BIOHACK YOUR BRAIN

How to Boost Cognitive Health, Performance & Power

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An Imprint of HarperCollins*Publishers*

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Foreword

When I met Kristen, I was looking for a neuroscientist who understood cognitive analytics to work on a research trial identifying dementia in asymptomatic patients. Kristen was ideally qualified, having both a broad base of knowledge in cognitive science and the unique experience of running research for a large brain-imaging clinic for years.

Our research team for the trial included many eminent doctors, neuropsychiatrists, and similar sorts. But from the onset, there was something special about Kristen—she was committed, driven, and determined to find solutions, which was all apparent from the moment I met her. Nonetheless, I was still surprised when she brought testing tools into our trial that not even the neuropsychiatrists who regularly relied on them had thought of. These were tools I hadn't thought of, either.

I've spent more than forty years studying and treating the brain. I've conducted numerous clinical trials and have been fortunate enough to be recognized for my work, including on the cover of *Time* magazine's "Heroes of Medicine" issue. You can imagine then how much Kristen impressed me when she showed a cognitive-health vet like me how things might be done differently.

Kristen is absolutely a committed and compassionate spokesperson for the brain. Not many neuroscientists and neurosurgeons can communicate clearly about what we can do to improve cognitive function, but she is concise and compassionate, and she speaks about the brain in a language everyone can understand.

When it comes to the brain, clear communication is increasingly invaluable. Over the past decade, we've seen more and more information disseminated about what we can allegedly do to optimize our cognitive health. Every time you open your news feed, there's another article—what's good, what's bad, what you should take and shouldn't take.

Much of this information, however, isn't based on good scientific data. If you search Google, for example, you'll find hundreds of supplements claiming to improve cognitive function, even though few have quality research supporting these claims. I've often wished I had a handbook I could give patients that outlined the interventions we actually know can improve brain health.

I now have one. *Biohack Your Brain* leverages what research has shown to optimize cognitive health. This is relatively new science and continually evolving, which is why it's critical to get advice from a trusted source. We've only recently learned, for example, that diet, exercise, mindfulness, sleep, and stress regulation play a big role in cognitive function—and in different ways than they do in heart health. And we now know certain lifestyle interventions can slow the risk of developing dementia by as

much as a decade.

If you only plan to live until you're forty, this book may not help you. But if you want to live as long and as well as you can, *Biohack Your Brain* can have a significant impact on both your cognitive health and overall quality of life.

In other words, you can biohack your brain if you have the right resources and information to do so. Personally, I can't think of anyone more qualified to show us the best ways to biohack the brain than Kristen. She's even taught me a thing or two.

—Keith L. Black, M.D., chair and professor, Department of Neurosurgery, Cedars-Sinai Medical Center

Prologue

The Case for Your Cognitive Health

The gospel of health and wellness is everywhere these days. You hear about the newest trends and solutions espoused by medical businesses, books, websites, food and fitness companies, hospitals, and health conglomerates. They all tell you to join a gym, try a diet, take these supplements, lose weight, lower cholesterol, drop blood pressure, get heart-healthy, prevent cancer . . . the noise can be deafening.

Amid all this, we don't hear nearly enough about the brain—the only organ in the body we can't live without, the one that orchestrates our entire lives.

I've been fascinated by the brain ever since I was a psychology major at Boston College. After earning my bachelor's degree, I was inspired to continue my education, getting a master's degree in physiological science and a doctoral degree in neurobiology from the University of California, Los Angeles.

During my graduate and postgraduate work, I spent years in research labs studying neuroendocrinology, neurophysiology, and neurogenetics. During this time, I was awarded a fellowship from the National Institutes of Health, which opened up opportunities to present my research at conferences around the world.

Following my postdoctoral training, I went into the field of brain imaging, taking the role of research director for the Amen Clinics, a nationally recognized mental health care center for the study of the brain. My time there changed my life—and the lives of many others. It was at the clinic that I helped lead several clinical trials with NFL players that revealed just how much cognitive damage the sport can cause—a groundbreaking conclusion at the time when my colleagues and I published our results. More important, we discovered noninvasive ways to help treat and even reverse some of the damage we saw by using diet, supplements, exercise, and cognitive training.

Later, I was lucky enough to be able to use the knowledge gleaned from those trials to help my father, who passed away in 2017 after years of living with symptoms associated with Parkinson's disease. While it was incredibly painful to watch his condition progress, I was able to hold on to hope knowing that I did have some tools to help him retain his quality of life. As his condition worsened, I encouraged him to adopt some of the techniques we used with the NFL players to help heal their brains. It was incredible to see how his balance and grip improved—such that he was able to hold on to some independence until the very end. To this day, I'm so heartened that I was able to give him some tools to make his last years more pleasant and full of hope.

This story epitomizes the number one lesson I've learned in my twenty-plus years of

study: everyone has the potential to change his or her brain. No matter how old you are or the choices you've made in the past, it is always possible to make improvements.

Today, after all, millions of Americans contend with cognitive issues. Many blame symptoms like memory loss, brain fog, poor concentration, anxiety, and depression on physical problems when the real root is brain based. It can be easy to dismiss cognitive problems as the by-product of stress—which, admittedly, is everywhere. Still, that doesn't mean you have to let it derail your cognitive performance. There are several science-backed ways to release stress's grip on the brain in order to restore your cognitive power and potential.

If you're concerned with dementia, you have every right to be. The umbrella term for cognitive impairment currently impacts 10 percent of all Americans over the age of sixty-five—a statistic expected to grow as the country ages. Cellular changes that lead to dementia can occur decades earlier, even as early as your thirties and forties, which is when the brain begins to age. This makes it the perfect time to care for your brain now, no matter how old you are, leveraging the time when you can make changes in your brain health habits in order to circumvent a dementia diagnosis later in life.

If you've experienced a mild brain injury like a concussion or are worried what the trauma could do to your children or grandchildren, especially if they play sports, the best way to confront fear is with knowledge. A brain injury isn't a reason to give up, but an opportunity to learn what you can do with your diet, exercise, supplements, and other lifestyle choices to restore your cognitive health.

The coronavirus crisis has also made taking care of your brain more imperative than ever before. The global pandemic has raised the stress, anxiety, and fear of millions of Americans, sabotaging their mood and interfering with their cognitive function and health. In this book, you'll learn how to counter that kind of stress, fear, and negative emotion in order to boost your brain and strengthen your mental resolve against a similar sort of tragedy in the future. What's more, everything you'll discover about how to improve your cognitive performance—what to eat, how to exercise, which supplements to take—will also improve your immune function, bolstering your body in the advent of another outbreak.

I'm writing this book to show you that no matter what the current state of your brain health is, you have the power to biohack your brain and improve its function. If you've ignored your cognitive health for years, you have the potential to turn this promise into a reality. I know because I've seen it happen, over and over again, even in those who have suffered debilitating degrees of cognitive damage. After all, if football players who've spent years taking hard hits to the head can change their brain in a matter of months, you can, too.

This is all to say that everyone has his or her own journey, and my purpose is to help you discover what you can do along that journey to harness the true power of your brain. Instead of thinking of the brain as an abstract structure inside your head, I'll show you how this incredible organ orchestrates your physical movements, directs your conscious mind, and powers the inner workings of your intelligence and personality. In short, your brain is what makes you *you*—unique, beautiful, and blessed to be alive.

1
Yes, You Can Change Your Brain

I live in Los Angeles. If you've ever been, you know the weather is warm, the beaches are beautiful, and the cars that drive down our palm-lined boulevards are incredible.

I'm not necessarily a car person per se, but when you live in the City of Sunshine, you can't help but be charmed by L.A.'s car culture. Spend an afternoon on Santa Monica Boulevard and you'll see everything from classic Cadillacs and old Aston Martins to brand-new Teslas, Porsches, and Ferraris. We also have plenty of beaters in L.A., including cars you can barely identify by model or even manufacturer because the hood is so crumpled, the back is banged up, and the exterior has been painted several times.

The reason I'm carrying on about L.A.'s car culture at the beginning of a brain book is because I can't think of a better analogy to explain the brain and why it matters how we take care of it. Similar to how a car is a complicated piece of machinery with hundreds of different working parts, so is the organ inside our heads that controls nearly every cell, thought, and behavior. Each and every part of our brain matters, as it does in a car: Let an inner valve rust, blow a fan deep inside the engine, or ding up a pump you've never even heard of, and your car may not run as well. Well, your brain is exactly the same.

I think about this car-brain analogy every time I step inside my front door because Mark, my fiancé, restores classic cars as a hobby. Our garage is full of old beauties, and he's won multiple awards that line our hallways and home office. I've learned from him, along with living in L.A.'s car kingdom, that people who are passionate about taking care of their automobiles are able to do amazing things with them, maintaining models from the 1950s, '60s, and '70s, so they look and run as well as any contemporary car. Conversely, people who don't take care of their cars often end up having to rely on something that doesn't handle well, is too slow, can't last as long, or may even be unsafe.

Here's where the car-brain analogy ends, though. Your brain, unlike your car, is a living, oxygen-consuming supercomputer with extraordinary processing capabilities. More than that, it's an essential part of who you are. So the consequences of not caring for your brain can be far worse than an expensive repair bill or getting stranded on an empty highway. If you don't perform regular maintenance on your brain by adopting brain health habits, you can jeopardize your ability to generate new ideas, maintain your focus, learn new information, and remember all the little things in life that make our time on this planet so precious. Without continual brain care—the automobile

equivalent of changing the oil, replacing the fluids, checking the tire pressure, and swapping out old air filters and dead batteries—your brain won't last as long, physically or mentally, and won't run as efficiently. And while you can always get a different car if you end up wrecking the one you have, or trade up if you lease, you can *never* get a new brain.

Not only are you stuck with one brain for life, it's also the most essential organ in your body when it comes to physical, mental, and emotional operations. Our brain controls everything we do, both our intentional actions—what we say, how we say it, how we move, and whether we want an ice cream sundae or kale salad—and the automatic ones, like our heart rate, blood pressure, breathing, sleep cycles, hunger, and thirst.

It also interprets and translates sensory information from the rest of your body, controlling what you see with your eyes, what you hear with your ears, what you smell with your nose, what you touch with your skin, and what you taste with your tongue.

The brain also communicates directly with other areas of your body, sending and receiving millions of messages through your spinal cord, which, along with the brain, make up the central nervous system. The central nervous system collates the body's physical and sensory information and coordinates physical, mental, and emotional activities across your entire body.

Just as the brain is the most important organ in our body, it's also the most complex. Our brain contains approximately 100 billion brain cells, known as neurons, and billions more glial cells, which support the neurons. A single neuron can form thousands of connections with other neurons, using gaps known as synapses to send messages between cells. This incredible labyrinth of elaborate cells, conduits, and signals results in more than 100 trillion connections in our brain—one reason why the human brain has been called "the most complicated object in the known universe."[1]

The good news? I'm here to help you crack the code behind biohacking your brain.

Changing the Brain Isn't Brain Science: What I Learned at a Nationally Recognized Brain-Scan Center

While the brain is immensely complex, the ways we can change the brain aren't nearly as complicated. In fact, changing your brain is really easy! After completing my doctoral and postdoctoral training, I started working as the director of research for Amen Clinics, where physicians treat a panoply of physical, mental, and emotional issues using information from patients' clinical histories and brain scans. I was surprised to see firsthand just how effective small changes to our daily routines, practiced consistently, can be to optimize brain health. These lifestyle changes can be as simple as choosing one food over another, engaging in a specific type of exercise, adopting a different mental approach to a common daily situation, and following certain protocols that are simple enough for a fifth grader to understand.

The clinics minister to a full range of cognitive conditions, including the kind you'd expect to see: dementia, Alzheimer's, memory issues, and other neurodegenerative problems. They also treat mental health issues like anxiety, depression, attention-deficit hyperactivity disorder (ADHD), self-harm, and suicide, anger management, schizophrenia, obsessive-compulsive disorder, bipolar disorder, and borderline personality disorder. Some patients have suffered concussions or other traumatic

brain injuries, while others have illnesses that affect the entire nervous system, like Lyme disease or toxic mold exposure. This range of problems is treatable, though, using information from patients' brain scans to help tailor lifestyle choices like diet, exercise, and supplements that will help influence their cognitive function and health.

One of the top issues we helped patients manage at the clinics was weight loss, since excess body fat has severe consequences on brain health. I coached hundreds of people on how to lose weight and keep it off using simple lifestyle protocols based on brain data.

My experience as the research director leading clinical neuroimaging trials gave me the equivalent of a de facto Ph.D. in the premise of this book: what the everyday person can do to biohack his or her brain. I saw thousands of brain scans both before and after patients implemented treatment protocols, and I was awed by remarkable and even inspirational differences they were able to make in a few months' time with simple lifestyle modifications.

A profound instance of this occurred when I helped lead a clinical research trial on current and retired football players in 2009. At the time, there had never been a large-scale study using brain imaging in living players to understand, in a comprehensive way, what was really happening under the helmet. For the study, we recruited one hundred active and retired NFL players from twenty-seven teams across all positions. To participate in the study, all of these guys had to have spent at least three years active on an NFL roster—in other words, these players weren't the ones keeping the bench warm. Many, both the offensive and defensive players, had experienced multiple hard hits and concussions, in addition to hundreds, if not thousands of milder subconcussive impacts.

While we were expecting to see some brain trauma, we were shocked to uncover the degree of damage in the players, who were some of the best athletes in the world. These players were highly tuned and conditioned—or they had been. They had spent their whole lives training, sleeping, lifting, eating, and breathing with a single goal in mind: to play and win the game of football. Technically, their brains should have been relatively healthy, not some of the unhealthiest the clinic had ever encountered.

We first put the players through a comprehensive set of neuropsychological and neurocognitive tests and conducted functional and electrical brain imaging. This allowed us to look deep inside their brains to see which areas were working well and which were not functioning as optimally as we would like them to. What we saw was eye-opening. Most players weren't getting the blood flow to their brains they needed, especially in areas responsible for memory and basic cognitive functioning.

While startling, the players' brain scans weren't discouraging. We believed we could help them recover their cognitive function and give them back the wonderful things their brains could once do quickly and effectively, both on and off the field. But doing so would mean changing their daily routine, which meant earning their trust.

For the next six months, we talked with the players, taught them about their brain function, and asked them to make specific lifestyle and dietary changes based on their personal cognitive data. Each player's individualized protocol dictated when and how much he slept and which nutritional supplements he should take and avoid. I coached them through it, meeting with them often in groups or one-on-one and cheerleading them to stick to the protocol. In the end, this earned me the nickname "Coach K."

After six months, we rescanned the players' brains and administered the same tests we did when they first arrived. What we saw then was even more impressive than their initial scans. In just 180 days, these men, who once had some of the unhealthiest

cerebral perfusion, or blood flow, we had seen, had turned around their brain function. In their six-month scans, we could see clearly that their brains were better perfused with blood and that they had restored function to certain cognitive areas previously damaged by poor health and repetitive hits.

If professional football players can change their brains, anyone can—and you'll have an easier time changing your brain unless you've also taken multiple hits from 250-pound men wearing twenty pounds of gear and polycarbonate helmets.

The Three Most Significant Ways You Can Change Your Brain

1. Yes, You Can Grow New Brain Cells at Every Age

First, a little truth: we lose thousands of brain cells every day as part of the natural aging process. Some of us lose more brain cells than others due to too much stress and exposure to heavy metals, pesticides, and other toxic chemicals in our environment, water, and food. Of course, having a drug and alcohol problem or suffering a mild brain injury, stroke, or cognitive disease like Parkinson's or Alzheimer's can also cause brain cell loss.

Now, a little good news: Our brain contains approximately 100 billion neurons, or brain cells, which are some of the longest-living cells in the body. The vast majority of the neurons we're born with and develop as a child remain with us for our entire lives—it's why maintaining your neuronal health is critical to your long-term cognitive function.

Finally, some fantastic news: Scientists used to think we couldn't grow new neurons as adults, but as it turns out, they were wrong. You can produce new brain cells as you age, even if you're in your sixties, seventies, or eighties.

The process of growing new brain cells is called neurogenesis. It takes place in the area of our brain known as the hippocampus, a seahorse-shaped structure located deep inside the brain's inner regions that plays a major role in memory and learning. You'll get to know the hippocampus much better in chapter two: "Brain Basics."

Neurogenesis isn't only for athletes or young people eager to unlock optimal brain function. Recent studies show that people in their seventies, eighties, and even nineties can stimulate new neuron growth by changing their exercise, diet, stress, sleep, and supplement habits. Research even shows older people, including those with Alzheimer's, can grow as many new neurons as young people.

When you create healthy new cells, you improve your neural capacity to activate, connect, and respond to all the information your brain processes and receives. The more healthy cells you have, the more quickly and effectively you can make smart decisions, hone your focus, preserve your memory, and retain facets of what we call our executive function—a broad umbrella term for the higher-level cognitive skills that control our behavior. Since neuronal death is the hallmark of brain aging, the more you're able to slow or counter that process with new cell growth, the younger your brain will be.

More specifically, studies show neurogenesis increases the volume and function of the brain's hippocampus, which can help preserve and even boost memory and

learning. Growing new brain cells also helps you to better deal with stress and can help mitigate mood disorders like depression, anxiety, and even posttraumatic stress disorder. And while the research is still in the early stages, studies look promising that brain-cell growth in the hippocampus can also play a role in slowing or even reversing the progression of cognitive diseases like Alzheimer's.

Both neurogenesis and neuroplasticity, or changes in neuronal connections from new learning, demonstrate the brain's ability to change over a person's lifetime. Growing new neurons is one way we can remodel our brain, giving us the lifelong ability to improve our cognitive function.

Throughout this book, you'll learn specific, science-backed ways to trigger new neuron growth. These modifications include certain forms of exercises, foods and nutritional supplements, and adaptations to how you handle stress. Some modifications are specific—for example, not all types of exercise have been shown to instigate new neuron growth. And similar to a car, the kind of consistency you give these habits makes the difference between a just-functioning brain and a shiny, new restoration job.

2. It's All About Blood Flow, Baby

This may not sound like fancy neuroscience, but boosting blood flow to the brain is exactly what evidence-based research shows we need for optimal cognitive health and performance.

If you're thinking that sounds simple, you're right. But simple doesn't mean universal: most people don't have optimal cerebral circulation.

The reason suboptimal cerebral circulation is so widespread requires understanding two components of brain health. First, our brain needs a rich and steady flow of blood to function properly. Second, many modern-day lifestyle habits negatively impact cerebral circulation without causing symptoms or problems until it's often too late.

While our brain takes up only 2 percent of our total body weight, it requires 15 to 20 percent of the body's total blood supply. Your body will even stop directing circulation to other organs in order to maintain a flow of oxygen and nutrient-rich blood to your cerebral headquarters.

The brain also uses three times as much oxygen as your muscles do. Blood is the only way to get oxygen to your brain cells so that they can function, fire, and signal efficiently. Without proper blood flow, brain cells begin to die.

Blood is also the brain's only source of glucose, or sugar, which brain cells suck up for fuel. Unlike your muscles, the brain can't store glucose, so if you're not getting enough blood to the brain, you're starving your cerebral tissue. And your brain is a hungry organ: it consumes 40 to 60 percent of the body's total blood glucose. Additionally, blood brings other vital nutrients to the brain, including vitamins, minerals, fats, amino acids, and electrolytes.

If you reduce your brain's nutrient and oxygen supply by even a fraction, you also reduce your brain's ability to activate areas that help dictate mood and cognitive function, including the ability to concentrate, remember details, come up with new ideas, make good decisions, and multitask.

There's another crucial role cerebral circulation plays: rinsing away tissue of metabolic waste that can build up over time. This includes the amyloid-beta protein, a protein that can become toxic when accumulated in the brain and has been associated

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FIRST EDITION

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Library of Congress Cataloging-in-Publication Data has been applied for.

Digital Edition DECEMBER 2020 ISBN: 978-0-06-299434-9

Print ISBN: 978-0-06-299432-5 (hardcover)

Print ISBN: 978-0-06-305752-4 (international edition)