiences, regulates our thoughts and emotions, and controls our actions."*
>
> —Eric Kandel, Nobel laureate[1]

The classic documentary *Private Universe*, produced by the Harvard-Smithsonian Center for Astrophysics, explores challenges in science education. In its opening scene, randomly selected graduates and faculty at a Harvard commencement are asked to explain why it is warm in the summer and cold in the winter. These bright young people who have had the advantage of the most sought-after education in the world happily list the science courses they took in high school and college and then embark on their descriptions of what causes the seasons. Most come down to a common conceptualization: The Earth's orbit around the sun is elliptical; when it passes nearest the sun, we have summer, and at the farthest reaches of its oval-shaped path, we dig out our winter coats and snow shovels. These Harvard graduates and several of their professors are well spoken and enthusiastic, and their astronomical interpretations are convincing, clearly explained, and—for 21 of the 23 people interviewed—just plain wrong.[2]

In much the same way, each of us relies on personal theories operating in our own "private universe," and these

theories have a profound impact on how we think and feel and what we achieve in our lives. One of the most influential theories is how we perceive our potential to succeed in school, in work, and in life. What sets high achievers apart from others? What stands between us and our aims of finding happiness, excelling in educational and career pursuits, and achieving our personal goals?

One prevalent conception holds that people's potential for achieving these aims is determined by the pre-established portion of innate talent, inherited intelligence, and deep-seated predilection toward optimism or pessimism that determines the level of their progress and outlook on life. A big portion leads to big success, and a smaller portion limits the ability to move ahead. This conception holds that innate talent is obvious in how easily some people do well in school and excel in their chosen fields. The necessity to work hard indicates a lack of potential. Intelligence is fixed, and IQ scores predict with eerie certainty how well people will do in life.

This view of potential is quite common. In their book *Teaching for Wisdom, Intelligence, Creativity, and Success*, authors Robert Sternberg, Linda Jarvin, and Elena Grigorenko note that single-faceted views of general intelligence, such as one called the "*g*-factor theory," are based on beliefs that intelligence, ability, and outlook are fixed from birth by genetic endowment. "In other words, according to this theory, you are born with a certain amount of smarts and the type of schooling you receive won't change it that much."[3]

Writing about widely held perceptions of success, Heidi Grant Halvorson contends that culture has a powerful influence on how we think about achievement. Western societies tend to equate accomplishment with innate abilities and label people as *geniuses* and *prodigies* in a

way that signals that their successes are rare and out of the reach of the rest of us "non-geniuses." Americans, especially, "celebrate people who we believe have special abilities and tend to see those who work hard to succeed as less innately capable."[4] Along the same lines, Carol Dweck has written extensively about the impact of a "fixed mindset," or the belief that intelligence and ability are largely unchangeable.[5] A group of British educational researchers sums up this perspective:

> It is widely believed that the explanation for the differences between individuals is that the likelihood of people becoming unusually competent in certain fields of accomplishment depends upon the presence or absence of attributes that have an inborn biological component, and are variously labeled "gifts" or "talents" or, less often, "natural aptitudes." It is thought that a young person is unlikely to become an exceptionally good musician, for example, unless he or she is among the minority of individuals who are, innately, musically "talented" or "gifted."[6]

K. Anders Ericsson, an eminent researcher on developing expert performance through what he describes as "deliberate practice," highlights similar findings about what many people believe about innate talent and performance. In an article in the journal *American Psychologist*, Ericsson and coauthor Neil Charness note that most people view the achievements of top performers in a variety of fields as so exceptional that this level of attainment must be attributed to unique inherent "gifts."[7]

These cultural beliefs are absorbed by children as they grow and may influence their level of motivation, attitudes about their abilities, and, ultimately, academic outcomes. In fact, this *g*-factor theory, this fixed mindset, this "secret" of success—call it what you will—influences the "private

universe” of many children and adults and thus their optimism about their future and performance in school, in work, and in life. If you believe that achievement results from innate ability and if you have no evidence that you are gifted or talented, why try?

Appreciating Brain Plasticity: The Key to Redefining Potential

We advocate for a quite different perspective on the potential of all people to lead happier and healthier lives and to achieve their personal and career goals. This view rests on an understanding that the human brain has tremendous capacity to change and improve in response to experience. As a result, virtually all people have the capacity to learn, to grow, and to improve at whatever skills they choose through a positive outlook and the use of effective strategies, persistent effort, and deliberate practice. While innate ability may be part of the puzzle, we submit that conscious, deliberate practice, the development of new skills, optimism, and resilience are what really separate successful people from those who do not achieve their aims. This conception of potential to lead a happier, healthier, and more fulfilling life is supported by a wide range of research explored in this book about the power of the brain to become smarter, in terms of increased skills in solving problems, applying creativity, and learning new things throughout the life span; the body to become healthier and stronger; and the spirit to become more optimistic.

We define *potential* as the neurocognitive capacity for acquiring the knowledge, skills, and attitudes to achieve a higher level of performance in any domain. In other words, potential represents the power for getting better at whatever you set as your goals by rewiring your brain and

body with new outlooks, knowledge, skills, and abilities. The foundations of human potential are built permanently into the brain's readiness for learning from infancy throughout one's life and in the ability of the brain and body to continually adapt to new challenges and learning.

The Path to Positively Smarter

The expression *positively smarter* captures the essence of increasing well-being across three interconnected domains of happiness, achievement, and wellness. In this book we will explore research and strategies to:

1. **Increase our positivity, optimism, and happiness** (also referred to as *subjective well-being*). Through the effective use of key strategies to change our attitudes and outlook, we can become happier and more optimistic more of the time. Scientists have pinpointed areas of the brain that are more active when people are optimistic, have a positive outlook, and exhibit resilience.[8] Over the long term, these and other elements of emotional style can be improved by the application of practical strategies. These advances in knowledge about the physiological basis of optimism and happiness (explored in Chapter 2) can inform practical approaches for improving our resilience and coping skills in the face of hardship, our emotional and social intelligence, and our sense of well-being (Chapter 3).[9] These changes, in turn, enhance cognitive performance and help us to be more creative and more successful at work, to have more fulfilling relationships, and to enjoy better health.
2. **Become functionally smarter for higher levels of achievement.** Our collective IQ, through the so-called *Flynn effect*, has increased over the last century, and we can continue to improve our individual intellectual

performance by cultivating cognitive and metacognitive strategies. This purposeful approach to enhancing our thinking abilities, which we call *practical metacognition*, can help us learn new things more efficiently, make better decisions, solve problems more effectively, and create new ideas. The increase in cognitive skills, sense of efficacy, and success in school, in work, and in life pays an added dividend in the form of increased levels of optimism and happiness. Chapters 4 through 6 explore findings from mind, brain, and education research on "working smarter" by wielding cognitive and metacognitive strategies and improving your social intelligence with the aim of enhancing achievement and success.

3. **Improve physical well-being, mood, and cognitive function through exercise and healthy nutrition.** In Chapters 7 and 8, we explore how healthy eating and regular exercise bolster physical and cognitive performance and improve mood and outlook. Making a habit of aerobic exercise, strength training, and good nutrition can produce lifelong health gains. In addition, exercise changes the brain in positive ways and is effective in improving mood. Regular physical activity is associated with improved quality of sleep, reduced fatigue, increased stamina, and lower anxiety. For some people, exercise may be as effective as medications in the longer term to treat mood disorders. A stronger body is also associated with enhanced cognitive performance in areas such as attention, memory, and problem solving.

All of these factors can be enhanced individually, and greater gains can be experienced through the synergy of improving them together so that we can become positively smarter, fitter, stronger, and better able to achieve

important goals while experiencing a greater sense of well-being.

The capacity to realize higher levels of happiness, achievement, and physical health begins with your amazing brain, powered by some 86 billion neurons. Just one cubic centimeter of your brain has as many connections as there are stars in the Milky Way.[10] Scientists have learned more about the brain in the last two decades than in the previous 200 years. These discoveries can have a positive and far-reaching impact on our lives, our work, our education, and our communities if and when these new understandings are used to inform policy and practice.

At the center of emerging scientific knowledge is one fundamental concept: Your brain and body are constantly changing in response to your thoughts, actions, and environment, and you have the power to steer those changes in positive directions. You can take charge of your thinking, attitudes, and behaviors in ways that affect:

- Neurogenesis, the creation of new brain cells;
- Synaptogenesis, the forging of new connections and strengthening or weakening of networks of connections as a result of learning new knowledge or skills;
- Myelination, the formation of a substance that insulates and increases the speed of transmission of new learning and improves skills; and
- Angiogenesis, the expansion of your body's network of capillaries to improve the functioning of the brain and body.

We refer to the dynamic interactions that influence these factors as *neurocognitive synergy* to convey that through your conscious (or *cognitive*) recognition of your ability to take charge of your brain (*neuro*), you can wield a game-

changing combination (*synergy*) to become more optimistic, functionally smarter and more productive, and healthier.

The research behind this concept informs, in part, the emerging field of educational neuroscience, which melds psychological and educational research and cognitive neuroscience to explore ways for enhancing teaching and learning. These findings also offer great promise to improve our personal and professional lives. Throughout this book, we will explore the research advances supporting the understanding that it is within your grasp to make steady gains if you are willing to commit to the sometimes hard work of deliberate practice, the learning of new knowledge, and the process of maintaining a happier outlook, developing your cognitive skills, and improving your physical well-being. These “upgrades” in attitude, thinking, and health habits in turn serve to sustain the behaviors that can have a positive influence in many areas of your life.

Learning about the brain's awesome power that can help each of us develop the knowledge and skills we need to achieve our goals is crucial. But to use that power to optimize our potential, we need to bring to the surface some deeply held misconceptions that may be holding us back.

Our Personal Introductions to the Science That Supports Ways for Becoming Positively Smarter

Our work together has focused on improving lives by applying the implications of research from fields including cognitive education; psychology; social cognitive and affective neuroscience; education; and well-being. We are codevelopers of curriculum for the master's and

educational specialist degrees with majors in brain-based teaching and a doctoral minor in brain-based leadership with Nova Southeastern University. These programs are among the first in this emerging field, also known as educational neuroscience and mind, brain, and education.[11] The principles at the core of this text have informed our work on the graduate degree programs and the presentations we have delivered through the Center for Innovative Education and Prevention.

Earlier in his career, Marcus applied research from these diverse fields in his work with organizations from business, law enforcement, military, government, and education sectors. He led a three-year, statewide initiative for the Florida Department of Education, implementations in two large school districts through Florida Atlantic University supported by an Annenberg Challenge Grant, a statewide initiative in Texas, and an implementation on improving well-being with the Winter Park Health Foundation. Marcus has continued to discuss the ideas and research at the heart of becoming positively smarter as an author and international speaker on increasing creative and critical thinking skills, developing expertise, and enhancing achievement and well-being.

Donna began her career as a classroom teacher and then an educational and school psychologist who completed post-doctoral studies in structural cognitive modifiability. She led an initiative in her school district to teach students how to use cognitive strategies—to “learn how to learn”—which resulted in significant academic gains. Co-teaching these concepts with other educators led Donna to discover her passion for working as a teacher educator. In the intervening years, she has led community and district initiatives and given presentations to state and national policymakers that put some key concepts from this book into practice.

Our aim is to highlight ways research and theory from cognitive education, psychology, and educational neuroscience suggest that we can harness the brain's incredible capacity to change in ways that may enhance resilience, optimism, motivation, happiness, productivity, performance, and well-being. If you set your sights on any of these areas, you can achieve benefits through the sustained application of practical strategies. The grand vision of becoming positively smarter is informed by research about the interconnections of emotional and physical health and cognitive performance: It is possible to make gains in all of these areas and create a positive upward spiral that can produce positive changes in the brain and in turn lead to a greater sense of well-being.

Our perspective is from the field of education, and our focus is on sharing relevant research and practical ideas for putting implications of research into practice. We have assembled here emerging, exciting findings from a broad range of scientific inquiry to discover how each of us can achieve more of our unique potential to become happier and healthier and achieve more of our personal and professional goals. The practical applications we have shared with educators, parents, businesspeople, firefighters, police officers, military members, and others in helping professions begin with a stunning fact: Our capacity to become happier, functionally smarter, and healthier begins with our marvelous, malleable brains.

Notes

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1
Building a Smarter Brain

> *“Brain plasticity is the stuff of life. As long as you're alive, it's with you as a precious exploitable asset. Don't neglect to take full advantage of it.”*
>
> —Michael Merzenich[1]

No matter what your age or current abilities, you have the potential to improve the knowledge and skills you need to develop to achieve your goals—in the form of your brain's amazing ability to change in response to learning. Recent research is overturning longstanding assumptions about the capacity of the human brain to change and improve. We now know that people, with the exception of some of those who have suffered traumatic brain injury, dementia, or other brain disorder, have the capability to change and grow their brains, especially those areas of the brain associated with attention, memory, and problem solving. These are the very areas we associate with becoming smarter. The term *neural plasticity* or *neuroplasticity* refers to how our thoughts, actions, and sensory input (what we see, hear, say, and touch) change the structure and function of the brain and how reinforcing that learning through repetition and practice strengthens those neural connections. When we focus our attention on information and engage in learning activities, the neural networks associated with those activities grow denser and larger, leading to what Fotuhi describes as “enhanced brain performance.”[2] In fact, these physical changes in the brain can be so significant that they can be seen by the human eye on MRI scans—and these changes can happen in weeks and months, rather than years.

Neuroplasticity in Action

In a regimen unlike any other in the world, London cabbies in training spend years memorizing their city's 25,000 streets and thousands of landmarks within a 6-mile radius of Charing Cross train station. Some of them take the Knowledge of London Examination, known simply as “the Knowledge,” a dozen times, and only about half ultimately earn an operating license from the Public Carriage Office.[3] Neurologists Katherine Woollett and Eleanor Maguire conducted MRI brain scans of 79 taxi trainees and a control group before the training began and again three or four years later after they had completed their exams. Of the three groups during the second round of testing—trainees who had earned their licenses, trainees who had not passed the exam, and control participants—the scans detected an increase in gray matter volume in the posterior hippocampi, the area of the brain associated with spatial memory, of the first group, but not the other two. The researchers concluded that “specific, enduring, structural brain changes in adult humans can be induced by biologically relevant behaviors engaging higher cognitive functions.”[4]

The cabbie research is among a number of studies conducted in recent years that show how the brain changes in response to learning. German scientists conducted brain imaging scans of medical students three months before their medical exams and immediately following the tests and compared them to scans of a control group of students. The brains of the medical students showed increased volume in areas of their parietal cortices and the posterior hippocampi, regions of the brain associated with memory retrieval and learning.[5] Another study compared the brains of professional musicians who practiced with their instruments at least an hour per day to the brains of

amateur musicians and non-musicians. The scans showed significant increases in gray matter volume in brain regions associated with motor, auditory, and visual-spatial functioning of the professional musicians in comparison with the other groups; amateur musicians also showed more development in these regions than non-musicians. The researchers concluded that those differences reflect the impact of “long-term skill acquisition and the repetitive rehearsal of those skills.”[6] These studies demonstrate neuroplasticity in action as the brain changes in response to learning new knowledge and developing skills. They also disprove long-held assumptions that adult brains cannot build new neurons.

Other research challenges the notion that IQ is unchangeable—that we are born with a certain level of intelligence and cannot “move the dial” on our intellectual capacity. As it turns out, that notion may be wrong on both counts: Research now suggests that we can increase our intelligence throughout life and that heredity may account for only a relatively small portion of our cognitive potential. By conducting DNA analysis and comparing IQ test results from people tested at age 11 and again when they were 65 to 79, Scottish researchers concluded that only about 24 percent of intellectual development is determined by genes; the rest owes to one's experiences and environment throughout life.[7] In another study, 33 adolescents ages 12 to 16 took IQ tests and underwent brain scans in 2004 and then repeated the tests three or four years later, now at ages 15 to 20. There were no cognitive interventions or tests between the two periods; in fact, the teenagers were not even told they would be invited back for further testing. The researchers' aim was to measure whether intellect, as measured by the Wechsler Intelligence Scale for children and adults, would change and to see if IQ changes would be reflected in brain structure. They discovered significant

shifts up and down in IQ—ranging from a drop of 20 points for one participant to a gain of 23 points for another in verbal IQ, a range of –18 to +17 in performance IQ (nonverbal skills, including spatial reasoning and problem solving unrelated to language), and a range of –18 to +21 in full-scale IQ—along with corresponding changes in gray matter density and volume in the brain scans.[8]

Scientists have varying opinions about what IQ tests tell us about people's intellectual capacity. These differences of opinion are evident in debates over what causes the “Flynn effect,” the steady rise in IQ levels around the world since the 1930s, which was first identified by New Zealand political science professor James Flynn. Are today's students really smarter than their grandparents, or are they just better test takers? Some social scientists attribute these IQ gains to the wider availability of public education, the increase in years spent in formal education, and even on improved nutrition. Others suggest that IQ tests evolve with each generation to emphasize the skills most prized during that era. Still others argue that this trend calls into question the reliability of IQ tests in measuring “pure” intelligence.

As we will explore in more detail later in this chapter, intelligence is multifaceted—and people have the capacity to improve many aspects of their intellectual functioning, including creativity, analytical problem solving, recall, and mental agility. In sum, then, the conclusion we can draw from this research on the mind and brain, notes Edward Hallowell in his book *Shine: Using Brain Science to Get the Best from Your People*, is that “we can all get smarter and wiser and happier the longer we live. The conventional, dreary wisdom that people can't change is scientifically incorrect.”[9]

Your Brain at Work: A Continual Construction Zone

As the control center in charge of all aspects of operating a living creature—from controlling basic functions such as heart rate and breathing to accepting and interpreting input from the senses to facilitating thought and experiencing emotions—the brain is understandably complex. As we explore the role of the brain in our efforts to improve our positive outlook, knowledge, skills, and well-being, we will present research findings on the workings of the cerebral cortex and the limbic system. The *cerebral cortex* is the outer surface of the human brain that grows so extensively that it folds in on itself in labyrinth fashion, giving it a cauliflower appearance. The largest part of the brain is the neocortex, so named because it is the newest part of the human brain (the terms *cerebral cortex*, *cortex*, and *neocortex* are often used interchangeably). In his book *Boost Your Brain*, Majid Fotuhi describes the cortex as "ground zero for … perceptual awareness, thought, language, and ability to make decisions."[10] The *limbic system* is located directly under the cortex and shares several structures with the cortex. A third major region is the brainstem, which connects the brain to the spinal cord (see Figure 1.1).

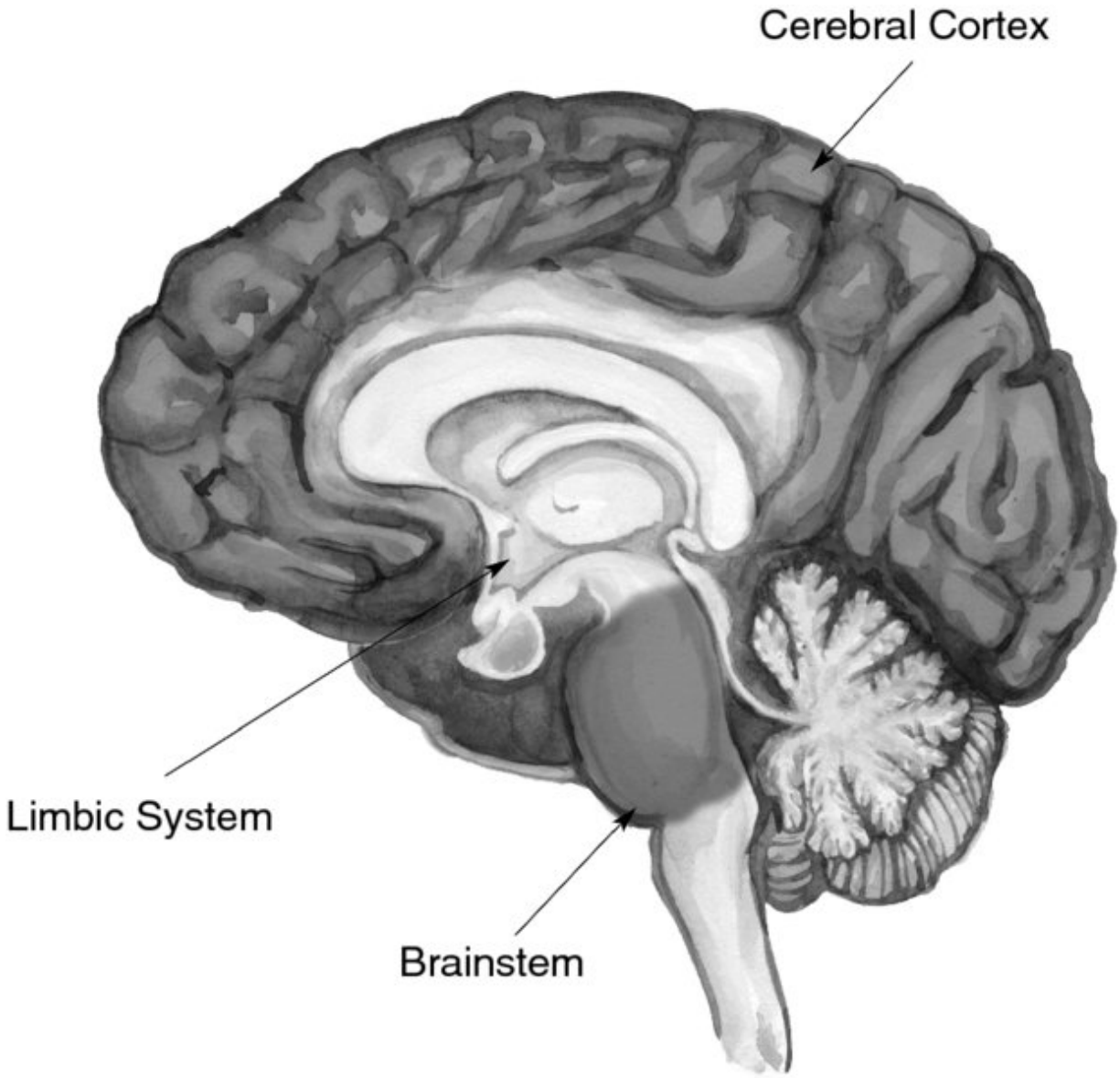

Figure 1.1 A Three-Part Brain Model. © 2015 BrainSMART, Inc.

The brain reflects the symmetry of the human body: We have two eyes, two ears, two arms, two legs, and two hemispheres of the cerebral cortex. The right and left hemispheres are connected by a band of nerve fibers called the corpus callosum. The right hemisphere controls most motor functions on the left side of the body, while the left hemisphere controls the right side. That's why a stroke or other type of brain damage in the left hemisphere may