

||| **Mindshift** |||

Break Through
Obstacles to Learning
and Discover Your
Hidden Potential

BARBARA OAKLEY, PHD

A TARCHERPERIGEE BOOK





tarcherperigee

An imprint of Penguin Random House LLC
375 Hudson Street
New York, New York 10014

Copyright ©2017 by Barbara Oakley

Penguin supports copyright. Copyright fuels creativity, encourages diverse voices, promotes free speech, and creates a vibrant culture. Thank you for buying an authorized edition of this book and for complying with copyright laws by not reproducing, scanning, or distributing any part of it in any form without permission. You are supporting writers and allowing Penguin to continue to publish books for every reader.

Tarcher and Perigee are registered trademarks, and the colophon is a trademark of Penguin Random House LLC.

Most TarcherPerigee books are available at special quantity discounts for bulk purchase for sales promotions, premiums, fund-raising, and educational needs.

Special books or book excerpts also can be created to fit specific needs.

For details, write: SpecialMarkets@penguinrandomhouse.com.

Library of Congress Cataloging-in-Publication Data
[Insert CIP]

Printed in the United States of America

1 3 5 7 9 10 8 6 4 2

Contents

CHAPTER 1	
Transformed	1
CHAPTER 2	
Learning Isn't Just Studying	16
CHAPTER 3	
Changing Cultures: The Data Revolution	29
CHAPTER 4	
Your “Useless” Past Can Be an Advantage: Slipping Through Back Doors to a New Career	44
CHAPTER 5	
Rewriting the Rules: Nontraditional Learning	58
CHAPTER 6	
Singapore: A Future-Ready Nation	76
CHAPTER 7	
Leveling the Educational Playing Field	97

CHAPTER 8	
Avoiding Career Ruts and Dead Ends	126
CHAPTER 9	
Derailed Dreams Lead to New Dreams	157
CHAPTER 10	
Turning a Midlife Crisis into a Midlife Opportunity	168
CHAPTER 11	
The Value of MOOCs and Online Learning	189
CHAPTER 12	
MOOC-Making: A View from the Trenches	218
CHAPTER 13	
Mindshift and More	245
Acknowledgments	261
Illustration and Photo Credits	263
References	265
Notes	277
Index	287

Chapter 1

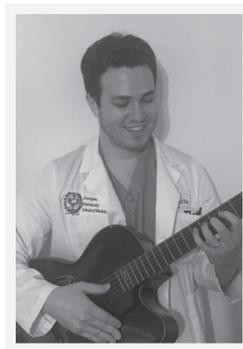
Transformed

GRAHAM KEIR'S CAREER was charging forward, unstoppable as a bullet train. He wasn't just following his passion—it was driving his life.

Or so he thought.

Even in grade school, Graham was obsessed with music. An upbeat child, he played violin from the time he was four, then nimbly expanded his repertoire by picking up the guitar at eight. In high school, the smoky world of jazz beckoned, and he began practicing this new freeform rhythm with nearly every breath he drew.

Graham lived just outside Philadelphia, once the home of jazz greats like Billie Holiday, John Coltrane, Ethel Waters, and Dizzy Gillespie. In the evenings, he would slip away from the spacious yard of his family's old Victorian house right next to a train station and onto the clanking Southeastern Pennsylvania Transportation Authority R5 train. Disembarking onto the stained concrete in Philadelphia, he'd



Graham Keir's career switch from the music he adored to the math and science he had loathed came as a shock even to him. Nowadays, he couldn't be happier.

step into the magical world of jazz clubs and live jam sessions. It was in listening to jazz that he came alive.

Eventually, Graham would train at two of the best conservatories, the Eastman School of Music and the Juilliard School, and he would be featured in *DownBeat* magazine as Best Soloist at the college level.

This wasn't to say that Graham was a success in every area of his life. Far from it. Pretty much anything that wasn't music-related was given short shrift. Math was a frustration—he blundered through algebra and geometry and never touched calculus or statistics. His high school science record was lousy. After his final exam in chemistry class, he came home and burned all of his work in the fireplace, thrilled to have passed. The night before the SAT, while other college-bound students lay awake nervously reviewing proofs and Advanced Placement history, Graham, flaunting his academic mediocrity, went to a jazz concert.

Graham knew that he wanted to be a musician and that was that. Even the mere *thought* of math and science made him uneasy.

But then something happened. Not an accident, or a death in the family, or a sudden shift of fortune. It was something much less dramatic, which made the change all the more profound.

Mindshift

For decades, I've been fascinated by people who change career paths—a feat most often seen among the well-to-do, who have ample social safety nets. Even with plenty of support, however, a major career change can be as fraught as jumping from one high-speed train to another. I'm also interested in people who decide, for whatever reason, to learn the unexpected or the difficult—the expert in Romance languages who overcomes his deficits in math; the floundering gamer who finds a way to soar academically in competitive Singapore; the quadriplegic who shifts into graduate-level computer science and becomes an online teaching assistant. In an age when the pace of change is ever increasing, I've become convinced that dramatic career changes and attitudes of lifelong learning—both inside

and outside of university settings—are a vital creative force. Yet the power of that force often goes unnoticed by society.

People who change careers or start learning something new later in life often feel like dilettantes—novices who never have a chance of catching up with their new peers. Much like wizards who think they're Muggles, they often remain unaware of their power.

Like Graham, I had a passionate contempt for math and science and did poorly in both from an early age. But unlike Graham, I didn't show any early talents or special abilities. I was a goof-off. My father was in the military, so we moved a lot, often landing at the rural margins of suburbia. Acreage on the edges, at least back then, was cheap, which meant we could have animals—big animals. Each school day ended with me dumping my books, leaping bareback onto my horse, and hitting the trail. Why would I care about academic learning or a lifelong career when I could be galloping through the afternoon sunshine?

Our household was monolithically English-speaking, and I floundered in seventh-grade Spanish class. My wise father listened to my whining and finally said: "Have you ever considered that the real problem isn't the teacher—maybe it's you?"

After we moved again, my father, surprisingly, was proven wrong. The new high school language teacher inspired me, making me wonder what it would be like to *think* in different languages. I learned that I liked studying languages, so I began to study French and German. Motivating teachers *matter*. They not only make you feel good about the material—they make you feel good about yourself.

My father urged me to earn a professional degree grounded in math and science. He wanted his children to be able to make their way in the world. But I remained convinced that math and science were outside my playbook. After all, I'd flunked my way through those subjects in elementary, middle, and high school. I instead wanted to study a language. At the time, there were no readily available college loans, so I bypassed college to enlist in the military where I could get paid to study a language. And I did learn a language—Russian.

But against all odds—and despite my early plans—I’m now a professor of engineering, firmly planted in the world of math and science. And with Terrence Sejnowski, the Francis Crick Professor at the Salk Institute, I teach the most popular online course in the world—“Learning How to Learn”—for Coursera/UC San Diego. The course is a MOOC—a massive open online course—and there were a million students from more than two hundred countries in the first year alone. By the time you read this book, we’ll be accelerating well past the two million student mark. Educational outreach and impact like this is unprecedented—it is clear that people are hungry to learn, shift, and grow. My lifetime list of jobs and careers is eclectic, to say the least—waitress, cleaning lady, tutor, writer, wife, stay-at-home mother, U.S. Army officer, Russian translator on Soviet trawlers on the Bering Sea, and radio operator at the South Pole Station. I discovered, more or less by accident, that there was more power within me to learn and change than I had ever dreamed. What I learned in one career often enabled me to be creatively successful in the next phase of my life. And often, it was seemingly useless information from a previous career that became a powerful foundation for the next.

Now, as I watch millions of learners all over the world awakening to their potential to learn and change, I realize it’s time for something new. We need a manifesto about the importance of *mindshifts* in producing vibrant and creative societies and in helping people to live to their full potential.

A “mindshift” is a deep change in life that occurs thanks to learning. That’s what this book is about.

A “mindshift” is a deep change in life that occurs thanks to learning. That’s what this book is about. We’ll see how people who *change* themselves through learning—and who bring prior seemingly obsolete or extraneous knowledge with them—have enabled our world to grow in fantastically creative and uplifting ways.

And we’ll see how we all can be inspired by their examples—and by

what we now know from science on learning and change—to learn and grow and achieve to our fullest potential.

Discovering Your Hidden Potential

People have unexpected twists in their career paths all the time. You sit down at your desk one morning, lean in to the day's work—and see your boss, flanked by security guards, ready to escort you from the building. Out of the blue, you've been let go, after two decades of hard-earned experience and mastery of the company's systems—systems that, like you, are being dumped.

Or . . . maybe you work for a jerk, and suddenly a joyous opportunity arises to escape the dungeon—if, that is, you're willing to learn something new and challenging.

Maybe you don't feel like you have a choice. Perhaps you are the obedient child who always followed your parents' admonitions, so you feel trapped in the luxury of your high-paying salary, nose pressed up against a window of longing for the career not chosen.

It might be that you eked your way through to a professional career in a place where good jobs were hard to come by. You wouldn't dream of taking a risk to shift careers, especially now that you've got children who will pay the price if you screw up.

Or . . . maybe your mother died the night before a critical exam, and you were one of the myriad students who failed the program in a system that seems purposefully designed to eliminate everyone possible. So you're stuck in a low-paying job.

Or . . . it could be that you graduated with your shiny new degree that you pursued like a zealot because you were determined to *follow your passion*. (That's what your friends always told you to do, after all.) And then, suddenly, you realize that your parents were right—the pay's lousy, the job's even worse, and to top it off, you have a career-change barrier in the form of a boatload of student debt to pay off.

Or . . . maybe you love your work, but you just feel there's something *more*.

Now what?

Different societal and personal situations place varying obstacles—some insurmountable—on learning new skillsets and on changing careers. But the good news is that worldwide, we're moving into a new era, in which training and perspectives that were once available only to the fortunate few are becoming available to many—with smaller personal and financial costs than ever before. This is not to say that a mindshift is easy. It's usually not. But the barriers have been lowered—in many cases and for many populations.

This availability of new ways of learning—new tools for a mindshift—is so overwhelming that the reaction has often been a collective *No, no, no, the older systems of career development and learning are fine. They're the only ones that matter! This new stuff is a flash in the pan*. But slowly—often unnoticed—the mindshift revolution grows. Such mindshifts don't just involve learning new skills or changing careers, but also changing attitudes, personal lives, and personal relationships. A mindshift can be a side activity, or a full-time occupation, or anything in between.

There's good evidence that our abilities to be successful in any given area aren't at all fixed. Stanford researcher Carol Dweck's "growth mind-set" centers around the idea that a positive attitude about our ability to change can help produce that change.¹ As adults, though, it's hard to know how this attitude plays out in real life. What kinds of changes can people *really* make in their interests, skillsets, and careers? What are the latest practical suggestions from research? And what role do new means of learning play in these processes?

In *Mindshift*, we'll follow people from all over the world who have made unusual career changes and overcome enormous learning challenges. There are profound insights from these "second chance" learners that are valuable no matter what career you might be shifting to or from or what you might be interested in learning. We'll watch people make difficult shifts from the humanities to the sciences or from high tech to

the fine arts. We'll see how overcoming depression shares attributes with starting a new business; how even the world's most brilliant scientists can be forced to hit career reset buttons; and how being not so smart can turn out to be an asset when you are learning tough topics.

We'll examine people's motivation and learn the tricks they use to keep themselves on track during the often disconcerting process of major change. We'll hang out with fascinating adult learners and see how, especially in this digital age, you actually *can* teach an old dog new tricks. (Hint: video games can help.) We'll see what science has to say about the fresh perspectives that career changers and adult learners provide, and we'll learn practical ideas from neuroscience that can allow us to better understand how we ourselves can continue to grow mentally even well after we've reached maturity. We'll also meet a new group of learners—"super-MOOCers"—who use online learning to shape their lives in inspiring ways.

Mindshift is so important that countries are even devising systems to foster its growth. So we'll travel to Singapore, one of the most innovative of those countries, to learn of new strategies that can enhance our careers. Insights from that tiny Asian island will allow us to see innovative new ways around the *passion* versus *practicality* conundrum that often bedevils us.

Through this book, we'll also travel around the world to share a fun insider's perspective on learning, as seen from my perch at the top of the world's most popular course—a course devoted to learning. What does it look like to peer into a camera lens with millions of learners on the other side? You'll find plenty of practical advice about how to select the best ways to change and grow through learning, both online and in person.

But it isn't all just high tech; simple concepts like mental reframing and even taking advantage of some aspects of a "bad" attitude can do a lot to get us past the hurdles that life throws our way. Unconventional learners can give us unusual ideas to get around seemingly insurmountable obstacles.

This book tends to emphasize changes from artistic to mathematical

or technological skillsets, rather than the other way around. This is because people often don't think an "artistic to analytic" change is possible. And, whether we like it or not, there are more societal tugs at present toward technology. But whatever you are interested in, you will find plenty of inspiration here—from the bus driver who overcomes depression, to the electrical engineer who converts to woodworking, to the publicly tongue-tied, mathematically gifted young woman who finds within herself a talent for public speaking.

Break Through Obstacles to Learning and Discover Your Hidden Potential—the subtitle of this book—paints a broad canvas. But that canvas is *your* canvas. As you'll see, the scope of your ability to learn and change is far broader than you might ever have imagined.

For now, though, let's return to Graham's story.

Graham's Shift

It was a simple thing, really, that kicked off Graham's career shift. One day, he was invited to play his guitar at a local pediatric cancer center. He hoped that his beloved music might boost the children's spirits. The brief visit turned into another visit, and then another. He found himself drawn to the courageous little patients, some of whose stories broke his heart. He was so moved by them that he eventually started a concert series for cancer patients.

As this unfolded, he began to discover something surprising. Playing music all day, every day, wasn't fulfilling him as a person. Somehow, the thought of caring personally for patients when they were at their most vulnerable began to feel more meaningful to him than performing for people he might never talk to or see again.

Suddenly, something clicked. Something impossibly scary: Graham decided that he would become a doctor.

He felt like a fool—there was nothing in his past to indicate that he could be successful in math and science. What made him think he could do this now?

Like many who struggle to reinvent themselves, he decided to start small in acquiring the mental tools he'd need. He signed up for a calculus class.

But he didn't just jump right into it. Several months before class began, he bought a precalculus e-book on his iPhone so he could run through the concepts while traveling to performances or commuting to school. At first, he found it disheartening. There were so many basic math concepts he had forgotten or poorly understood to begin with—*you mean there are rules for exponents?* He couldn't help but think, *Oh my God, what am I doing? I am at the top of my field in music, and I am about to start at rock bottom in medicine.*

However, he was well aware that one of his strengths—one he had built through years of practice in music—was the simple skill of persisting at difficult tasks. If he could practice for all of those hours to get into Juilliard, well, there was no reason he couldn't learn this new material. It would just take hard work and focus.

Knowledge of his strengths didn't remove his doubts—and didn't change the fact that his studies were often really, *really* difficult. Most of the people taking the calculus course were Columbia premed and engineering students who had taken it in high school and just wanted to boost their science GPA by retaking it. Graham felt like he was in a go-kart competing against seasoned race car drivers. When he mentioned to the professor that he was a musician, the professor couldn't figure out why Graham would want to take his class. But in the end, he fought his way to an A-minus. Not bad for a math-and-science loather's first college calc class!

A bit of Graham's doubt began to recede. But his own words convey the struggle he continually faced:

I remember losing sleep before almost every exam because I thought, "If I don't get an A, I won't get into medical school. I just threw away my music career, and if this doesn't work, what will I have?"

And there were reminders everywhere of what I had given up. The

night of the Super Bowl, I was studying for a double whammy of bio-chem and organic chemistry tests on the following Monday. I wasn't watching the Super Bowl, but I knew in the back of my mind that one of my friends was playing saxophone with Beyoncé during the halftime show. I had to stop looking at Facebook, because all I would see was fun things my friends were doing, be it tours or high-profile performances. I had made my decision and I needed to stand by it.

One of the hardest parts was well-meaning friends and family who tried to discourage me. They knew how successful I had been in music and couldn't see why I was doing what I was doing. Others suggested different careers that might not be as difficult. These friends planted seeds of doubt in my head that made it very hard to make it through the most difficult moments. I had to reaffirm why I was making the change by remembering specific moments of clarity that had steered me in this direction. At the same time, I didn't tell most of my musician friends what I was doing. I wanted to leave things ambiguous because it was important to maintain my connections in the jazz scene and be hired for performances. I was essentially pretending to be two different people.

At first, I limited my performing because I thought I needed to really buckle down and get to work. However, my second semester, I started playing a lot more. I got the exact same GPA as the semester before, but I was enjoying life so much more because I had a release from the daily routine. Performing was my socializing, income, and release all wrapped up into one activity.

The science classes were hard. When I first started, I had to get over the nausea that I naturally felt from math and science. Once I got into it, the material was fun and interesting. I actually started to enjoy the process of drawing organic chemistry figures and puzzling over math problems. I would smile or chuckle to myself when I saw a particularly clever solution in a textbook.

Still, I was not accustomed to the level of detail required in science classes. I would convince myself that the tests were unfair or that I really understood something but didn't show it on the test. I quickly real-

ized, though, that someone in the class was surely getting those questions right that I wasn't. They must have certainly had a better understanding than I did. It wasn't the teacher's fault, but my fault.

I found that it wasn't enough to understand something once. I had to practice, just like I had on the guitar. I met with professors and asked questions in class. In high school, I never went for extra help because I was in denial that I was struggling with the material. I thought only the "slow" kids went for extra help. I realized, though, that I had to put my pride aside. The goal was to do well on the test, not look like a genius all the time.

I was fortunate enough to have read *Moonwalking with Einstein* just before taking these classes. I used several memory techniques such as loci, memory palace, to commit information to memory. I know that some people have naturally good memories for numbers and abstract ideas, but I wasn't one of them. It was important to figure out my limitations early on. Once I knew what I was working with, I could do what I needed to overcome them.

Graham decided to take the rest of the science requirements in a year and a summer. The first class was his old nemesis—chemistry. "Believe it or not," he noted, "I came out with an A. I had gotten a C+ in the easier high school version, but now that I had committed myself to learning the material, I had become a completely different student."

As he progressed, he found himself with A's in organic chemistry, biochemistry, and other tough classes that he would never have seen himself taking ten years before. Graham took the MCAT (Medical College Admission Test) one week after his last final. He is now in his third year of medical school at Georgetown University. I met him online after he took "Learning How to Learn" to further improve his medical school studies.

Graham's background in music has proven to be a boon to his medical career in both large and small ways. For example, in auscultation—diagnosing through listening to heart sounds—he found that his trained

ear, which is sensitive to very fine differences in timbre and timing, allows him to pick up on those differences much faster than other people.

However, it is the general benefits of his background in music that have had the most impact. It is essential, of course, for physicians to have a solid understanding of the science and physiology of medicine. But Graham has found that it is perhaps equally important to be able to listen to patients and be empathetic. Playing in ensembles with other musicians, Graham learned to listen to the musicians around him and not just immediately interject his own musical thoughts. In a similar way, he found that giving patients space to talk and not immediately talking over them can lead to a better diagnosis as well as a better patient-physician relationship.

More than that, Graham has discovered that the characteristics needed to perform as a musician are surprisingly similar to those needed to “perform” in a patient encounter or procedure. He is coming to appreciate how his years of practice with musical improvisation spill over into his new life in medicine. He finds himself coping well with unexpected situations or emergencies in which he must use his growing expertise in new ways. The difficult switch from music to medicine has also allowed him to grow more comfortable with being pushed out of his comfort zone.

Physicians often tell medical students that in medical school, so much must be memorized that it can inadvertently set an expectation that medicine will be a cut-and-dried science. However, in practice, medicine is much more mutable and often relies on intuition and the “art” of healing. Graham already has the sense that his medical career will feel much more natural to him than to many medical students because of the time he has spent performing music.

But there is more. Graham wrote me:

In my first year of medical school, I still faced struggles studying. One of the reasons I started taking your course on Coursera was because I

knew something about my studying was inefficient. I was spending so many more hours than most people but not necessarily learning the material any better. Your course helped me realize that it is important to make studying an active process. I would spend hours rereading slides, but half the time I would just space out and lose focus. By using the Pomodoro technique and frequently testing myself, I am already seeing improvements.

So there you have it. It's possible to make enormous changes in your life—your “preprogrammed” passions or what you *think* you're good at don't have to dictate who you are or what you ultimately do. Along those lines, it's worth noting that people don't just want to change to go *into* medicine. Doctors have also slipped *out* of medicine into completely different fields. For example, despite his Harvard MD, Michael Crichton, the bestselling author of *Jurassic Park* and the television show *ER*, never bothered to obtain a license to practice medicine. And Sun Yat-sen, the founding father of the Republic of China, gave up his medical studies in Hawaii to become involved in the revolution.

The Pomodoro Technique



The Pomodoro technique is a deceptively simple, extremely powerful focusing technique developed by Francesco Cirillo in the 1980s. *Pomodoro* is Italian for “tomato,” and the timers Cirillo recommended were often shaped like tomatoes. To do the Pomodoro, all you need to do is turn off all potentially distracting beeps or buzzers from your cell phone or computer, set a timer for twenty-five minutes, and then focus as hard as you can on what you're working on for those twenty-five minutes. When you're done (and this is equally important),

allow your brain to relax for a few minutes—do a bit of web surfing, listen to a favorite song, walk about, chat with friends—anything to comfortably allow yourself to be distracted.

This technique is valuable in dealing with procrastination and keeping on track—even as it also has built-in periods of relaxation that are equally critical for learning.

You might say, “Hey, wait a minute. Graham was obviously a pretty bright guy—he just never put his effort into math and science before.”

But how many of us are like that, with whatever subjects, skills, or areas of special expertise we’ve never seriously tried to tackle?

How many of us, for whatever reason, go off track in our lives? And how many of us eventually find ways to turn things around through learning new skills and approaches? How many others seem to be on track career-wise, but have an itch for something new and sometimes scarily different?

→ **Key Mindshift**

The Value of the Beginner’s Mind

.....
Learning something new sometimes means stepping back to novice level. But it can be a thrilling adventure!

Many ordinary and extraordinary people have made fantastic changes in their lives by keeping themselves open to learning. You’ll see how previous expertise in very different subject areas doesn’t need to be a shackle to a past you are trying to escape. Instead, it can serve as a launching pad for creative career pathways in your present and future. And, as we’ll discover in the chapters to come, science has much to say about why we choose the fields we do, how we can slip the bonds of biology, and how we can continue to learn effectively, even as we age.

Welcome aboard the new world of mindshift.

★ **Now You Try!**

Broaden Your Passion

Have you unnecessarily limited yourself by heeding common advice to *follow your passion*? Have you always done what you're naturally good at? Or have you challenged yourself with something that was really hard for you? Ask yourself: What could you do or be if you decided to instead *broaden your passion* and tried to accomplish something that demanded the most from you? What skills and knowledge could you bring with you from your past that could serve you as you really challenge yourself?

Surprisingly often, capturing your thoughts and putting them onto paper can help you discover what you really think and help you take more effective action. Grab a piece of paper, or better yet, a notebook you can use for this book, jot a header of "Broaden your passion," and then describe your answers to the above questions—whether your answers result in a couple of sentences or several pages.

We'll have plenty of brief active exercises like this throughout this book—as you'll discover, these exercises form outstanding ways to help you synthesize your thinking and learn at a very deep level. Reviewing your notebook or papers when you reach the end of this book will give you invaluable overview perspectives about yourself, your learning lifestyle, and your life's goals.