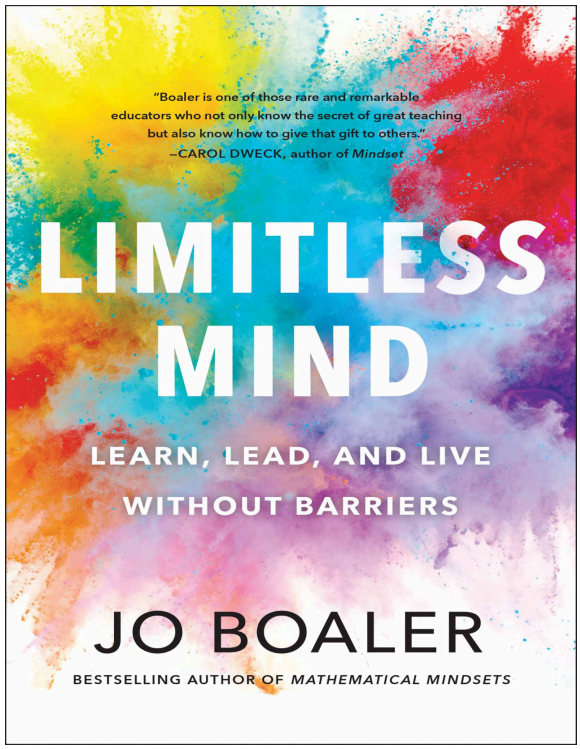


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Introduction

The Six Keys

IT WAS A SUNNY DAY and I stopped to appreciate the sunlight playing on the columns of the San Diego museum as I walked into my presentation. A flutter of nerves passed through me as I climbed the steps of the auditorium, ready to share the latest science on the ways we learn to a room packed with medical professionals. I speak regularly in front of teachers and parents but was uncertain how a different audience would relate to my latest discoveries. Would my ideas fall flat?

I needn't have worried. The response from the group of medical professionals was the same as that of the many students and educators I regularly work with. Most were surprised, some were shocked, and all could immediately see the crucial connections of these ideas to their work and lives. Several even started to see themselves in a new light. Sara—an occupational therapist—rushed up to me afterward to tell me how she dropped out of a math major many years ago when the work got difficult and she felt as if she didn't belong. She recalled an experience of being held back by damaging and incorrect beliefs about her ability. She believed, as most people do, that there were limits to what she could do.

But what if the opposite is true, and we can all learn anything? What if the possibilities to change our expertise, to develop in new directions, to form different identities as people are actually endless and continue throughout our lives? What if we wake up every day of our lives with a changed brain? This book will share evidence that our brains—and our lives—are highly adaptable, and that when people fully embrace this knowledge and change their approach to their lives and their learning, incredible outcomes result.

Almost every day I meet people who believe damaging ideas about themselves and their learning, and they come from all ages, genders, jobs, and walks of life. Typically people will tell me that they used to like math, art, English, or another subject area, but when they started to struggle, they decided they did not have the right brain for the work and gave up. When people give up on math, they also give up on all math-related subjects, such as science, medicine, and technology. Similarly, when people get the idea they cannot be a writer, they give up on all subjects in the humanities, and when people decide they are not artistic, they give up on painting, sculpture, and other aspects of the fine arts.

Every year millions of children start school excited about all they will learn, but quickly become disillusioned when they get the idea they are not as "smart" as others. Adults decide not to follow pathways they had hoped to pursue because they decide they are not good enough for them, or they are not as "smart" as other people. Thousands of employees enter meetings in the workplace anxious that they will be found out, and exposed for not "knowing enough." These limiting and damaging ideas come from inside us, but they are usually sparked by incorrect messages sent by other people, and by institutions of education. I have met so many children and adults whose lives were limited by incorrect ideas that I decided it was time to write a book dispelling the damaging myths holding people back on a daily basis; it was time to offer a different approach to life and to learning.

A large number of people are told directly that they are not a "math person" or an "English person" or an "artist" by teachers or parents. In an attempt to be helpful, adults tell young learners that a particular subject is "just not for them." This happens to some when they are children. For others, it happens later in life when they are taking college courses or interviewing for their first job. Some people are given negative messages about their potential directly; others assume it from culturally embedded ideas—that some people can achieve and some cannot.

When we learn the new science in this book and the six keys of learning I will present, our brains function differently, and we change as people. The six keys not only change people's beliefs about their reality, they change their reality. This is because as we begin to realize our potential, we unlock parts of ourselves that had been held back and start to live without limiting beliefs; we become able to meet the small and large challenges we are faced with in life and turn them into achievements. The implications of the new

science are important for everyone. For teachers, leaders, and learners, the changed possibilities created by this new information are far reaching.

I am a Stanford professor of education who has spent the last few years collaborating with brain scientists, adding their knowledge of neuroscience to my knowledge of education and learning. I regularly share the new knowledge that is in this book, and invite people to think differently about problems, and it changes the way they think about themselves. I have spent the last several years focusing on mathematics, the subject with the most damaging ideas held by teachers, students, and parents. The idea that math ability (and a host of other capabilities) is fixed is a large part of the reason that math anxiety is widespread in the US and the world. Many children grow up thinking that either you can do math or you can't. When they struggle, they assume they can't. From that point on, any struggle is a further reminder of their perceived inadequacies. This affects millions of people. One study found that 48 percent of all young adults in a work-apprentice program had math anxiety;[1] other studies have found that approximately 50 percent of students taking introductory math courses in college suffer from math anxiety.[2] It is difficult to know how many people walk around in society harboring damaging ideas about their math ability, but I estimate it to be at least half of the population.

Researchers now know that when people with math anxiety encounter numbers, a fear center in the brain is activated—the *same* fear center that lights up when people see snakes or spiders.[3] As the fear center of the brain becomes activated, activity in the problem-solving centers of the brain is diminished. It is no wonder that so many people underachieve in mathematics—as soon as people become anxious about it, their brains are compromised. Anxiety in any subject area has a negative impact on the functioning of the brain. It is critical that we change the messages that are given to learners about their ability and rid education and homes of anxiety-inducing teaching practices.

We are not born with fixed abilities, and those who achieve at the highest levels do not do so because of their genetics.[4] The myth that our brains are fixed and that we simply don't have the aptitude for certain topics is not only scientifically inaccurate; it is omnipresent and negatively impacts education and many other events in our everyday lives. When we let go of the idea that our brains are fixed, stop believing that our genetics determine our lives' pathways, and learn that our brains are incredibly

adaptable, it is liberating. The knowledge that every time we learn something our brains change and reorganize comes from perhaps the most important research of this decade—research on brain plasticity, also known as neuroplasticity.[5] I will be sharing the most compelling evidence on this topic in the next chapter.

When I make the point with adults—often teachers and educators—that we should reject ideas of fixed thinking and instead see all learners as capable, these adults invariably tell me about themselves as learners. Almost all of them can recall their own experience and realize the ways in which they themselves were limited and held back. We have all been fully immersed in the damaging myth that some are smart—they have a gift or special intelligence—and some are not, and these ideas have shaped our lives.

We now know that ideas about limits to potential or intelligence are incorrect. Unfortunately, they are persistent and widespread in many cultures across the world. The good news is that when we challenge these beliefs, incredible results follow. In this book, we will upend these ingrained and dangerous self-limiting beliefs and reveal the opportunities that open up when we adopt a limitless approach. The limitless approach starts with knowledge from neuroscience and expands into a different approach to ideas and to life.

The original discovery of neuroplasticity is decades old, and the groundbreaking studies that have shown brain growth and change—among children and adults—are well established.[6] The science, however, has for the most part not made its way into classrooms, boardrooms, or homes. It has also not been translated into the much-needed ideas for learning that this book will share. Fortunately, a few pioneers who have learned about brain change have taken it upon themselves to spread the news. Anders Ericsson, a Swedish-born psychologist, is one of those people. He first became aware of the brain's incredible ability to grow and change not from the neuroscience that was emerging at the time, but from an experiment he tried with a young athlete, a runner named Steve.[7]

Ericsson set out to study the limits of people's ability to memorize a random string of digits. A study published in 1929 found that people could improve their ability to memorize. The early researchers managed to train one person to memorize thirteen random digits and another person, fifteen. Ericsson was curious to know how people improved, so he recruited Steve,

whom he describes as an average Carnegie Mellon undergraduate. On the first day that Steve began working with the researchers to memorize digits, his performance was exactly average: he could remember seven numbers consistently, sometimes eight. On the following four days, Steve improved to just under nine numbers.

Then something remarkable happened. Steve and the researchers thought he had reached his limit, but he managed to push through the "ceiling" and memorize ten numbers, two more than had seemed possible. Ericsson describes this as the beginning of what became the two most surprising years of his career. Steve continued to steadily improve until he had successfully memorized and could recall a string of eighty-two random digits. Needless to say, this feat was remarkable, and it was no magic trick. This was an "average" college student unlocking his learning potential to accomplish a rare and impressive feat.

A few years later, Ericsson and his team tried the same experiment with a different participant. Renee started off much like Steve, improving her memory beyond the level of an untrained person, and she learned to memorize close to twenty digits. Then, however, she stopped improving, and after another fifty hours of training without improvement, she dropped out of the study. This set Ericsson and his team on a new quest—to work out why Steve had managed to memorize so many more digits than Renee.

This is where Ericsson began to learn more about what he called "deliberate practice." He realized that Steve's love for running had made him highly competitive and motivated. Whenever he hit what seemed like a limit, he developed new strategies to become successful. For example, he hit a barrier at twenty-four digits, so he developed a new strategy of grouping numbers into four four-digit strings. At regular intervals, Steve developed new strategies.

This approach illustrates a key takeaway—when you hit a barrier, it is advantageous to develop a new approach and come at the problem from a new perspective. Despite how logical this sounds, far too many of us fail to make adjustments in our thinking when we run into those barriers. We often decide, instead, that we cannot overcome them. Ericsson has studied human performance in many fields and concludes: "It is surprisingly rare to get clear evidence in any field that a person has reached some immutable limit on performance. Instead, I've found that people more often just give up and stop trying to improve."[8]

For the skeptics reading this—and deciding that Steve's incredible memory feat meant that he was in some way exceptional or gifted—there's more. Ericsson repeated the experiment with another runner named Dario. Dario memorized even more than Steve—more than one hundred numbers. Those who study remarkable feats performed by seemingly ordinary people find that none of the people have a genetic advantage; instead, they put in a lot of effort and practice. Not only are ideas of genetic ability misguided; they are dangerous. And yet many of our school systems are built on a model of fixed-ability thinking—limiting potential and preventing students from incredible achievement.

The six keys of learning I will share in this book create opportunities for people to excel in the learning of different subjects, but they also empower them to approach life in a different way. They allow people to access parts of themselves that were previously unavailable. Before the journey I will set out in this book, I had believed that learning about brain science and the limitless approach would change how educators approached the teaching and learning of school subjects. Through the interviews I have conducted for this book—with sixty-two people from six different countries, people of different ages, jobs, and life circumstances—I discovered the limitless approach means much more than that.

A woman who has done an enormous amount to change people's ideas about what they can do is a colleague of mine at Stanford, Carol Dweck. Dweck's research reveals that how we think about our talents and abilities has a profound impact on our potential.[9] Some people have what she has termed a "growth mindset." They believe, as they should, that they can learn anything. Others have a damaging "fixed mindset." They believe that their intelligence is more or less fixed, and although they can learn new things, they cannot change their basic intelligence. These beliefs, she has shown through decades of research, change the scope of what we can learn—and how we live our lives.

One of the important studies Dweck and her colleagues conducted took place in mathematics classes at Columbia University.[10] The researchers found stereotyping to be alive and well: young women were being given the message that they did not belong in the discipline. They also found that the message hit home only with those who had a fixed mindset. When students with a fixed mindset heard the message that math was not for women, they dropped out. Those with a growth mindset, however, protected by the belief

that anyone can learn anything, were able to reject the stereotypical messages and keep going.

Throughout this book, you will learn about the importance of positive self-beliefs and ways to develop them. You will also learn about the importance of communicating positive beliefs to yourself and others, whether you are a teacher, parent, friend, or manager.

One study conducted by a group of social psychologists dramatically showed the impact of positive communication by teachers.[11] The study focused on students in high-school English classes, all of whom had written an essay. All of the students received critical, diagnostic feedback (the good kind) from their teachers, but half of the students received an extra sentence at the end of the feedback. Remarkably, the students who received the extra sentence—especially students of color—achieved at significantly higher levels in school a year later, with higher GPAs (grade point averages). So what was the sentence that those students read at the end of the feedback that caused such a dramatic result? It simply said: “I am giving you this feedback because I believe in you.”

When I tell teachers about this research, I do so to show the importance of teachers’ words and messages—not to suggest that they put this message at the end of every student evaluation! One teacher in a workshop raised her hand and said, “Does that mean I don’t put it on a stamp?” Everyone laughed.

Studies in brain science present a very clear case for the importance of self-beliefs and the role of teachers and parents in influencing them. Yet we are living in a society where the widespread message we receive through the media on a daily basis is one of fixed intelligence and giftedness.

One of the ways children—even those as young as three—develop a damaging fixed mindset is from a small, seemingly innocuous word that is used ubiquitously. The word is “smart.” Parents regularly praise their children by telling them how smart they are in order to build up their self-confidence. We now know that when we praise children for being smart, they at first think, “Oh good, I am smart,” but then later when they struggle, fail, or mess up in some way, as everyone does, they think, “Oh, I am not so smart”; they end up constantly evaluating themselves against this fixed idea. It is fine to praise children, but always praise what they did and not them as people. Here are some alternatives for use in situations where you may feel the need to use the word “smart.”

Fixed Praise	Growth Praise
You can divide fractions? Wow, you are smart!	**You can divide fractions? That is great that you have learned how to do that.**
You solved that tricky problem like that? That is so smart!	**I loved your solution to the problem; it is so creative.**
You have a degree in science? You are a genius!	**You have a degree in science? You must have worked really hard.**

I teach an undergraduate class at Stanford called “How to Learn Math” to some of the most highly achieving students in the country. They too are vulnerable to damaging beliefs. Most have been told, over many years, that they are smart, but even that “positive” message—“you are smart”—damages students. The reason it makes them vulnerable is that if they believe they are “smart” but then struggle with some difficult work, that feeling of struggle is devastating. It causes them to feel they are not smart after all and give up or drop out.

Regardless of your experience with the fixed-brain myth, the information in these pages will change your understanding of ways to raise your and other people’s potential. Taking a limitless perspective is about more than a change in our thinking. It is about our being, our essence, who we are. If you live a day with this new perspective, you will know it, especially if it is a day when something bad happens, you fail at something, or you make a serious mistake. When you are limitless, you feel and appreciate such moments, but you can also move past them and even learn new and important things because of them.

George Adair lived in Atlanta after the Civil War. Originally a newspaper publisher and cotton speculator, he went on to become a highly successful real-estate developer. His success was probably spurred by an important insight that has since been widely shared: “Everything you’ve ever wanted is on the other side of fear.” Let’s think together now about ways to become limitless and move to the other side of negative beliefs and fear.