

Mindshift:  +  +  = 10

- Expressions -

△ xx wasn't given short shift.

△ flounder x2

△ xx is outside my playbook 

△ eclectic   

nemesis
archenemy  

boom
blessing  

click 

cut & dried 

- Content -



Waste y/p
⇒ Takeaways

① core skill/sets 

② beginner mindset 

③

S	W
O	T



Learning ≠ Studying



- biological underpinnings - Exercise
- know what makes the brain tick
- Mindset

Juke punch 

fizzle 

- peter out - 

- excruciating agonising - 

- imbaoglio - 

- Waterloo downfall undoing - 

- unguzzingly - 

- do a number on - 

- get your money's worth - 
- get the best bang for your buck -



Changing Cultures



- retool
- dabbler
- sweat by

- go south
- go one's way



- prototype your life

- Every act of conscious learning

Hobby → Profession



▷ go mano a mano
↳ on a par with
↳ rival

★ tenor of the discussion

▷ exude - ooze

struck

- take a glee
- provoke

▷ malevolent, sinister
incendiary, inflammatory
↳ lightning rod (for)



Rewriting the rules



▷ Contrarian

▷ fodder for gossip

▷ prodigiously 17r

▷ rub off on, by osmosis

▷ panacea



▷ a cultural backwater
↳ basket case
↳ bellwether

★ virtuoso

Future-ready yourself

T 16 17 18

19 can out

▷ upskill

↳ future-ready
↳ backup skill
↳ fail back



3

- diffuse mode -

不相上下

释义

例句

释义

不相上下；难分高低；相差无几 >

与…不相上下；可与…媲美 cl... >

...分胜负；不相上下 dead heat >

均衡的；不相上下的；同一水... >

与…相匹敌；和…不相上下 m... >

...要等)；不相上下；伯仲之间 | >

势均力敌的；不相上下的；旗... >

...匹敌的；不相上下的 well ma... >

一些科目的教学一直远达不到标准。

• be par for the 'course

(disapproving) to be just what you would expect to happen or expect sb to do in a particular situation 不出所料；果不其然

SYN the norm

◆ Starting early and working long hours is par for the course in this job.



开工早、工时长是这份工作的常态。

• on a par with sb/sth

as good, bad, important, etc. as sb/sth else 与…同样好（或坏、重要等）；不相上下；伯仲之间

• up to 'par

as good as usual or as good as it should be 达到通常（或应有）的水准

SYN up to scratch

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10:49 Thu Jul 27

91%

rival

词目

词目

rival

noun >

rival

verb >

近似词目

rivalry

>

rivalries

irregular form of >

rival n

rival

CET4 CET6 NETM

BrE /'raɪvl/

NAmE /'rɑːvl/

verb

(-l-, NAmE also -l-)

~ sb/sth (for/in sth)

to be as good, impressive, etc. as sb/sth else 与…相匹敌；比得上

SYN compare with

◆ You will find scenery to rival anything you can see in the Alps.

你看到的景色可与你在阿尔卑斯山所看到的景色相媲美。

→ see also unrivalled

检索 书签 检索记录 分类词汇 参考信息 学习卡 阅读器 设置

Chapter 7

Leveling the Educational Playing Field

E)

AT AGE NINE Adam Khoo was expelled from primary school for fighting. In secondary school, Adam's grades were stuck in the bottom tier. He couldn't pay attention very easily in class.

People who did poorly in school sometimes say they are actually very smart—it was just that the material was somehow boring and beneath them. Adam doesn't say that. Learning was just plain hard for him. Reading books was even worse than listening to a teacher—books just made him sleepy.

It didn't help that Adam's parents divorced when he was in his teens, and he suddenly found himself with a stepsister in the gifted student program. She attended the top school in Singapore, while Adam was in the bottom one. Over and over he was told, "Why can't you be like Vanessa? Get straight A's like Vanessa?"

A lot has changed since then. I met with the forty-one-year-old Adam Khoo at his offices in downtown Singapore. Adam is now the multimillionaire founder and executive chairman of one of the largest educational training firms in Southeast Asia: the Adam Khoo Learning Technologies Group. Though Adam has a reputation as a titan of industry, he's also a nice guy who hopes to inspire others by sharing insights about his early struggles and what had shifted his path.

I enjoy traveling to Singapore, because its common use of English makes it such an easy place for Westerners to navigate. Adam's native language, for example, is English—he's had his share of struggles trying to



At age thirteen, Adam Khoo swiveled from incorrigible failure to astonishing success by reframing his mind-set and acquiring powerful new techniques for learning. He now leads a company devoted to helping people make similar successful changes in their lives.

pick up Mandarin.

However, one aspect of Singapore that can be difficult for Westerners to wrap their minds around is the level of competition. High population densities in places like Singapore and elsewhere in the East mean that, whatever you are doing, you can find yourself competing with hundreds of thousands or even millions of other people—often with goals identical to yours.

Perceived success in Asia, as in many other parts of the world, is often tied to material success—a job

with good social standing, a high salary, and education. Parents place a lot of pressure on their children to become doctors or lawyers, despite the fact that not everyone is geared for those disciplines, and the world doesn't need only doctors and lawyers.

Math and science are considered particularly important for long-term success. Parents urge their children to excel in math so that they can go to a top university and have their pick of lucrative careers. Singapore has been working hard to change attitudes—to show that artists and athletes, for example, can be just as valuable as engineers. But old mind-sets are slow to change, particularly when people look at economic realities. The bottom line is that it's often harder to make a living at more “fun” jobs like being a writer or musician.

School competition is especially intense. Standardized tests are the equivalent of lining up several hundred thousand students at a starting line, firing a pistol into the air, and giving medals to the few who struggle to a nanosecond lead across the finish line. Because of this, school preparation has turned into an arms race. Students are being drilled at younger and younger ages. It used to be that if a student scored four A's on Cambridge A-level exams—the big exams that dictate which universities you might enroll in—they were among the best. Now, it takes seven A's.

Singapore is working to reduce the pressure such tests put on students and to change the tests themselves to foster more open approaches to thinking and learning, but the system is still punishingly rigorous. However, in other Asian countries less attuned to the need for change than Singapore, the testing systems can be even more brutal. Millions of students compete for just a few slots in top universities. Those with inferior scores are relegated to lower-prestige regional universities, colleges, and vocational schools. Many simply aren't able to progress academically after secondary school.

"Good" students in Singapore, as elsewhere in Asia, are often channeled in early grade levels into faster tracks. This makes sense—it keeps students moving at a pace that's more suited for them. But in Asia's face-oriented culture, it *matters* how your child is classified. This puts a double burden on students. If you do poorly on a test, it isn't just that you yourself have failed. You've also failed your family—shaming them in front of others. And there's other baggage: If you're put in the slowest group, you're also among the rowdier and less academically driven kids. This makes it harder to concentrate and reinforces feelings of inadequacy. You also lose access to the best teachers. Your thoughts become home to the refrain: *I'll never be as good as an upper-tier kid.*

Once you're on a downward scholastic path, it can seem impossible to change. Everything is geared to drive you further down.

But it is possible to reverse course—even if you're one of the "slow" kids.

< o w t

★ Now You Try!

Mind Tricks for Success

Have you ever felt outclassed by intense competition? As this chapter will reveal, there are mind tricks that can help you get back in the running. Can you anticipate what some of those tricks might be? Under the title "Mind Tricks," put your ideas on paper.

Adam Khoo: A Reboot on Life

Adam Khoo was a latchkey kid—one of tens of thousands in Singapore who shared similar circumstances. When Adam came home from school, there was no one to even check on him. This was perfect as far as he was concerned—all he cared about was playing computer games. He had no interest in school, which was frustrating for his parents, who spent a lot of money on tuition and tutors.

Adam drove the tutors away, running around and ignoring what they were trying to teach him. Failing grades in school? He didn't care. Beyond computer games—along with comic books and television—he was only interested in hanging out with friends and getting into fights. Adam was an attention seeker—always wanting to stand out. If he couldn't stand out in a good way, he was happy to stand out in a bad one, picking arguments and joining disruptive groups of other wayward youths.

Adam's businessman father was loving, but he was at a loss for how to encourage and motivate his son. Adam's mother was one of the top journalists in Singapore—a high-flying career woman. She was also loving, but unhelpful in a different way. When Adam found himself unable to do math, she would shake her head and say, "I think you got my genes."

"I had this label placed on me; I was lazy and stupid," says Adam. The labels weren't that far off base—Adam is the first to admit that he's a slow learner, and being slow made him want to avoid his studies. **What Adam hadn't realized is that there are mental tricks that could have allowed him to overcome the drawbacks that arose from his "non-standard" intellect. As his success has since shown, once he overcame those stumbling blocks, he could leverage his brain's advantages.**

It's trendy to think that motivational youth camp programs don't make any real difference in a student's life, but for Adam, at age thirteen back in 1987, one of these programs did. It was Super-Teen Camp—the first such program in Asia.

"I was exposed to ideas from the human potential movement," says Adam. "We are all born gifted. There is no failure, there are only learning experiences. I was inspired by examples of people who had turned their lives around."

→ $\frac{a}{b} \frac{c}{d}$



Adam reflexively taps the desk in front of him as he bounces back and forth in his chair. He has a flickering kind of attention—his smarts don't necessarily build in solid, step-by-step blocks of conventional rationality. It's no wonder conformist schooling nearly called it quits on him.

"In the Super-Teen program, I learned tricks with memory. How to visualize and associate. I would say to my friends, 'Give me fifty words. I'll memorize them in five minutes. Let's bet two dollars.' I got a new identity—as a genius. But it was really all in the techniques I'd learned."

Adam was a creative individual who loved daydreaming, drawing, cartooning, and music. Staring at the pages of a book was boring for him. But a technique called "mind mapping" he'd learned in camp allowed him to pick what was in a textbook and reorganize it in a highly visual way, using cartoons that triggered his memory.

But the program didn't just teach learning tools. It also taught him to dream big. The instructor challenged him, "Do you want to be mediocre or exceptional?"

"Exceptional."

"If you want to be exceptional," the instructor said, "you have to set goals that you cannot achieve with your current level of capability. You need goals that will make you stretch."

This made sense to Adam.

He aimed high—very, very high. He set a goal that year, when he was thirteen, to go to Victoria Junior College, one of the top junior colleges in Singapore. The secondary school Adam was attending wasn't the best—in fact, no one had ever gotten into Victoria from his school. His teachers told him the goal was unrealistic.

"That was one of the hardest things for me—the people I was around," Adam says. When people heard his goals, they made snide remarks: *You're crazy. Can't be done.* To his dream of entering the National University of Singapore, his father just said, "There's no way." But Adam is by nature a contrarian. The more people would tell him he couldn't do it, the more he'd set his mind to it.

But on top of all this, Adam had another dream: to build his own business. He built this dream by visualizing and imagining. In secondary school, he would draw his own name cards. *Adam Khoo, Chairman*. He developed a dream that he could *be* someone—that dream kept him

One of Adam's mind maps from college. Drawing out the key concepts of what he was learning about helped him remember and understand what he was learning. Notice the drawings embedded throughout Adam's mind map— sketches like these have been shown by research to enhance your ability to learn and remember the relevant concepts.¹

He worked hard, especially in math, which was not a natural subject for him. In junior college, he majored in math, despite, or perhaps because of, its difficulty. Mandarin was also difficult for him. At that time, it was virtually impossible to advance without it. Adam spent half his time studying the sounds and characters of a language that he just couldn't seem to grasp. He failed important tests time and again over many months. Finally, he got a D. "Suddenly, there was a glimmer of hope!" Adam grins. "And then I kept studying, took the test again, and got a C. I got to go to junior college!"

In the meantime, he DJed and performed magic, becoming a very efficient time manager. There are many pockets of time people ordinarily waste—riding a bus, waiting for the teacher to come into class, sitting on the toilet. . . . By using all those minutes, Adam got an extra two to three hours a day. He brought his books everywhere and used whatever spare moment he could to be learning. Between classes, waiting for the teacher to arrive, he would be tidying up notes on what was taught the previous lesson.

"I was so obsessed with becoming a top student that on family vacations, I would find a bench and draw mind maps whenever my father stopped and went into a store to shop. By the way, did I also mention that I had a girlfriend on top of all that?"

I can't help but laugh as I glance up from note-taking. "So basically you acquired a positive mind-set and some tools for learning, discovered ways to be more efficient, and then things started unfolding in a better way. Is that a valid summary?"

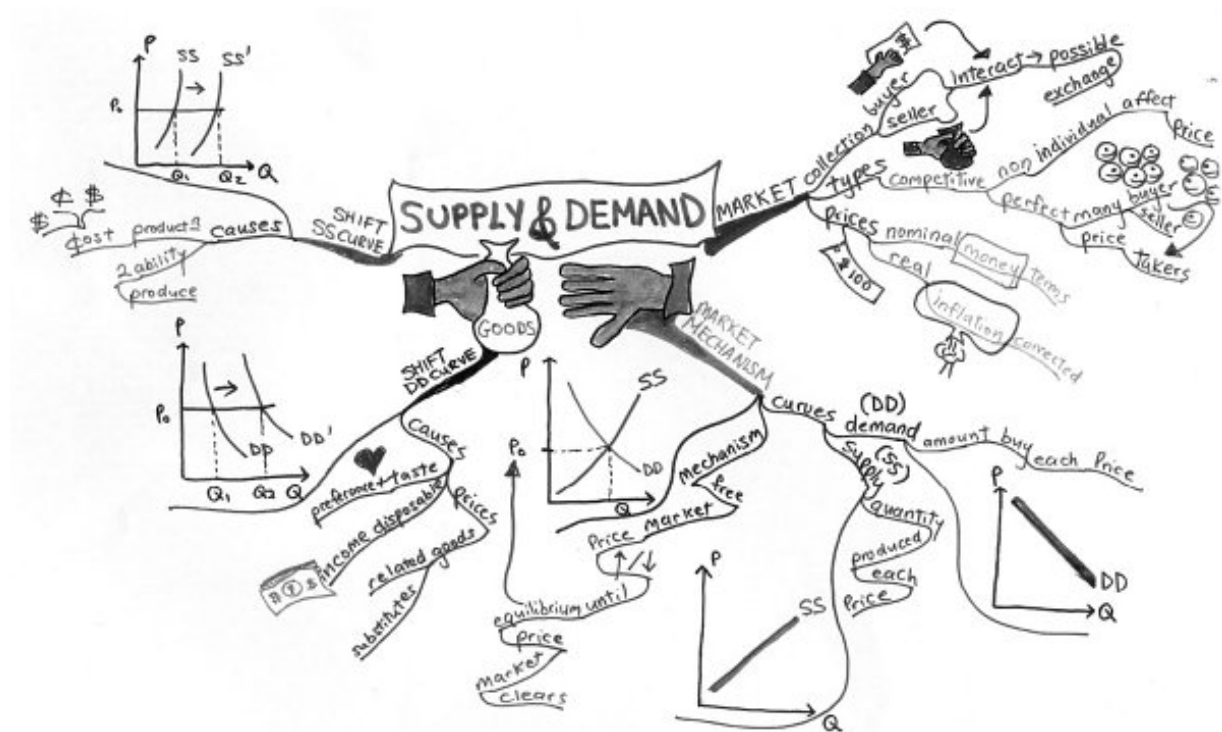
"Yes. But it was lot of hard work. When I started secondary school, for example, my math teacher called my mom up and said, 'Your son should not even have passed primary school and come to secondary school, because his level of mathematics is so low.'" But because Adam was so motivated to get A's in secondary school, he went back to his primary school books and started practicing every question to really learn the basic concepts. It was hard work—not like some kind of easy miracle. Adam's

motivated. He pasted his goals all over his room. *Junior college, here I come! National University of Singapore, here I come!* A poster that says, *I'm a winner.*

Adam started topping his class. His geography teacher couldn't understand what was happening to her former "bad boy" student, but she knew enough to take advantage of a good thing. She asked Adam to use a class period to teach his friends what he was doing.

Adam started to write articles that he printed and distributed to friends: how to set goals, manage time, stay motivated. The other students began to look up to him, to respect him. He gained a new identity, and he enjoyed it. That was when he discovered his passion: *He was here to inspire.*

To deal with the fact that he was a slow learner who was always behind in class, Adam started asking his teachers what they were going to be teaching the next day. He'd preread the chapter and do a mind map. The next day, listening to his teacher, he would be hearing the information for the second time, which meant he understood it better. He would ask a lot of questions in class, which allowed him to add to his mind maps. He drew funny cartoons that helped him remember.



stepsister could read a new chapter of math and get it pretty much instantly, whereas Adam struggled, reading and rereading until whatever he was trying to grasp finally made sense.

Adam knew how easily he could think he knew a question, but then forget or make a careless mistake when it came time for the exam. “So even though I knew how to do a question,” he says, “I’d cover the answer and do it again. Cover the answer and do it again.” Adam would keep at it until the ability to do the problem somehow became so fluid that it was subconscious.



→ Five Key Mindshifts That Enhance Learning

1. Create vivid mind-map sketches that bring the material to life.
2. Memorize by using visual association.
3. Use pockets of time that are often neglected, such as sitting on a bus.
4. Practice over and over again until you can work a tough problem with ease.
5. Visualize your successful future with whatever you are learning.

What Lies Behind Good Learning?

Adam’s “do it till it’s subconscious” approach is backed by sound neuroscience. The article “Reading and Doing Arithmetic Nonconsciously” by psychologist Asael Sklar and colleagues, published in the *Proceedings of the National Academy of Sciences of the USA*, opened plenty of eyes about the fact that multistep, effortful arithmetic equations can be solved below people’s level of awareness.²

A technique known as Flash Anzan teaches children to rapidly add numbers on a mental abacus. And by “rapidly,” we’re talking *spooky-fast*—numbers in the hundreds or even the thousands are flashed momentarily on a screen. The number 3,492, for example, is quickly replaced by 9,647, then 1,785, and so on, as youngsters watch and do their mental summation.³ Kids enjoy this technique, which they start learning by drumming on the table with their fingers as if an abacus were there in front of them.⁴ Gradually, students learn to let their hands lie still as their minds race ahead.

It's difficult for an unpracticed individual to glimpse fifteen three-digit numbers flashed on the screen in a total of less than two seconds—yes, two seconds—and imagine that anyone could add them that fast. But with practice, it's absolutely possible. And doing this has great benefits. The mental abacus method teaches students to use the visual and motor parts of their brain in adding—a thought process very different from those that use simple pencil-and-paper techniques.⁵ Children who use the mental abacus can gain such fluency with mental mathematical processes that they can even do Flash Anzan while simultaneously playing the language game *shiritori*, which involves saying a word that begins with the final kana character of the previous word. It seems the verbally oriented *shiritori* and the math of Flash Anzan use different parts of the brain.⁶

Procedural fluency is a sort of automaticity of thought that arises because you've done something many times before. Examples include being able to casually back up a car (not so easy the first time you might try it!), perform a pirouette in dance, flawlessly repeat a tongue twister, or play a piano concerto. In math, it might encompass the ability to easily multiply two numbers together or, on more advanced levels, to take a derivative in calculus.

Practice is what builds the well-connected neural networks that underlie procedural fluency. You can draw these previously constructed, well-connected neural networks as “chunks” easily to mind when you need to do something that's difficult.⁷ These well-integrated mental chunks underlie the partly or sometimes entirely nonconscious ways of thinking that allow people to draw mental patterns easily into working memory. A neural chunk is a little like a computer subroutine—you call it to mind when you need it, but you don't really have to think about what it's doing.

Researcher Anders Ericsson has for many decades studied the development of expertise.⁸ **He has found that “deliberate practice”—practice that focuses intensely on the most-difficult-to-master aspects of the material—**is what moves people ahead most quickly when they are trying to learn anything new or trying to get better at a task they already know well.

Let's take the simple task of tying your shoelaces. When you are first learning to do this, you must concentrate intently, using your working memory. Later, the task becomes so easy and natural that you can tie your

shoelaces while, for example, simultaneously telling a complicated joke. All you have to do is think “tie my shoes” and off the subconscious parts of the brain go to do the shoe tying while your working memory focuses on telling the joke. These sorts of practiced chunks can make our lives much easier. If you’ve ever watched a master knitter or crocheter deftly creating an intricate pattern on a sweater while holding a casual conversation, you’ve seen the benefits of chunked expertise.

Cognitive load theory, first developed in the late 1980s and increasingly supported by recent neuroimaging research, posits that if you overload working memory, the brain simply can’t process the information.⁹ As a person gradually develops expertise in any topic or area, neural imaging shows that the areas of the brain associated with working memory seem to calm down, showing reduced activity.¹⁰ Basically, it seems that chunking—those solid, well-connected neural patterns developed through practice and procedural fluency—really does seem to offload thinking processes from the working memory area (centered in the prefrontal cortex) to other parts of the brain. This leaves working memory with a lighter load, giving it space to handle new thoughts and concepts.

Neural chunks developed through procedural fluency may be particularly useful for people who have less capacious working memory. The more you’re able to offload tasks onto subconscious, automatic processing through chunking, the more working memory you leave available for problem solving—or telling jokes.

→ Key Mindshift

Develop Neural Chunks Through Deliberate Practice

Whenever you are trying to learn a difficult new topic or skill, focus on deliberate practice with the toughest parts of the material. Break whatever you are learning into tiny chunks—a little part of a song on the piano, a word or verb conjugation in Spanish, a side kick in Tae Kwon Do, or a homework solution in trigonometry. Practice that chunk of material until you have created a solid “neural chunk”—a pattern that you can easily call to mind and accomplish. Once that chunk is mastered, however, don’t fall into the trap of re practicing it just because it’s easy and feels good—instead, keep the bulk of your focus and practice on what you find most difficult.

Creating Luck

At age eighteen, the end of Adam's "prepping" time at Victoria Junior College, he had to take his A-level examinations, which determined whether he could get into a university. His dream, of course, was the National University of Singapore. Mandarin came back to haunt him—he again failed it on his A-level exams. But, mirabile dictu, Adam did so well in everything else that he received a special probationary entry. His family was astonished. He was elated.

And then the hard work began. In the end, using the techniques he'd learned and taught about how to grasp and retain difficult concepts, he was to graduate with honors with a degree in business administration. It was a far cry from the failing student he'd been a little more than a decade before.

I wondered how much luck played into Adam's success.

Adam told me that he believes there are two kinds of luck.¹¹ There's dumb luck—"what we call 'ass luck' here in Singapore"—and then there's created luck. Adam's thoughts are perhaps rooted in astrological beliefs, which can reign strong in Asia. Some people are believed to have "astrological luck" while others are less fortunate.

Adam recalls, "I once had this employee who had that astrological kind of luck. He won two cars in two lotteries in Singapore. *Cars in two lotteries!* He won the weekly lottery so many times it was off the charts, statistically. You just can't explain it. Anyway, when I was young I went to one of these fortune-tellers for fun. He read my astrological path and said, 'You just don't have the luck.' I don't know if this is a self-fulfilling prophecy, but for some reason all my life, whenever I play a game of chance like poker, blackjack, I never win." Adam shakes his head, nonplussed. "I always lose. I don't know why. Maybe there is a bit to this ass luck thing, but I don't have it and I don't need it."

Adam instead quotes the Roman philosopher Seneca: "Luck is what happens when preparation meets opportunity." In order to be lucky, Adam explains, you must have three things.

First, you must have the opportunity. Adam believes that *opportunities never arise looking like opportunities. They always come disguised as problems.* It takes a certain kind of mind-set to turn problems, which we all

encounter every day, into opportunities. “Lucky” people are those who see opportunities when others see problems.

Adam laughs. “I have so many opportunities because I keep seeing so many problems!”

The second thing is preparation. “Even if you have an opportunity, if you’re not prepared with the right skills and knowledge, you won’t be able to take advantage. Like the Boy Scouts say: ‘Be prepared.’ Constantly make sure that you learn and you upgrade your skills, so that when an opportunity comes along you can take advantage of it.”

The third thing is action. “You suffer from paralysis of analysis if you only think without doing. If you don’t jump in, you never get lucky.”

Adam “jumped in” right after his mandatory army service, teaming up with Patrick Cheo, a whip-smart friend he’d made at the National University of Singapore, to continue his mobile DJ business. Patrick was the operations manager, while Adam served as the DJ and magician. But Adam wanted to find a way to give back to society as well as run a business. One day, he went back to his old alma mater, Victoria Junior College, and told the principal the story of how he’d gone from a failure to success. He asked if he might train Victoria Junior College students in some of his techniques.

The principal agreed, and Adam started doing that. “At first, I didn’t charge any money. I was doing it for fun because I loved it. And after a while I found that not only did I love it, but hey, I could make a career out of this! I began coming up with one-, two-, three-day training programs.”

It was then that he wrote the book *I Am Gifted, So Are You!* “That book started everything,” Adam says. He explains that it could be seen as luck that he had that book published, but what really led to it was having a problem. “The problem was, I was a lousy student who had difficulties learning.”

That problem became an opportunity. He realized that he could show that “if a loser like me can do it, so can you.” Adam was prepared to write a self-help book because not only had he had an opportunity because of the failure he’d overcome—he’d also read many self-help books. He knew the genre. And he was able to go to the third thing: He took action.

At the time, people questioned what credentials he had to write a book. But he just went ahead and wrote it—four hundred pages. He says, “I went

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I Am Gifted, So Are You!

Book by Adam Khoo

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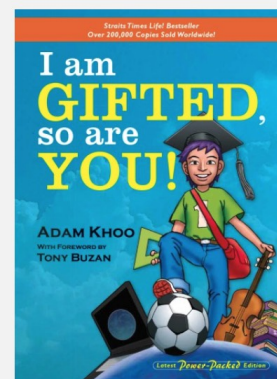
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I am gifted, so are you!

Marshall Cavendish Editions, Updated edition, 2014

Khoo, Adam

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to over a dozen publishers with the manuscript. Simon & Schuster. Prentice Hall. Addison-Wesley. They all rejected me.” He just kept resubmitting.

One day, he got a call from the Singapore office of Oxford University Press. They had him come in for a meeting. The editor found his book interesting—said it had potential—but called his English “commercially unviable.”

Adam laughs: “Essentially, that meant my writing sucked.” The editor told him they’d consider the book if he’d rewrite it—which he did. Next, she edited the content. Adam shaved it to about two hundred pages and kept working at it. His mom helped.

The book was published Adam’s second year at the National University of Singapore. “I was so excited!” But he couldn’t find it in stores. Adam discovered there was no marketing budget—the publisher couldn’t afford to put many resources into a book from an unknown first-time author.

“I thought, *Okay, I’ll handle it.*” He went around to the schools and bookshops in Singapore and did free talks. Doing these free talks forced him to learn public speaking. Six months down the road, his book became one of Singapore’s bestsellers. It was on the bestsellers’ list consecutively for years.

can-do

Adam Khoo’s Suggestions for Career Resiliency

Adam suggests reading books and taking courses and seminars to keep yourself prepared, no matter what twists or turns your career may take. “The only way to ensure your skills don’t become obsolete is to always keep learning,” he notes.

Learn more about your area of expertise, but also learn about things outside your area of expertise. Be open to learning even nonacademic topics, just as Adam learned magic and DJing. These two skills, which are completely unrelated to Adam’s college degree in mathematics, have contributed a lot to his career by teaching him how to effectively engage with audiences.

TL

Bad Traits as Best Traits

One of Adam Khoo’s most admirable characteristics is that he doesn’t try to paper himself over publicly as some misunderstood prodigy who deigns to

✓

climb off his mountaintop to share his genius. If Adam *is* special—and I believe he is—a part of that is his willingness to share the challenges that his sometimes not-ready-for-prime-time brain has forced him to overcome.

Over the next week while I'm in Southeast Asia, Adam and I are scheduled to speak at some of the same events. As we prepare in the greenroom for an audience of two thousand in Jakarta, I nervously ask if he ever gets stage fright. He gently replies that he used to, but he finds focusing on the audience and their needs gets him out of his own head and past feelings of stage fright. Because Adam is open about his shortcomings, I can't resist asking him about his worst traits.

He comes right out and tells me that he's "not very smart"—and has no problem telling people that. They typically think he's saying that for effect, but he means what he says.

"I have to make things simple so that I can understand them," he explains. But this becomes a positive—it turns out that people like Adam's books because he can make things simple.

"What are some other bad traits?"

"I'm stubborn. A regular donkey. Contrarian. And I'm very naive. My wife and Patrick [his good friend and the company CEO] always tell me that I get conned all the time. So when it comes to negotiation they don't let me be there, because I will give away the farm.

"Patrick's the numbers guy. I'm the creative guy. So we are a great fit. He's the polar opposite of me—very details oriented. I'm the big-picture guy—the dreamer. His catchphrase might as well be 'Adam, stop dreaming.'"

"Other bad traits?" I ask.

"~~I'm obsessive—a compulsive worrier.~~" Adam doesn't like worrying all the time, but he senses how useful it is for him—he's afraid that if he reduces his worrying, he may not be as sharp. He tends to think of the worst possible thing that can happen, then he prepares compulsively until he feels a confidence arising that he's prepared enough.

"The bad thing about being obsessive," I venture, "is that when something goes wrong, it's hard to stop obsessing about it. That leads to a negative mind-set."

Adam nods. "That used to happen to me." Again, he learned mind tricks—how to reframe and put the issue behind him. He's learned tricks to shift

—to know when to stay obsessed and then when to disassociate.

Adam has a wealth of other creative mental tricks to keep him, and his students, on task. For example, he tells his students that motivation is like bathing—it doesn't last.

“You can't wash once and be clean for the rest of your life,” he says. “Because no matter how much you bathe, you get dirty and smelly and you've got to bathe again. Likewise, no matter how motivated you are, the world can be a negative place. Things don't go your way. You get criticized. You get ‘dirty’ again. So you have to learn how to motivate yourself every day, just like washing.”

In true tough-love fashion, when Adam runs programs for the kids, he tells them, “I'm not here to bathe you; I'm here to give you the soap, the brushes. You learn how to bathe yourself.”

One of Adam's most powerful tricks is reframing. He makes a practice of seeing problems as opportunities—seeing how to transform a liability into an asset. He loved Steve Jobs' reframing of his firing from Apple. As Jobs put it: “Getting fired from Apple was the best thing that could have ever happened to me. The heaviness of being successful was replaced by the lightness of being a beginner again.”¹²

Adam also chooses to believe that everything happens for a reason. No matter how bad things might seem, there is something he can learn from it. Remembering this keeps him motivated through setbacks.

For example, when publishers rejected him over and over again, he would tell himself, “This means I must rewrite the book in the way that makes it even more powerful and compelling. When it finally becomes a bestseller, I will have a great story to tell.” He did something similar when he was posted to a lower-ranked school, telling himself it was a blessing because he could more easily get to the top there.

Adam says: “I keep playing these crazy movies in my head like I did in the past. I'd see myself on stage performing magic or inspiring people. Constantly playing that movie creates the compelling drive to want to go do that.”

Though Adam makes his way through a good bit of his personal and business life using his imagination, he is a constructive fantasist. He's learned to keep playing his goals in his head to make them as vividly real as

he can. He feels it's important to review not just what you want to do, but *why you want to do it* every day. And he does that—reminding himself that he wants to be successful so he can help people. Of course along the way, 70 percent doesn't go according to plan, which can be frustrating. To keep himself motivated, he watches inspiring videos on YouTube of people who have overcome great challenges, and he loves reading biographies. “I often see my problems are trivial by comparison.”

Nothing works for everyone. But Adam's continuing search for new ways to not only learn what he's actively studying—hedge funds, for example—but to reframe adversity in a positive way forms part of his intellectual strength.

The Power of Mental Tricks

Again, the intuitions that underlie Adam Khoo's thinking and approach are backed by solid neuroscience. A recent neuroimaging meta-analysis analyzed what is termed “cognitive reappraisal of emotion”—that is, reframing.¹³ The study revealed that finding positive ways to think about a negative occurrence extinguishes negative emotions arising from the fight-or-flight center of the amygdala. For example, an alarming picture of someone bleeding can be cognitively reframed as “that's just a movie, and they're using ketchup.” Or negative feelings about an illness can be reframed into something more positive by focusing on how that person will get better. Reframing is such a powerful approach that it lies at the heart of the cognitive behavioral therapies used to treat depression, anxiety, and other psychological challenges. We'll go deeper into reframing—that is, understanding the context with which we view the world and everything in it—in the next chapter. (Caution, snakes!)

Three years ago I had difficulties finding freelance IT assignments. I realized this was actually a positive. It meant it was time to upgrade my skills—to both broaden and deepen what I know. Today, I'm over fifty and have no issues finding work—contrary to most people my age.

—Ronny De Winter,
freelance software engineer, Belgium

One might think that, in some cases, such reframing would simply be unworkable mental trickery. After all, what if we're talking about real life, and a person you are close to has a terminal illness and they're *not* going to get better? In that case, you may want a different way of reframing, perhaps by focusing on the *quality* of life rather than the absolute *quantity*. (Hospice workers are masters of this type of reframing.) It seems consciously finding a way to *change the meaning* of what is experienced reduces the flood of stress-related neurotransmitters released by the hypervigilant amygdala. This provides a pathway for the mind to uncover deeper truths, even if it's through what appears to be mental sleight of hand.

★ Now You Try!

Making Your Luck

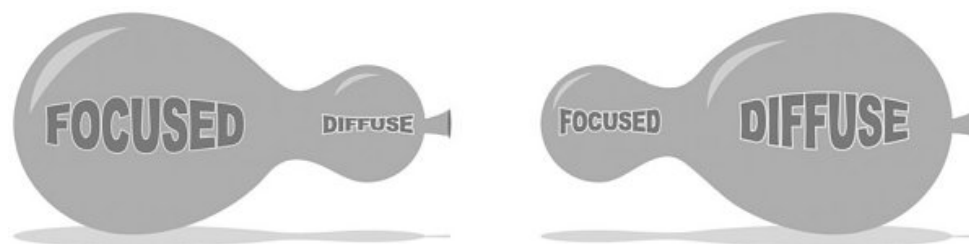
"Lucky" people are those who learn to see opportunities when others see problems. Adam Khoo has achieved a great deal by cultivating an "everything happens so I can learn something from it" type of attitude to reframe adversity.

Bring to mind a major challenge in your life that you can reframe as an opportunity. Under the title "Becoming Lucky," jot down what concrete steps you could take that might allow you to take advantage, either now or in the future, of the opportunity and others like it. On a paper, or better yet, on the back pages of a daily journal that you keep to record your progress and feelings, start making a list of mental tricks you can use to reframe various challenges.

Creativity

In Chapter 3, marketing expert Ali Naqvi alluded to the brain's two fundamentally different operating modes: "focused" and "diffuse." Research has shown that the "focused" mode pops into gear as soon as you turn your attention onto something. The "diffuse" mode, on the other hand, pops up when you're not thinking about anything in particular—like when you're standing in the shower, looking out the window of a bus, or going

for a run. We can't generally be in both modes at the same time—our brain puts its energy into either one mode or the other.¹⁴



The balloon on the left represents your brain in focused mode—most of the energy is poured into your intense focus. The balloon on the right shows your brain in diffuse mode—most of your energy is poured into the other, more relaxed, diffuse networks.

The diffuse mode is actually a set of neural “resting states,” that is, more wide-ranging patterns that our mind falls into when we’re not focusing tightly on a task.¹⁵ Creative new ideas seem to emerge from these broader diffuse states.¹⁶ We can slip into the diffuse mode for minutes or even hours at a time when we’re daydreaming. But the diffuse mode can also pop up momentarily—even blinking appears to activate it.¹⁷ (Clever martial arts experts look for when their opponent blinks—that micromoment’s change of awareness is a good time to launch an unexpected move.)¹⁸

Researchers are beginning to understand that learning seems to involve two steps. First, you focus your attention, activating your “task positive” networks—you’re conscious of this part of the learning process. Then, you take your focus *off* what you’re trying to learn by going into diffuse mode. You’re not really conscious of this second learning step—in fact, it might seem like you’re doing nothing. But this second step is what allows the brain to creatively consolidate what you’re learning.¹⁹ Metaphorically speaking, it’s as if your brain first focuses to pick up the material in front of you, then as soon as you relax and let your mind wander *off* the material, the brain is freed up to tuck the material away. This is why that little break after your mental workout with a Pomodoro session is so important—it starts giving your brain a chance to consolidate the material you’ve learned.

It’s easy to imagine that educational systems that constantly rely on focused attention could inadvertently inhibit development of diffuse networks.²⁰ Your brain needs breaks.²¹ The effects of too much focusing

time might be even further magnified when society promotes relaxation mechanisms, such as certain forms of meditation, that also encourage focus.

In fact, meditation can have surprisingly different effects depending on the type. The vast majority of meditation techniques center on the development of *focused attention*.²² In contrast, *open monitoring* types of meditation, such as Vipassana and mindfulness, appear to improve diffuse, imaginative thinking. There is a lot of variety in how open monitoring meditation techniques are taught, however, and focused concentration may play a role, or at least a prelude, to mastery of the form.

In the end, practices that encourage focusing can be a boon for learning. But having some daily time when your mind is encouraged to relax and wander freely is also important, particularly if you want to encourage creativity. From a practical standpoint, then, if you are a meditator, you might try to avoid feeling you should *always* be steering your thoughts back into focus if you catch your mind wandering outside meditation sessions.

This might be why people also find the Pomodoro technique so useful in promoting creative productivity. It trains your ability to focus, but the reward when you're done is that you get to let your mind wander onto whatever it feels like. With this technique, it's as if you first complete a focused workout in your mental gym, after which you head to the mental spa—overall an enjoyable experience.

Back now to Adam. It's interesting to note Adam's care in reframing. His occasional obsessive worry involves mind wandering about bad things that could happen—as neurolinguist Julie Sedivy has noted, mind wandering has “a possible connection to neuroticism.”²³ Still, Adam doesn't try to completely eliminate mind wandering—at least, not until after his mind wandering has done its duty in preparing him. He simply waits for the right moment to reframe his thinking.

Working Memory and Mind Wandering

Working memory basically amounts to how much information you can hold temporarily in mind—like the five names of people in a group you've been

introduced to. (Wait, was the first one Jack?) Working memory, as it turns out, has a counterintuitive relationship with both intelligence and creativity.

Intelligence is often equated to the strength of your working memory.²⁴

People with steel-trap minds—strong working memories—often have the enviable ability to hold many aspects of a problem in their head at once. This leads to easier problem solving. A person with a limited working memory, on the other hand, must find a way to simplify complex topics to work with them. The process of finding ways to simplify can be tedious and time-consuming. But surprisingly, research has shown there's a hidden benefit—people with less capable working memories are *more likely* to see shortcuts and have conceptual breakthroughs. It seems the “smarter” person with large and retentive working memory sometimes has less incentive to see the material in newer, simpler ways.²⁵

There's another drawback to having a steel-trap mind. If *you* can understand something by easily holding ten steps in mind at once, your tendency is to explain it to others in ten-step fashion—even if people have become lost after step three. Steel-trap brilliance, in other words, can make it harder to teach others, especially if your steel-trap mind is coupled with a “doesn't suffer fools gladly” mentality. In Adam's case, he's got a teaching advantage. As he notes, once he comes to the point where *he* understands something, he can generally explain it so *anybody* can understand it. There are other advantages to having a limited working memory. The ideas you want so badly to hold in mind may float away despite your best efforts—to be replaced randomly by other ideas, thoughts, and sensations. This may sound less than ideal, but this is also what underpins creativity.²⁶ Poor working memory, incidentally, is often correlated with attention deficit disorder, so if this condition is making school tougher for you, it's important to realize it also gives you advantages.²⁷

You may argue that a strong working memory not only helps with problem solving—it helps as well with getting good grades. But research has shown that there is a countercorrelation between school grades and creativity.²⁸ The better your grades, in other words, sometimes means the worse your creativity. There is also a correlation between disagreeableness and creativity.²⁹ It may simply be that disagreeable people are more willing to be brats—to throw aside the compliant, deferential demeanor of their

more agreeable peers. Looking back at Adam's wild streak as a youngster, it's possible that it was just a manifestation of his creativity.

Incidentally, enhancing your working memory can be tough. Exercises to build working memory may strengthen your ability to do that particular task, but they often don't seem to build the overall capacity of working memory itself.³⁰ Only one set of programs, those by BrainHQ, seems to reliably increase working memory.³¹ This program won't turn you into a genius, but it does appear to mildly improve memory, processing speed, and general cognition, in some sense stopping or reversing the mental clock as you age. We'll discuss BrainHQ further in Chapter 8.

Whether the effect is small or large, there appears to be a surprising side benefit from such exercises: They seem to improve mood—decreasing feelings of anger, depression, and fatigue.³² Rather than dampening the sometimes crabby amygdala, these exercises reduce activity in the anger-modulating apparatus of the insula. This is a part of the brain that allows us to experience not only pain, but a number of the basic emotions, including anger, fear, disgust, and happiness. Working memory-related practice may give us stronger mental “muscles” for cognitively managing emotional stimuli. Since learning frequently entails exercises like those used to enhance working memory, this may help explain why adopting a learning lifestyle can just plain make us feel better.

→ Key Mindshift

The Hidden Good Side of a Poor Working Memory

When you might be struggling to hold something difficult in mind as you are trying to understand it, remind yourself that your struggles may well arise in tandem with your creativity. You wouldn't want to trade your creative streak, even if it does mean that sometimes you need to work a little harder!

Adam Khoo's Helpful “Bad” Characteristics

Before Adam's mindshift at age thirteen, he had plenty of time to play at whatever he wanted because he didn't care about his grades. Later, however, after attending the educational boot camp, he didn't just devote

himself to conventional schooling—he also kept up his DJing, magic, and coaching activities. So Adam was always learning and growing—just not necessarily through a conventional academic lens of focused, intense study.

We tend to emphasize obvious positives such as a good memory and an ability to focus as being the most important elements for learning. But sometimes our negative characteristics can also be surprisingly worthwhile. Here's a recap of Adam's "worst," yet most helpful characteristics in learning:

- 
- **He's not very intelligent.** Like many "less intelligent" individuals, Adam seems to have a poor working memory. But his poor working memory forces Adam to simplify concepts and to focus on the central aspects of any situation. It can take him longer to figure things out, but in the end, he understands clearly, deeply, and simply. His poor working memory forces him to discover simpler ways to grasp concepts, ways that are often missed by the seemingly more intelligent. Adam's comfort and familiarity with workarounds have also opened him up to searching for other mental techniques to allow him to grapple successfully with learning—and life.
 - **He's a worrier.** Adam has learned to take advantage of his anxiety, using it as a reminder to prepare carefully. Once he is sufficiently prepared, he lets go by reframing his thoughts to calm his amygdala, which allows his anxiety to subside. This approach is akin to applying the serenity prayer—Adam has learned to change the things he can and accept the things he can't.
 - **He's a contrarian.** Adam's stubborn nature means that negative comments strengthen, rather than weaken, his resolve to achieve the goals he sets for himself.
 - **He's a naive dreamer.** "Dreaming big" has supported Adam in founding his own successful businesses. Adam partners with and listens to practical people to ensure he grounds his dreams in reality.

★ Now You Try!

Revisiting Mind Tricks for Success

At the beginning of this chapter, you anticipated some of the mind tricks for success that we would explore. Revisit your thoughts now and add any mind tricks that you might have also learned about in this chapter. Your final list will form a useful reference tool for you in the future.

What Adam Teaches Us

There may well be a reason I feel so comfortable around Adam and his group. Creative people sometimes say that one of the best ways to be creative yourself is to be around creative people. Adam and Patrick are themselves highly creative and they seek highly creative, can-do people for their team. Time and time again, I discover that one of their team members did not do well on standardized tests when they were in school, but they are, say, a world-class computer gamer, or a novelist, or a magician.

It's possible that the high bar set by the stringent Singaporean system of educational testing—similar to testing systems in many Asian countries—has systematically served to select for and reward students with strong working memories. *But the more creative types often have poorer working memories.* In other words, Singapore's educational system doesn't necessarily instill a lack of creativity. It instead may actively select *against* creativity, regularly penalizing creative people for the seemingly less efficient way their brains work. And it doesn't just leave the creative types behind—it leaves them with feelings of hopelessness and inferiority.

What Adam and his group have done is show that certain mental tricks can allow unconventional minds to compete more effectively. This, in turn, levels the educational playing field and allows different ways of thinking to flourish—ways that not only support learning, but that also help improve creativity.

Educational workshops such as those promoted by Adam Khoo are sometimes thought to simply be heightening the education arms race. But there's another way to see Adam's work. He's busy democratizing education: bringing a set of mental skills to great swaths of students—often more creative types, who are frequently washed out of the educational

system and discouraged by well-meaning teachers, friends, and family who don't understand that conventional learning tools don't work well for these students. Adam's old identity as an education system reject who found acceptance with outcasts—coupled with his very real leadership abilities and desire to stand out—could have taken him down a dark path. Instead, he forged a positive way forward that allows others to follow in his wake.

Of course, school success is not the be-all and end-all for every student—nor should it be. However, academic success, not to mention general success in life, shouldn't be a zero-sum game with prescribed winners and losers. All of society benefits when a large percentage of the population is both well educated *and* creative. This is still the case when “well educated” just means graduating from secondary school with a decent ability in reading, writing, and working with figures, and being “creative” simply means being able to flexibly envision new approaches.³³

Adam Khoo was lucky. He came from a pragmatic but loving family with the resources and will to keep trying until they found an approach that clicked. And Adam himself had just the right combination of stubborn, neurotic, naive, optimistic, and creative characteristics to seize the initiative and sally forth—once he grasped the nuances of a new mind-set.

No teaching method comes with a 100 percent guarantee of success. But there are hundreds of millions of students with inattentive minds around the world who don't come from well-to-do families, and who, for various reasons, are unable to peel off the label of academic loser. These students often wash out of educational systems, with their creative abilities untapped. They can be left feeling both hopeless and worthless.

Perhaps it's time for educational systems worldwide to co-opt Adam Khoo's thinking and methods. Both conventional and unconventional students can learn new techniques to become successful learners and to live happy, fruitful lives.

In the meantime, we can all use Adam's insights to our advantage.

★ Now You Try!

Considering What Underpins Your Mindshift

Early on, if your parents were upward striving, they might have encouraged you to follow time-honored paths toward success, such as becoming a medical doctor. Such parental pushes are understandable. Healing sick people, for example, is a darned handy skill, it pays well, and people respect you—not to mention that your career success reflects nicely back on your parents. Some cultures around the world place special value on traditionally successful careers, which means some children can feel stronger pressure to fulfill parental dreams.

But of course, not everyone can be, or wants to be, a doctor.

Your friends have a different set of needs—they often want to see you smiling *right now*, reality be damned. If you want to be a movie star or champion basketball player, your friends will often be right there for you, pushing you forward no matter how unrealistic your dreams might be. This can be why we sometimes see a shocked singer on talent shows who finds herself ridiculed when she finally faces the public instead of her friends. But it's also important to realize that friends aren't always necessarily supportive. Because they see you as part of their world, they can subtly undercut any efforts you might make that would take you out of their circle. And if you are successful, jealousy can sometimes rear its head.

Teachers and professors can provide useful insight on careers, but like parents and friends, they, too, can have their vested interests. A bioengineering professor, for example, may encourage you to become a student in his department (which keeps his department alive) by praising bioengineering as the fastest growing field in engineering. He may not mention that the reason the field is growing so fast is that it started from a tiny base, and that there aren't a lot of jobs for bioengineers.

If you are married, you will have spousal considerations. If you have or desire children, there are other factors in play.

You might think career testing would give direction in your mindshift, but such testing often provides mechanistic feedback about what your strengths and passions are *now*, with little consideration about how you can change.

And speaking of passions, we're often encouraged to follow them. But a world of passion could be an unhappy place—who would build cars or houses, or stock grocery stores, if everyone simply followed their passion?

It's worth noting that mindshift successes can result from a blend of a person's own "pie in the sky" desires with the constraints of the real world. Scientist Santiago Ramón y Cajal, for example, reluctantly became a doctor instead of an artist because of his father's adamant insistence. But in the end, as a doctor, Ramón y Cajal won the Nobel Prize in part because he brought his artist's insight into his work.

In the face of all these conflicting considerations, what do *you* believe? Under the title "Attitudes and Influences on My Mindshift," take the time to reflect and write on the following questions:

- Do you feel that people have a "true potential" that others should support no matter what?
- Should others' considerations be taken into account when you are planning a significant mindshift? If so, how strongly?
- Should the reality of the working world be a factor in your mindshift? If so, how strongly?

- Do you have a weakness you can change into a strength? How can you accomplish this?

Chapter 8

Avoiding Career Ruts and Dead Ends

TERRENCE SEJNOWSKI HAS a broad forehead, a craggy smile, and a quick way with a quip. His lean, athletic build masks the fact he's in his late sixties.¹ You wouldn't recognize him walking the palm tree-lined streets or jogging on the beach near La Jolla, California. Little known even to his neighbors is the fact that Terry Sejnowski is one of the handful of people who are simultaneously members of all three of the top national scientific, medical, and engineering academies of the United States. In the rarefied world of neuroscience, he's something of a legend.

But back in the psychedelic 1960s, when Terry was in his twenties, he was just another student—an admittedly good student, of course, as well as a smart guy. Unfortunately, he was not smart enough to recognize that sitting in on some biology lectures would lose him his girlfriend.

Terry grew up in Cleveland, Ohio, already a science nerd in elementary school. By high school, he was running the radio club. The adviser, Mike Stimac, inspired his students to think big with projects like Moonbounce, which used a commercial radio transmitter and an array of antennas perched on top of the high school to send signals to the moon and back. Stimac, a pivotal mentor in Terry's life, advised the aviation club as well, where Terry learned to fly.

Looking back, Terry notes, “Being a good student and being smart aren't necessarily what's important to be successful. It was at the radio club where I learned how to build things, to have goals, how to plan long-term projects.

As the president of the club, I learned how to manage people and work with them toward a goal. It was not formal academics that formed my future career. It was really how to take the knowledge that you've learned and turn it into a new direction.”²

After earning his bachelor's degree in physics in 1968 from Case Western Reserve University, Terry received a National Science Foundation fellowship and went to Princeton University to study theoretical physics. John Wheeler, the legendary Manhattan Project physicist who coined the term “black hole” and shepherded studies of general relativity, took Terry under his wing as his master's student.

Wheeler was another exceptional mentor, who also encouraged Terry to think expansively. One day, Terry wondered, “What would happen if we have a black hole that's pea-sized?” Wheeler's response? “Terry, that's a crazy idea. But it's just not quite crazy *enough*.” No, wedging an object the size of a solar system into a quarter teaspoon just wasn't weird enough for Wheeler.



Terry Sejnowski reading Vladimir Nabokov's Ada as a physics grad student at Princeton, roughly 1976. Note the then-typically Princetonian tie and slacks—this would eventually get Terry into trouble.

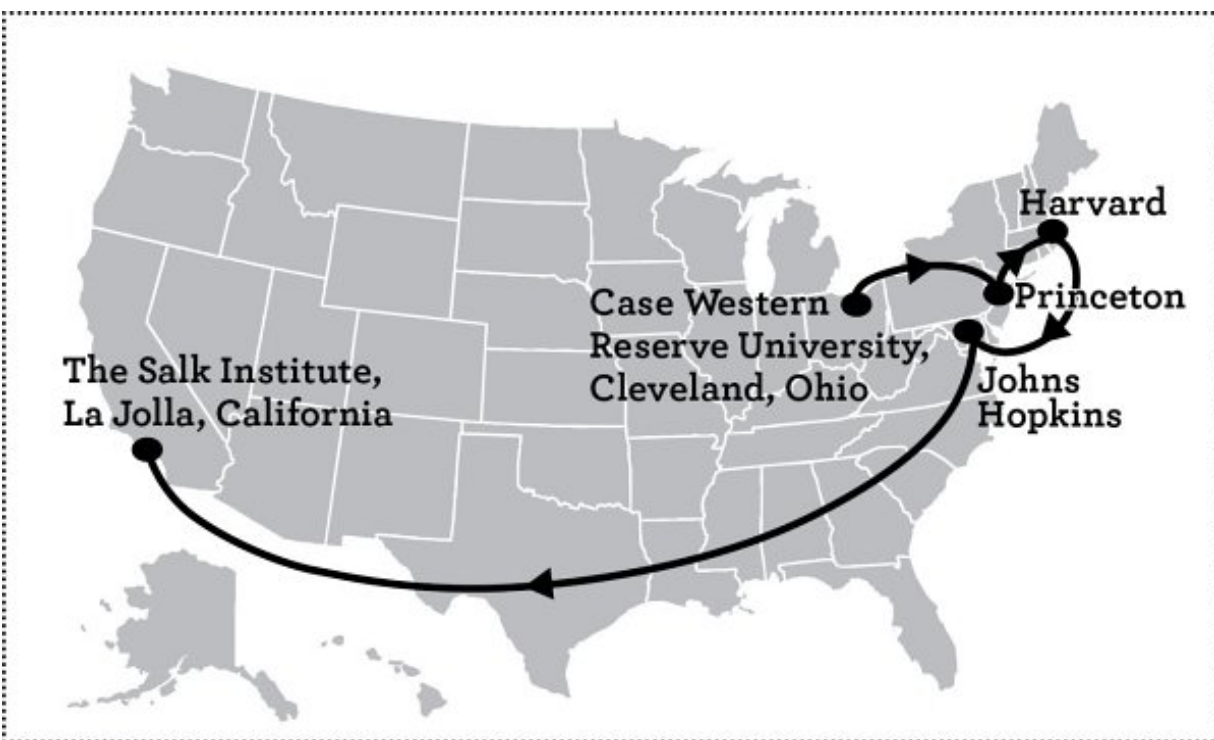
Getting Around the Barrier of Intelligence

Terry wasn't just focused on physics—he was a people watcher as well. Studying at Princeton, he saw clearly that there were a *lot* of smart people in the world. Intelligence was necessary for his line of work, but he began to realize that it wasn't enough. “Intelligence can, in fact, be a liability,” Terry observes. “With intelligence, you see the options, but you also see the barriers. This means that the smarter you are, the easier it can be to talk yourself out of things.” One idea he'd wanted to investigate not long after arriving at Princeton—what would a giant black hole look like at the center of a galaxy?—was shot down by some of the professors around him. The topic was later published by someone else—with fanfare. “Persistence is also key,” Terry adds.

Terry's time with Wheeler gave ever-deepening insights into physics' most complex challenges. But Wheeler taught him something else: "Terry, everybody makes mistakes. But when you do make a mistake, don't persist in it. Get off that road and get past it as quickly as you can."

The advice would resonate in big ways.

Terry was already immersed in physics, but the subject would eventually occupy virtually every aspect of his consciousness. At the time, Princeton had a process in which, in one week of grueling general exams, graduate students demonstrated all the physics they'd learned from classical mechanics, quantum physics, electricity and magnetism, thermodynamics, statistical mechanics, condensed matter physics, and particle physics all the way through general relativity.



Terry's studies and work would take him to some of the leading research institutions in the United States. Today, conferences and collaborations with fellow researchers bring him around the world.

These kinds of qualifying exams are common in doctoral programs all around the world. What is uncommon is that the world-class Princeton physics professors, happily engaged with their super-smart students, began to create exams that were more and more challenging each year.³ Each professor devised questions that delved ever more deeply into the most

thought-provoking intricacies of their specific areas. When the questions were all put into one big qualifying exam, that exam started to become not just demanding, but off-the-scale, next-to-impossible difficult. Great students began washing out of Princeton's physics program.

Finally, someone had the bright idea to give the full exam to the physics professors themselves. Some very smart people flunked it. The questions were scaled back.

But before then, Terry took the incredibly difficult test. He aced it.

Stepping Back to Look at a Career Big Picture

Terry's master's degree focused on general relativity. String theory, he found, was becoming the only game in town for theoretical particle physicists, and it was becoming more and more esoteric. Experimental studies needed big explosions in space or massive accelerators to make even the tiniest advance. Accelerators were needing ever more energy. At some point, physicists were beginning to realize, it would take the annual budget of the United States to build a big enough particle accelerator to make real progress. Meanwhile, cosmology had similar issues—it needed wildly expensive satellites and giant interferometers.

These issues were initially storm clouds on the horizon—isolated from the day-to-day toil of pulling physical ideas, like taffy, from the math. Terry enjoyed the intense rush of discovery—the *click* feeling as new findings and theories sprang to life in his mind, sometimes making fresh connections even the original theorists hadn't seen.

But once past the doctoral exams, Terry wasn't all work. He was a gregarious guy—had fun with friends, went to movies and out to dinner. He also had a charismatic girlfriend who was smart, vivacious, and beautiful. The reality was that Terry was the perfect catch for any family with intellectual aspirations. It was hard to be more academically serious than to be a student of relativity at Princeton, mentored by one of the greatest advisers in the world. Career-wise, Terry was set to soar.

But then the storm clouds came in closer, making Terry question his commitment to physics. What kind of impact could he make in foundational research on relativity when throughout his career, he would be hearing, "We

just can't afford to build the device you need"? He'd invested so much into his first love, physics, that it was hard to imagine shifting paths. But he just couldn't find a way to push away the thought: *Should I be looking elsewhere for my career?* Was there a place where he wouldn't always be battling the constraints of enormous costs? It felt almost sinful to ponder that in the bastion of the physics group at Princeton, where advancing knowledge of relativity was a sort of research Holy Grail.

Despite—or perhaps because of—his passion for physics, Terry was interested in everything. He had friends in biology, so he decided to take a course from noted neurobiologist Mark Konishi on neuroethology.⁴ This is a way of applying ideas from physics to the study of natural behavior, such as how owls use sound to work out where their prey is and how baby birds learn to differentiate their own species' song from the hundreds of other songs they hear.

Intriguing ideas in biology started coming to Terry from different angles. A lecture by visiting professor Chuck Stevens, from Yale, revealed that synapses, the connectors that allow neurons to talk with one another, are unreliable. "How," Terry wondered, "could the brain compute with such unreliable parts?"⁵ He went to a meeting of the Society for Neuroscience and was surprised at the size and enthusiasm of the crowd.

There were, Terry had begun to realize, two very different universes. There was life *outside* the brain—which included the billions-of-light-years-broad universe as well as the femto-level tininess within atoms. This splendid collection of macro and micro was all within the realm of physics.

But there was also the universe *inside* the brain: the unknown, seemingly mystical home of our thoughts and feelings and of consciousness itself. People had just started using a new term for studying these subjects: "neuroscience." However, neuroscience, at least in the late 1970s, didn't have the gravitas of relativity studies—instead, it was still a toddler in the firmament of science. Careers in neuroscience didn't even seem possible. Biology itself seemed a poor relation to the vaunted study of physics.

Meanwhile, Terry's girlfriend's parents were aghast. Here Terry was, a top physics student, slumming around with an interest in *biology*? As far as they were concerned, Terry was an academic playboy—not serious about establishing a world-class career.

After a few tense weeks, his girlfriend broke up with him.

It was an emotional gut punch, but the experience made Terry take a second look at the world and his place in it. He began hanging out at the labs of Charles Gross and Alan Gelperin, two professors of neurobiology at Princeton. Instead of working with John Wheeler in relativity, Terry would ultimately have a doctoral adviser who had himself transitioned from physics to neuroscience: the dazzling scholar John Hopfield. Hopfield had done groundbreaking work in the late 1950s with polaritons, a sort of “almost” particle where electrons couple with surrounding solids. Among other breakthroughs, Hopfield eventually developed the famed “Hopfield net,” which has led to a better understanding of the neurocircuitry that underlies memory. Terry’s transition from relativity to neuroscience happened over several years. During this time he led a double life, going to biology classes during the day and writing his physics thesis at night. Encouragement from John Hopfield made all the difference. Terry went on to publish a series of papers on models of neural networks that were inspired by the groundbreaking, ultimately Nobel Prize–winning work of David Hubel and Torsten Wiesel on the visual cortex. Terry’s own papers became his doctoral thesis: “A Stochastic Model of Nonlinearly Interacting Neurons.”

Watch Out for Ruts

In science, researchers frequently spend years mastering a technique that allows them to grapple with a particular set of problems. The technique might center on, say, a type of imaging or a way of statistically analyzing data. An entire career frequently emerges from variations on this technique.

“The process of variations on the same theme is not unique to science,” Terry observes. “You get a skill. You use that skill over and over again. But after a while, you get stuck in a rut. You’re bored. Or the field changes and you begin to realize you need new skills. However, you may not have gotten the skills early that you need for a new direction you’d like to pursue. In science, it’s especially difficult in that, after a decade of effort, you may have a PhD in one narrow field. But you’re still an amateur in other fields.”

Terry's doctoral adviser, John Hopfield, had shown firsthand that it was possible to make a career transition between physics and biology that could pay off. And Terry was convinced that there were ways to apply the mathematical modeling tools of physics to better understand biology and, particularly, neurons. But he also knew that he still didn't have the in-depth biology he needed to be an expert in neuroscience. As his mentor Alan Gelperin would later say, Terry needed to get "neurons under his fingernails."

But then, even if Terry was able to get the background he needed in neuroscience, how could he break into the field? Despite growing interest in the field from researchers, there weren't many established neuroscience departments around the country. Finding a job could be tough.

Networking to Find the Right Place

Harvard was pretty much *the* place to be if you wanted to be on the inside of research in neurobiology. However, Terry was doing his doctorate in physics at Princeton, hundreds of miles away. He was in the wrong place and the wrong field, even if he was quietly twisting the edges of acceptable physics research with his interests in neurons.

As it happened, in the summer of 1978, there was a course on neurobiology at Woods Hole, a research center on a corner of Cape Cod. Terry signed up. He had heard rumors that Woods Hole was a casual place, so he showed up with standard Princeton attire—a white shirt and suit coat. To meet the "casual" standards, he left off his tie.

This immediately made Terry the butt of a series of good-natured jokes from both fellow attendees and summer school faculty. Neurobiologist Story Landis, the woman who would go on to become the director of the National Institute of Neurological Disorders and Stroke at the National Institutes of Health, bought Terry his first pair of jeans. But Landis did more for Terry than simply expand his wardrobe. With her help, and that of others at the summer course, Terry began his magical summer of 1978, throwing himself headfirst into a new discipline.

The course was difficult—Terry had never worked so hard in his life. At the same time, it was thrilling—the group was taught by some of the best

neuroscientists in the world. The class ran from June through August. In September, however, Terry was still in Woods Hole, finishing a project on skate electroreceptors that would eventually lead to his first paper in biology.

One day, while he was sitting in the lab at Woods Hole, the phone rang and Terry picked it up. It was Harvard neurobiologist Steve Kuffler. Would Terry like to come to Harvard to do his postdoc studies with Kuffler? It was like getting a call from Saint Peter himself—Kuffler was often referred to as the “father of modern neurobiology.” In fact, Kuffler would have been a shoe-in for the Nobel Prize, save for his unfortunate later career move of dying too early. (Nobel Prizes are given only to the living.)

Kuffler’s call was a sign—Terry was moving up to the big leagues. But it wasn’t quite as easy as all that. There was some rapid shuffling as Terry wrapped up his doctoral dissertation. Then, off he went to join Kuffler at Harvard.

★ Now You Try!

Competence Is Key

Terry went to Harvard because he was in an extremely specialized discipline, and that was the best place to gain the expertise he needed for the research he wanted to do. *Knowing your subject matter is key.* For a restaurateur, for example, knowing your subject matter doesn’t mean going to Harvard. It means understanding every aspect of restaurant operation because you’ve done it yourself, from busboy to manager.

Think about an area you’re already expert in, or that you *want* to become expert in. Under the title “Competence Is Key,” jot down some key ideas about what you have done in the past, or what you need to do in the future, to truly master the subject matter that holds your future.

↪ The Value of Selective Ignorance

Terry’s strong technical background created a surprising disadvantage for him. He knew he could easily be made into a technician rather than a real

Handwritten red notes: "tune out" and a diagram showing a horizontal line with two curved lines below it, and the letters "I I I E" to the right.

biologist. (*Hey, this new guy Terry seems to know his way around a computer— let's get him to write programs.*) Because of this, Terry vowed not to touch computers for the three years of his postdoctoral studies.

Instead, he did nothing but live and breathe neurobiology.

Terry's painstaking focus on the core of his new discipline paid off. Even if he wasn't the top postdoc emerging from Harvard in the field of neuroscience, he was still outstanding, like everyone else from the program. But Terry was different from the other students. Hidden beneath his new array of neuroscientific tools was a comprehensive knowledge of physics, with its rich ways of modeling the world. **Even Terry didn't yet realize the full power of his mental arsenal.**

Harvard prepared its postdocs to know how to speak, not only to experts, but also to others who don't have a background in the field. At Harvard, Terry learned how to build intriguing story hooks for everyone from beginners to experts.

This relates to how I first met Terry, when I gave a presentation on my scientific research—with a few embedded story hooks—for the National Academy of Sciences. The event took place as part of the Sackler Colloquia at the Beckman Center in Irvine, California, where I felt like a cub in a lion's pride of world-class researchers. Terry was serving as moderator, and he put me instantly at ease. We became friends over shared wonderment about how people learn and change.

I told a former boss I wanted to learn how to do everything at the company. Her response? "Don't do that. You need to cultivate 'selective ignorance,' because if you know how to do everything then you become everyone's bitch." Turned out to be good advice. Cultivating "selective ignorance" has often prevented me from getting drafted into projects I had no interest in participating in or time for.

—Brian Brookshire,
online marketing specialist at Brookshire Enterprises

→ **Key Mindshift**

Selective Ignorance

You only have so much cognitive energy. Be selective about what you choose to become expert in—you don't want to be typecast as an expert in areas you do not want to spend time on.

Keeping an Open Mind

A year and a half after my National Academy of Sciences presentation, my hubby and I spent a sunny July day at the glide port by the Salk Institute near San Diego with Terry and his brilliant, medical doctor-researcher wife, Beatrice Golomb. (I ended up peeling like a boiled tomato.) Terry reflected on creativity and career change as we watched hang gliders and paragliders soaring from the cliff's edge out into the skies above the ocean nearly four hundred feet below.

“There is a disadvantage to being well integrated into your discipline,” Terry observed. “Different disciplines have different cultures. The more comfortable you are with one culture, the tougher it can be to shift to another.”

Neuroscience, with its exciting potential for breakthroughs, has become a target for many as they've changed careers—Terry has had a front-row seat in watching people transform themselves. “Career shifting can be like starting a new relationship,” he notes. “It's a process that can take years—but it's exciting and rejuvenating. For example, even if you stay only in the field of medicine, rejuvenation can come through moving from one specialty to another.”

The rejuvenation can also lead to career-enhancing breakthroughs. After all, new insights often come the first time you're learning something new. Once you've absorbed the material, it closes your mind off to looking at the material in fresh ways. “It's *not* your chronological age,” Terry continues. “It's how many years you're in your field.” But being on the forefront of scientific research isn't easy. As Terry says, “You can always tell the pioneers by the arrows in their backs.”

Of course, part of grasping new insights is also being open to what the facts actually tell you—instead of what you *want* the facts to tell you or what everyone agrees the facts say. Beatrice was the first researcher to publish findings revealing that cholesterol-lowering statins, which

sometimes prolong life, can also pose problems such as muscle pain and memory issues.⁶ But getting those facts into publication wasn't easy for her —journal reviewers felt uncomfortable approving findings that ran counter to the expectation that statins were a largely unalloyed good.

The Importance of Humility

Terry has reflected deeply over the years on the fields he has been associated with. Physics, Terry has observed, ~~is a field imbued with hubris~~ —the academic equivalent of Wall Street “Masters of the Universe.” (Even so, I have to admit, one of the reasons I like Terry is for his lack of hubris. Like many highly intelligent people, he leaps to conclusions that are sometimes wrong. But unlike many, he is quick to correct himself and change course once he's detected his error. Also he's one of those rare people who isn't wedded to an idea just because he thought of it. In this way, he's surprisingly different from many academics.)

Physicists have a tendency to believe that physics is the most difficult subject to master and that physicists are the smartest researchers. The reality, of course, is that physics is a field that does have a lot of intelligent people. ~~And this makes it all the more interesting to observe their more spectacular goof-ups.~~

One distinguished theoretical particle physicist at Caltech who Terry knew decided to go into neuroscience. Despite his lack of knowledge about the field, this top-flight researcher built a lab, hired a talented postdoc, and began ordering him around. It all blew up—the lab fell into disarray and was dismantled. The reason? You can't assume that just because you've mastered field A that you can master field B. It's easy to think a research idea is going to be groundbreaking if you don't know enough about the field to understand that your idea isn't feasible or has already been explored.

Experimental particle physicist Jerry Pine typified the other way to go into neuroscience. Jerry was a full professor at Caltech, at the pinnacle of his career, when he decided to make the shift. He took the Woods Hole neurobiology course with Terry (arriving in jeans, Terry noted sheepishly). Jerry and Terry were, in fact, the only physicists in the course—all the

others were biologists. Afterward, Jerry packed his family up and took off for three years as a lowly postdoc at Washington University in St. Louis. Eventually, he went on to build electronic chips that neurons can grow on, giving researchers a better understanding of how neurons interact with one another in groups.

Learning a second discipline, as both Terry and Jerry did, takes time—maybe a lot of time if the second discipline is very different from the first. You will need to find a place where you can learn the ropes and where other people will help you. There are likely to be setbacks in the learning process. In fact, at first, it may feel like taking two steps back for each step forward, but if you're lucky, you can marry some of your old skills with new ones.

To avoid falling into a career rut, it's important to be open to change, like Jerry Pine. Humility is important during the learning process, along with persistence. These traits allow you to better place yourself into a new context—and as we'll touch on next, it is *context* that allows you to make the shift.

→ Key Mindshift

Learning a New Discipline Takes Time

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If you are learning something new and difficult, explore boot camp-like experiences to make new connections and immerse yourself in the new ideas. No matter how smart you may be, give yourself the time you need to truly learn the discipline.

Context Is King

The circumstances in which we perceive something—its *context*—have an enormous effect on how we react to it. Your actions would be different if, a few feet away from you, you saw a poisonous snake poised to strike in a glass cage as opposed to skittering toward you on a table.⁷ We constantly take in all sorts of cues from the environment, and also from our own thoughts and feelings.

This, in fact, is why the placebo effect can be so powerful. Our conscious thoughts, which are formed in the prefrontal cortex, can spur physical changes throughout the body. For example, if a nurse tells us that a procedure is going to hurt, levels of stress hormones rise within seconds. This can make the experience more painful through the nocebo effect, which activates the pain-boosting “CCKergic”

systems.⁸ Similarly, if we *believe* that a particular substance will reduce pain—even if it turns out to be sugar water or saline solution—that belief can activate the body’s natural opioid systems and reduce pain.⁹ The placebo effect is so powerful that once it’s been in place for just a few days, the effect persists—even after people are told that they aren’t getting the real drug.¹⁰

It isn’t just pain-related systems that can change with differing perceptions. For example, if we believe a first type of milkshake is more filling than a second type, the first milkshake will do more to reduce levels of the pro-hunger hormone ghrelin.¹¹ Swallowing a strange-tasting drink that has an immunosuppressive drug in it can eventually produce immune suppression from the taste alone.¹² And anxiety-reducing drugs that reduce unpleasant reactions to fearful and threatening pictures can later produce the same effect when they’re replaced by a placebo.¹³

All in all, your expectations about what will happen, and the underlying context, can powerfully shape your mind and body’s reaction, both for good and for ill. It was what underpinned Claudia Meadows’ escape from depression. It is what allows for the dramatic success of cognitive behavioral therapy.

And it can also underpin your own success in whatever you are trying to learn and become.

Immersion

Terry and Beatrice’s friend Francis Crick was keenly aware of the importance of context in changing careers. As the codiscoverer of DNA, the secret code of life, Crick was a towering figure in science. Crick had already reinvented himself once in his early thirties—a career change that underpinned his Nobel Prize–winning breakthrough. He’d been a promising physics student at University College in London until a World War II German bomb fell through the roof of his laboratory and destroyed his equipment.

Delayed for years during the war by his work designing mines that could avoid German minesweepers, Crick finally took up the study of biology at the advanced (at least in the science world) age of thirty-one. For Crick, as for Terry, the transition from physics to biology was difficult—Crick had said it was “almost as if one had to be born again.”¹⁴ Despite the difficulty of switching from physics’ “elegance and deep simplicity” to the complexity of biology’s evolving chemical mechanisms, Crick felt, oddly enough, that his original training in physics had given him something of great value—that double-edged sword of hubris. Proud Masters of the

Universe—his colleagues in physics—had made enormous breakthroughs. If they did it in physics, why couldn't he do it as well in biology?

And thus unfolded the career change from physics to biology that underpinned Crick's vitally important role in the discovery of the structure of DNA. However, one major, Nobel Prize-winning career change wasn't enough for Crick. As he neared sixty, an age when many people begin to slow, Crick developed an interest in one of science's toughest problems: the origins and workings of human consciousness. Unlike many at the time, Crick had a gut feeling that the underlying neuroanatomy was key. To begin to understand consciousness, then, he needed to delve into neuroscience.

Crick's challenge, however, was that he was too good at what he'd already mastered. The profoundly important discovery of DNA and its accompanying Nobel Prize meant that he found himself locked with golden handcuffs to the throne of laboratory molecular biology, with his world-class research digs at Cambridge forming a sort of scientific prison.

To break out, Crick decided to move from England to San Diego, to the Salk Institute. *He shifted his context.* In this new, sunny environment, his day-to-day interactions weren't with molecular biologists—they were with neuroscientists. "He'd have dialogues that would go on for days," Terry recalls. "He'd ask people to come and train him through discussions."

Crick immersed himself in his new discipline. Though he wasn't able to solve the problem of consciousness (a tough nut to crack), he played an important role in moving consciousness studies onto a solid research foundation. He was busy editing his latest article on neurobiology just days before his death at age eighty-eight.

Changing and learning something new, as Terry did when he was younger and as Crick did in later life, is absolutely possible. Research is giving us clues about how we can improve our abilities to learn and change—even as we age.

Never Too Old to Learn and Change

Surprisingly often, we feel guilty about changing our careers or learning something new. When we are in our twenties, we think, "I could have been a first-rate guitarist if I'd just started when I was a kid!" When we reach age sixty, we look wistfully back at

the more open possibilities of our thirties. We forget that when we were in our thirties, our options often seemed equally limited. Even college freshmen look with envy on other students who began studying French, physics, or philosophy in high school. No matter what our age, we often feel too old to learn something new.

Often, it's hard to realize that the path not taken always seems alluring—and to see that there are benefits to the path you *have* taken. Retraining your brain to master something new as an adult can have profound benefits—not only for you, but for those around you and for society as a whole. These benefits are so valuable that you may be surprised to learn that even the world's most accomplished people actively seek out career change. Some even plan for regular changes in their careers ahead of time. Stephen Hicks, a professor of philosophy at Rockford University in Illinois, observes:

When I was a grad student and becoming serious about a career in philosophy, I was impressed by a profile I read about Subrahmanyan Chandrasekhar, the physicist. His strategy was to read and think intensively for several years in one area of physics and then write several papers and an overarching book to integrate the ideas. Then he would shift to another, often quite different, area in physics and do the same thing. Over the decades, he avoided rut thinking and was able to make creative contributions to many areas.

Since philosophy is such a sprawling discipline, and since one feature that attracted me to philosophy is its fundamentality to many different intellectual areas, I resolved to follow Chandrasekhar's strategy. Since finishing grad school, my career has been in six-year units—four years of reading, thinking, and writing shorter articles in an area and then two years to finish a book. Then I jump to another distinct area.

The six-year pattern was not mechanically scheduled but emerged organically. And while I've worked in several distinct areas now, there are nonetheless connections between them, so I expect and plan that by the time I am done, I will have completed work that integrates to form an overall philosophy.

Setting Up a Context That Works for Big Learning Changes in Your Life

Shifting your mind-set about your capabilities often isn't easy. Those around you can sometimes conspire to keep you where you are instead of where you want to go. There are different ways to deal with this challenge.

- **Leave:** If the situation is toxic, “damn the torpedoes” and remove yourself from it. This was the approach Zach Caceres took in dropping out of a toxic high school.
- **Double life:** Live a double life for a while, simulating the old lifestyle and interests while developing new interests on the side. This approach worked for Graham Keir

and Terry Sejnowski—it prevented each from getting into a situation where others could continually argue against a switch.

- **Contrarian:** Take pride in being a contrarian. The more others say you will fail, the more it can bolster your internal resolve. This worked for Adam Khoo, who set up interim goals—like getting into a well-known junior college—that proved to himself as well as to others that he could achieve his aims. Keep in mind, however, that it's important to choose reachable and doable interim goals and checkpoints to assess your progress. For example, if you try as hard as you can but repeatedly get a very low score on the MCAT, it may be time to reassess your dream of medical school.

If you are lucky, those around you will support you in your attempts to change. Rejoice and use the opportunity to go as deep as you can into the learning experience. This is what physicist Jerry Pine did when he moved himself and his family from Caltech to St. Louis and went from full professor to lowly postdoc to retool his career.

Don't play up mental roadblocks that will keep you from a newly discovered passion. But don't minimize important considerations either—like whether you've got at least the basics of what it might take to succeed. You don't want to be like a cluelessly bad karaoke singer warbling haplessly into the night.

↳ You Can Teach an Old Dog New Tricks

Terry has developed powerful computer modeling techniques that support our understanding of complex phenomena like memory, thought, and feeling. This means he has an astonishingly broad understanding of many different facets of neuroscientific research.

“As you shift into later stages of your life, learning something new can become slower and more difficult,” Terry says. “But you can still do it—the brain is still plastic. What’s especially interesting is that there are breakthroughs on the horizon that can prevent cognitive decline with age.”

As we age, we tend to lose synapses and even neurons, like water trickling out of a dam. But it's not an entirely losing proposition—not, that is, unless we let it. Exercise, learning, and exposure to new environments can help create and nurture new neurons and synapses. Activities like these serve as a sort of cognitive rain that replenishes the water behind the neural dam. This builds up what's known as a “synaptic reserve,” which is especially important as you grow older, to help balance the neurons and synaptic connections that are being lost.

I asked Terry which researchers he thinks are extraordinary in uncovering ways we can keep improving our brains as we age. “Daphne Bavelier,” said Terry, without hesitation.

Bavelier, a cognitive neuroscientist at the University of Geneva in Switzerland, studies video games—shoot-’em-up, action-style video games. What she has found has upended stereotypes about how bad video games are for you—and has given insight into future therapies to keep the brain in top shape even as we get into our “golden years.”¹⁵

Conventional wisdom is that too much screen time with video games worsens eyesight. To Bavelier’s amazement, when she quantified the eyesight of action video game players, they had *better* vision than average. That vision was better in two subtle but important ways—action gamers were better able to pick out minute detail within a field of clutter. They could also pick out more levels of gray.

This difference might seem shrug-off-able, but translated into real-world terms, this means action gamers can drive better in foggy conditions, and as they get older, they can read the fine print on prescription bottles without using magnifiers. In other words, video gaming allows us to improve in some of the very areas that can cause danger and difficulty for people as they age.

But Bavelier and her colleagues have discovered even more.

Many people believe that video games lead to distractibility and problems with attention. But when it comes to action video games, the opposite occurs. In Bavelier and her colleagues’ studies of action gamers, they have observed that key “focusing” areas of the brain become much more efficient. Action gamers can also switch their attention quickly with only a small mental cost. In essence, gamers concentrate better. They can, for example, more easily flick their focus from the road in front of them to the dog darting in from the side.

Basically, it seems that action-style video games allow us to improve on many of the areas that begin to falter for us as we age. As Bavelier notes, “Complex training environments such as action video game play may actually foster brain plasticity and learning.”¹⁶ Action video games not only seem to help us see better, focus better, and even learn better, but the effects last a long time, showing up even many months later. (Incidentally, if you

want to improve your ability to do spatial rotation—an important skill in both art and engineering—*Tetris* is for you.)

As far as neural improvement, the brutal-but-engrossing *Medal of Honor* beats *The Sims* hands-down. This may be because in *The Sims*, you do not have much demand on attentional control. In *Medal of Honor*, however, your attention changes around to different areas on the screen, from very spread out as you monitor your environment for new enemies to very focused as you need to aim accurately. *Medal of Honor* also gets you viscerally involved in play, with background music and lots of unexpected changes and looming motions that attract attention at multiple neural levels below conscious awareness.¹⁷ This kind of attention-grabbing may lie at the heart of plastic changes.

So why don't we already have great video games that are specifically designed to correct age-related declines? Bavelier equates it to coming up with tasty chocolate (the video game) that's combined with healthy broccoli (the cognitive enhancement).¹⁸ Combining chocolate with broccoli in a form people want to consume is not easy—not even for a master chef. But brain scientists working together with artists and the entertainment industry are making progress.

Of course, common sense is also important when it comes to video games—researchers agree that excessive bingeing isn't healthy. But fortunately, bingeing isn't needed—positive effects were only found in those playing for short periods, thirty minutes or so per day, regularly over a period of a few months.

Retaining the ability to learn and change as an adult is a multifaceted challenge. It goes beyond just interacting with a video game, textbook, fellow students, or a teacher. Physical exercise, as we've mentioned, is vitally important. Pharmaceutical drugs such as Ritalin and Adderall can sometimes also enhance our ability to learn. But they're loaded with unwanted side effects—the equivalent of throwing a bucket of lead-based paint at a tiny speck of dirt on your living room wall. Good nutrition can be a boon as well, although at some point it's hard to make more improvements in cognitive function even as you've begun to step into the choppy waters of contentious nutritional theories.

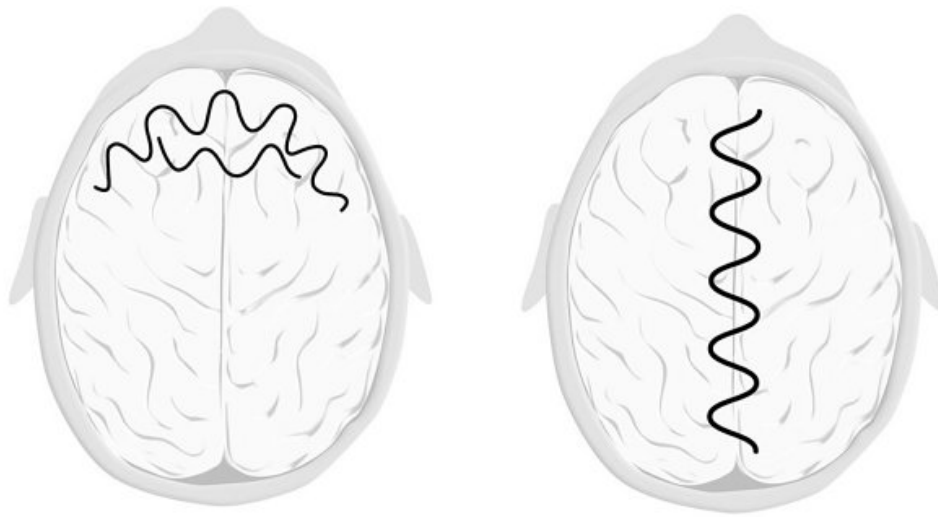
But action-style video games are gaining the attention of leading researchers because of their extraordinarily broad impact—they provide easy ways to see how sights, sounds, actions, and activities can produce changes in key learning processes like attentional allocation, resistance to distraction, working memory, and task switching. We can already see how certain types of gamers use their brain more efficiently—needing fewer neural resources for demanding tasks. Gamers are also better at suppressing irrelevant information.

Building in part on Daphne Bavelier’s decade-plus body of research, UC San Francisco researcher Adam Gazzaley—another of Terry’s recommended researchers—also focuses on video games. Gazzaley, who is both a neuroscientist and neurologist, points out that video games are among the most powerful forms of media. They’re both interactive (and isn’t that what teachers are striving for?) and fun. Gazzaley is attempting to create a more potent mix of gaming and therapy—and he’s succeeding. *Nature*, one of the world’s most prestigious scientific research journals, put Gazzaley’s research on its cover under the title “Game Changer.”¹⁹

Gazzaley’s approach to developing new therapies is indeed a game changer. His *Neuroracer* is a deceptively simple game in which you drive a speeding race car along a roadway where signs randomly pop up, forcing you to react.²⁰ Gazzaley found that older subjects who played just one hour of *Neuroracer* a day, three days a week for a month—twelve hours of total play—experienced a strong and lasting improvement in concentration. The game is going through an FDA pathway, and Gazzaley hopes to see it become the world’s first prescribed video game.

It turns out that your ability to focus your attention, hold something in working memory, and keep other thoughts from intruding arises from what’s called the “midline frontal theta.” This is a burst of electrical waves that appear toward the front of your brain when you are engaging your attention.²¹ But it isn’t just the front of the brain that’s important when you’re trying to concentrate. The front of the brain also needs to be able to send signals and communicate with the back of the brain. Technically, this relates to the “long-range theta coherence.” As you grow older, the power and coherence of these interconnecting brain waves can weaken. Decline in the midline frontal theta and the long-range theta coherence is one reason

why older people can find themselves standing in the kitchen wondering what they came in for. It's also why their driving reactions slow.



On the left, we can see lines that represent the “midline frontal theta waves” that appear toward the front of the brain when you are concentrating. On the right is a wave representing the theta wave communication between the front and the back of the brain. Both of these types of wave activities can decline with age—but can be ramped back up through the powerful effects of playing video games.

Neuroracer gives people the ability to practice and improve their ability to focus. It's fun to boot. What's most important in all of this, though, is that we can see *why* the improvements happen. *It's due to the changes in theta rhythms.* As Gazzaley's research has shown, with a gaming approach, sixty-year-olds can learn to outperform twenty-year-olds! *Neuroracer* appears to pinpoint the neural markers that serve as pivots for many of the most important cognitive skills, like working memory and vigilance, and enhances them. That means these skills are also improved, even though the game doesn't specifically target them.

We're beginning to learn the elements of a cognitively winning game system. Art, music, and story can create the kind of immersion and engagement that produces ideal conditions for neural plasticity. A good game, in other words, creates a sort of neural retooling kit to mold and shape cognition. There's also evidence that video games may combat the ill effects of ADHD, depression, dementia, and autism.

Gazzaley's goal is real-time feedback. He's working to create a system that pinpoints weaknesses in neural processing and uses the information to challenge the player. Weakened neural signals could be improved in an

easy, entertaining way. “What would it be like to enter your own brain,” Gazzaley asks, “with your challenge being to improve the neural processing you’re seeing? You could learn to control how your brain is processing information.”²²

On another front, neuroscientists Mike Merzenich and Paula Tallal developed computer-based exercises to allow people with dyslexia to more easily distinguish certain sounds. This in turn can make dramatic improvements in reading ability. The results of this innovative research were published in *Science*—and resulted in a deluge of more than forty thousand phone calls from parents desperate to improve their challenged children’s ability to learn.²³

Merzenich recently won the Kavli Prize, which is the equivalent of the Nobel Prize for neuroscience—he’s also a member of the National Academy of Sciences as well as the National Academy of Medicine. In other words, Merzenich is the real deal as a highly respected scientist. Building on the success with brain-training for dyslexia, Merzenich has created a company, Posit Science Corporation, that focuses on improving cognitive performance. BrainHQ, the company’s flagship product, isn’t meant to make you into a genius—instead, it is structured to allow you to reach and maintain your cognitive peak by giving you exercises to speed neural processing, strengthen attention, and improve working memory. Reputable studies show that BrainHQ does appear to make a difference, whether it’s in helping you remember people’s faces, being more responsive while driving, or keeping up with rapid-fire conversations.²⁴

There are hundreds of brain-training programs available online—most have less-than-compelling evidence that they work. But top scientists like Bavelier, Gazzaley, and Merzenich are leading the way in showing that “mental therapies” really can make a difference.

Building a Cognitive Reserve

We know that some fourteen hundred new neurons are born every day in the hippocampus. There’s only modest decline in this neural birth rate as you age.²⁵ But unless the brain continues to encounter novel experiences,

many of these new neurons will die off before they mature and hook into the larger neural network, rather like vines that languish and die for want of a trellis.

In adults, new “granule” neurons allow us to distinguish between similar experiences and store them as distinct memories. These newer cells are different from older cells, which carry patterns that associate similar memories to one another.²⁶ New neurons are especially valuable when it comes to avoiding the rekindling of older, sometimes more traumatic memories.²⁷ All this means that, for new learning as well as mental health, it’s important to help new neurons to be born, survive, and thrive. This is why neurogenesis has become a hot area in treating depression and various anxiety disorders.²⁸

Of course, as mentioned earlier, *exercise* is one of the most powerful “medications” we know of that produces new neurons. It’s as if exercise scatters seeds that become neural sprouts. *Learning*, on the other hand, is like water and fertilizer that encourage the growth of those neural sprouts.

The younger you are, the more likely it is that anything you experience is novel. As you age, it gets easier to fall into a rut. Even when you tell yourself you’re learning something new, it’s often just a slight riff on something you already know. Learning that makes an impact on the brain often means going just a bit beyond your comfort zone.

Larry Katz, a neuroscientist at Duke, suggested that a useful way to allow the new neurons to survive, thrive, and make new connections is to do something new and different every day.²⁹ This automatically presents your brain with novel experiences. These novel experiences can be as simple as using your left hand to brush your teeth if you’re right-handed. Or just sitting in a different chair at the dinner table. This is also why travel can be so invigorating. It keeps the brain tuned up, especially if you do your best to immerse yourself in the new culture and surroundings. Learning a foreign language when you are older may also be especially worthwhile, because the areas of the brain positively affected by language learning include many areas that are negatively affected by aging.³⁰

In brain terms, if you don’t use it, you can lose it—no matter how innate and natural your gifts might seem. Widely admired orator Robert Sobukwe, who spoke so eloquently for the cause of liberation of black South Africans

from the rule of apartheid, was subjected to six years of solitary confinement on remote Robben Island. He could communicate with other prisoners only through furtive hand signals. During this terrible time, Sobukwe could feel his powers of speech slipping away.³¹ Those who have endured the winters at remote Antarctic stations with few opportunities to speak with others have experienced a similar sensation—and discovered themselves stumbling through simple conversations upon their return to civilization.³²

A variety of hobbies keeps us mentally tuned up—especially when those activities are combined with exercise. If you knit, sew, quilt, do plumbing or carpentry, play games, use your computer, or read, for example, research shows you're more likely to have stronger cognitive ability as you age.³³ These findings make sense—for example, measuring and cutting for either quilting or carpentry clearly help maintain your spatial abilities.³⁴ On a side note, one recent controlled study found that those who read books for three and a half hours or more a week were 23 percent less likely to have died over the twelve-year study period.³⁵ It's definitely books that had the effect—magazine and newspaper readers didn't fare so well. (Yay to you and your longer life for reading this book!)

One intriguing study of more than sixteen thousand participants in rural China showed that the probability of Alzheimer's disease was distinctly correlated with a person's level of education.³⁶ This also makes sense. The more the intellectual stimulation, the lower the Alzheimer's risk. Yes, it's just a correlational study—we don't know for sure that the intellectual stimulation is truly the *cause* of the lower Alzheimer's risk. But we do know that more education produces more synapses, and the more synapses, the bigger your cognitive reserve. In any case, education isn't just something to get a dose of when you're younger. Studies have shown that the more active a “learning lifestyle” you have as an older person, the lower your risk of Alzheimer's.³⁷ What you learn as a mature adult, or as an older person, continues to build and maintain your cognitive reserve.

→ Key Mindshift

Comfort Zones and Synaptic Reserve

Day-to-day activities as simple as talking, knitting, or shooting hoops keep us in mental as well as physical shape by retaining abilities we already have. But when we go a bit beyond our familiar comfort zone by learning something that challenges us, it helps build a synaptic reserve. This reserve is increasingly important as you age.

Learning and Changing at Any Age

Just as Terry surmised, there have been few major advances in his former area of physics in the last decades, and exorbitant equipment costs have played a role. Many of Terry's friends who did go into particle physics ended up looking for jobs in other fields.³⁸ The allure of a seemingly hot area, the “sheeple” mentality, and lack of knowledge about limited opportunities are phenomena that arise in many careers and vocations. In any academic discipline there can be a lemming mentality, with professors encouraging students to major in their particular specialty even if the job prospects are dim and tuition costs are stratospheric. Students look to one another, thinking, *Hey, professors wouldn't be so encouraging if it was a bad idea.*

Despite the fact that he was at the pinnacle of prestigious physics studies at Princeton, Terry Sejnowski used common sense to step back, assess, reevaluate, and make a reasoned bet that a career change was in order. This was despite the fact that such a change would be difficult, and that at the time, few were making it. In the final analysis, the benefit from Terry's willingness to risk his career and head where he felt he could make the greatest scientific and social impact has been enormous.

Quantifying how neurons speak to one another means that we can better conceive of our essence as human beings—how we form memories, why we can smell a rose, how we hit a baseball, and why we dream. Thanks to Terry and his colleagues' work, we now better understand how the brain works, how to tease more useful data from



research analyses, and how to make predictions that can maximize chances for research breakthroughs. The algorithms and tools Terry has developed have helped researchers worldwide.

Among many other areas of research, Terry Sejnowski has worked to reveal the importance of exercise in cognition and learning. He makes a point of incorporating exercise into his daily routines, wherever he might be. Here he enjoys a break at the Waterton Lakes National Park in Alberta, Canada.

But what happens when you're looking for a career, and unlike Terry, your promising dreams and opportunities are crushed early on?

In our next chapter, we'll meet Princess Allotey, who will show how youthful resilience, and willingness to take advantage of unexpected opportunities, can make all the difference.

A Career in Neuroscience?

To have a career spearheading scientific research of any kind, you need to put in the time, effort, and money to get a doctorate. This is all before you could even begin to *think* of the intensely competitive process of applying for a tenure-track job at a university. It's typical these days to have hundreds of applicants for a single position.

Neuroscience is now so popular that there's reason to be cautious when considering the field. But as neuroscientist Alan Gelperin points out, competition has always been heated in most academic fields, including biology, physics, engineering, and of course neuroscience.



Princeton neuroscientist Alan Gelperin has been working in neuroscience for more than fifty years. His valuable insights on competition apply to many fields.

Alan asks, "Which is your favorite trendy area that's currently sucking people in? Developmental biology? Molecular biology? The powerful gene-editing technology CRISPR? Want to modify some genes? Get a cookbook—you can order it off the web. Get some eggs, and God knows, you can make a frog that can talk."

A career in scientific research often includes risk-taking. One of the biggest risks is that someone else publishes the results you were just planning to publish. Alan suggests taking a "sufficiently unique combination" approach, where your idea and your skills combine to make it reasonably unlikely that, by the time you've started to make progress, another researcher will suddenly scoop you.

Even so, there are famous instances of people who followed that reasonably unique approach only to pick up a journal after five years of research and—*oh my, what a great paper!*—someone else just published the findings you were about to put out. Of first order importance, then,

is figuring out something that's unlikely to appear in a journal in the time period it's going to take to make some progress.

"Going into a new area, you need to learn enough to see what the big questions are," Alan says. "Where do you have an interest and think you can make an impact? Has your big idea already been published?"

But it's an exciting time now—new equipment and techniques are developing rapidly. This means there are opportunities for people to identify a niche in neuroscience. Alan draws from his decades of experience when he observes, "Tools from math, optics, solid-state physics, or electrical engineering can put you in a reasonably unique position to do work that few other people on the planet could do. However, remember that there are no guarantees. All you can do is work the probabilities and have fun doing it."

★ Now You Try!

Where Is Your Field Heading?

Sometimes we can get lost in the day-to-day of our chosen careers. It can be worthwhile to stop, take a step back, and imagine how your career, and the careers of those around you, will play out in the long term. Physical constraints such as costs, or even new inventions, can suddenly relegate entire industries to the past, even while new industries are being born. Don't make the mistake of thinking that just because lots of smart people are headed in a certain career direction, that it's what you should be doing, too. You may be in a good job now, but will it stay that way? Take out your notebook or sheet of paper and write the title "Foretelling Career Challenges." Then draw a line down the middle of the page to make two columns. In one column, outline possibilities for change in your area of expertise. In the other column, outline how you might successfully handle those changes.

Bonus exploration: If you are planning a major career shift, it can be wise to take tentative steps to test the waters—as Terry did when he started taking biology classes and enrolled in the Woods Hole neuroscience boot camp. If you *are* thinking of a career change, how can you test the waters and see if your projected career path might be the right one for you?

Chapter 9

Derailed Dreams Lead to New Dreams

IT'S DIFFICULT TO be eighteen and find your dreams crushed.¹

Such was the case with Princess Allotey.

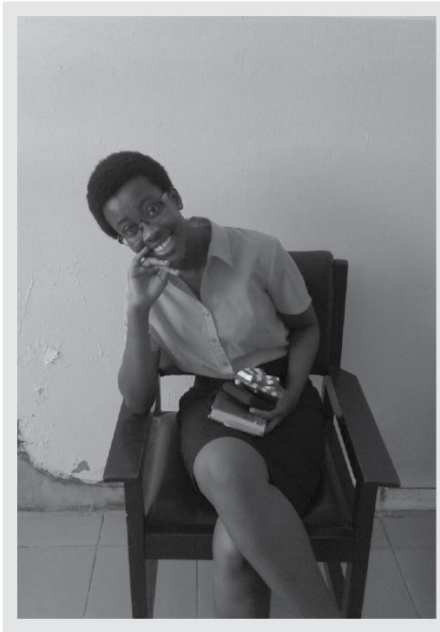
Princess grew up in Ghana, in Klagon, near the capital city of Accra. Klagon is known for its high illiteracy rate and school dropouts. Princess's parents only completed a basic education—the equivalent of junior high school in the United States—but they had always encouraged their four children to go on to college.

English is the official language of Ghana, but most people from Ghana have both a Ghanaian and an English name and speak English as well as at least one of the seventy local African languages.

Princess was named “Princess” because she was the firstborn girl in her family—her oldest brother was named Prince. But since Princess's father was of Ga heritage, her full name, in accordance with Ga tradition, is Princess Naa Aku Shika Allotey. She speaks three languages fluently: English, Ga, and Asante Twi, the language of her mother, a Fante from Eshiem, a rural community in central Ghana.

In elementary school, Princess squeezed in with some eighty other children into a classroom meant for thirty. She and two friends typically shared one tiny desk. Despite the cramped conditions, she was hungry to learn—especially math—and she practiced a lot, asking her teachers many





At age eighteen, Princess Allotey of Ghana started Kids and Math—an organization that provides school children with the basic mathematical resources they need to help them excel.

questions. She eventually earned A-pluses in math in both elementary and middle school. She also earned A's in the school certificate exams in all nine of the other fundamental subjects. This allowed her to be accepted into the prestigious Achimota High School—one of the best coeducational high schools in Ghana. Princess dreamed of one day becoming a math teacher—but not just any math teacher. She wanted to be a math teacher informed by insights on education from other parts of the world.

To help broaden her knowledge, she enrolled in a summer program to gain basic science, engineering, and technology skills and to become a more creative problem solver. She and her friend Shaniqua were the only girls among the twenty-one participants. Being different was hard on the girls—they felt the boys would be skeptical about whatever they might contribute. Princess felt like an imposter, despite the fact that the boys she worked with were supportive.

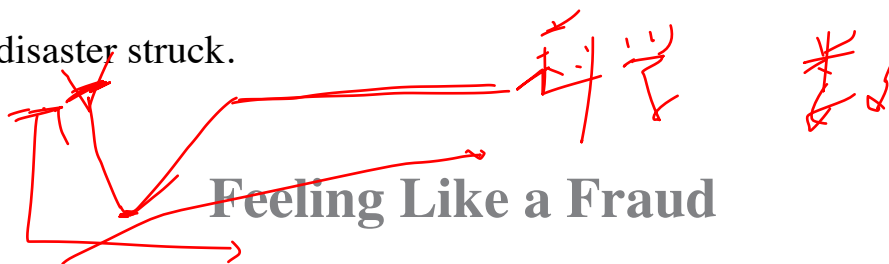
Young people typically have lots of dreams, and Princess was no different. For example, she longed to show the vision and courage of Nobel Prize winner Leymah Gbowee, who, in 2003, led women in a mass movement to put an end to the second Liberian Civil War.

The problem was that Princess had a terrible time speaking in public. It wasn't that she was shy—her conversation flowed easily when she was with her friends. However, if she even thought about getting in front of an audience, her nerves would kick in. Even with a written speech in front of her, she would find herself garbling words or she would just plain freeze.

The Achimota school Princess attended is supported by the older Achimotan alumni, including many of Ghana's ex-presidents and parliamentarians. It is also government-owned, which means that the fees are quite modest. Princess's father George, a hardworking man despite his struggles with asthma, owned a medium-size cement block company. He

could easily afford to pay Princess's Achimota tuition and board fees. In spite of her challenges with public speaking, Princess excelled at her studies.

Until disaster struck.



Feeling Like a Fraud

“Imposter syndrome” is the feeling that you are not truly deserving of your accomplishments—or, at the very least, far less able than those around you. Though it’s called a “syndrome,” feeling like an imposter is not a mental disorder—it’s simply an emotionally harmful way of framing your achievement. If you are successful, you think it must have been an accident or lucky timing. Or maybe people were somehow fooled. In other words, the way you see it, your success wasn’t really your doing. If you fail, on the other hand, you see it as your fault.

Women, in particular, seem to experience these feelings often, though men can as well. (It’s possible that men just aren’t as forthcoming about their feelings.) As Drs. Pauline Clance and Suzanne Imes noted in their original research paper on the topic back in 1978: “Despite outstanding academic and professional accomplishments, women who experience the imposter phenomenon persist in believing that they are really not bright and have fooled anyone who thinks otherwise.” And, sadly, this belief—this feeling that they are frauds—persists even in the face of solid evidence of their intelligence, achievements, and capabilities.²

~~Imposter syndrome~~, oddly enough, occurs most commonly in high achievers. Part of the challenge in overcoming the syndrome is that the imposter’s humility can be refreshing for regular people who catch a whiff of it (*she’s humble!*). Women, perhaps because of their heightened sensitivity to the feelings of others, might tend toward being bashful to avoid the stigma of being considered a braggart.³ Testosterone may play a role here as well—the hormone is associated with aggressiveness, dominance, and risk-taking behaviors.⁴

→ Princess found herself experiencing full-blown imposter syndrome in the technical summer camp she attended. She was placed in charge of an all-

male team designing a long-term vegetable storage container for farmers. In managing her team, she not only had to speak in front of the group—always a problem for her—but she also had to tell the group what to do. *Who was she to be put in such a position of authority?*

This “I am not worthy” attitude led Princess to take care in how she issued directions to her team. “Do you think this is correct?” she would wonder aloud. To her amazement, she began to realize that the team saw her as a leader—one who made good decisions. This encouraged her to take her blinders off and really look at what was going on around her. This informed, more objective assessment of reality, as it turns out, is an important step in overcoming feelings of imposterhood. Ultimately, Princess’s reframing toned down those self-critical, second-guessing-herself circuits that were running in her head. Clearly she *was* capable. And she was further reassured of that by guidance from mentors. She began to realize something else—that she didn’t always need to be stereotypically dominant, just ordering people around, to be a good leader. This, in turn, allowed her to recognize that she could move past the imposter syndrome while also benefiting from it.

Self-doubts are by no means always bad. Military officers and embassy officials, for example, can be full of a subconscious cultural rectitude that their perspectives are correct—an attitude that can get them into trouble once they arrive at their overseas assignments. In the realm of science, Nobel Prize-winning neuroscientist Santiago Ramón y Cajal said that one of the biggest challenges of the geniuses he worked with was that they would jump to conclusions and then be unable to change their minds when they were wrong.⁵ History is replete with business executives, generals, and politicians who only listen to others when they reinforce their own thoughts—these leaders then steer with blithe conviction toward disaster. Doubt, of course, can be overdone—but it can also be undervalued.⁶

And the reality is that although talents and skills matter, luck can also play an important role in our lives. A toss of the dice between two equally talented applicants can leave one with a job and the other feeling like a reject. A concussion from an out-of-the-blue automobile accident can mean college prep exams go badly—meaning your chances of getting into that top university are reduced. Perhaps the most wonderful piece of luck of all

is to be born into a loving and supportive family—a sort of luck that some can only wish for.

Thus it's natural that most of us—except perhaps the most brash and narcissistic—can occasionally fall prey to feeling like an imposter. Accepting that these feelings are normal and reframing them to our advantage forms a healthy way to move forward.

Princess's Problem

Princess was highly focused on her studies at Achimota High School—in that elite environment, she averaged a 3.7 GPA. Meanwhile, Princess's father, George Allotey, was facing a good problem: his business was doing so well that he needed to expand. To do that, he bought additional land, paying more than 300,000 Ghanaian cedis (Ghc) in cash—about U.S. \$75,000. In Ghana, that was an enormous sum. The individual he bought the land from was powerful, highly placed, and (George thought) a longtime friend. No receipt was given—George never told his family why, but perhaps he felt embarrassed requesting written documentation from such a powerful mentorlike figure. In any event, George knew that once he started building on the land, it would be clear that the transaction had been approved.

But before George could get a start with building, disaster struck. Another businessman disputed George's claim, saying *he'd* purchased the land.

In any legal case, it is often difficult to tease the truth from claims and counterclaims, and of course, this story is told from Princess's perspective. But in circumstances such as these, there can be a compelling impetus for a landowner to accept money from two parties. A single decisive word from the landowner could settle an issue like this in favor of the proper claimant—but then, the landowner would receive only one payment.

There was no decisive word. Instead, the landowner simply suggested that the two parties settle the matter in court.

Because George had poured such an enormous sum of money into the location, he couldn't afford to just walk away. Beyond that, he was a very

determined, hardworking man—which is why he had been so successful in the first place.

During Princess's final two years in high school, the litigation ran its course. George was forced to travel back and forth to the capital to file court documents, all the while paying enormous sums to his lawyer. He was desperate—he'd paid for the land, after all. But when he meanwhile tried to start building on the land, he and his crew were dragged off and beaten. One of his workers ended up in the hospital and George's expensive tools were destroyed—some even looked like they'd been run over by bulldozers.

This strife began to take a toll on the family and on Princess's studies. She continued to work hard, but her grades began to fall. Sometimes, heartbreakingly, she even got D's—unheard of for her.

Still, Princess kept working, trying to do her best. As the final year of high school rolled around, she began studying for the critical West African Secondary School Examination, which would determine whether she could get into a university—whether at home in Ghana or abroad. The test would begin at the end of February 2014. She was determined to give it her best.

George had borrowed Ghc60,000, about \$15,000, from a well-to-do friend to take his fight for the land to the highest courts. He had put his all into the case, and, as the proceedings rolled on to completion, he was down to Ghc250—about U.S. \$60.

On January 2, 2014, two years after the litigation started, George learned the court's decision.

He had lost.

The next day, George's asthma worsened dramatically. He sent Princess off to the pharmacy to get drugs. While she was gone, George passed out in the kitchen, where he was found by Princess's mom. She struggled to get him into a taxi to the hospital. The first two drivers declined, refusing to take what they said was a corpse. The third driver accepted them into his car and sped to the hospital, but to no avail.

George had died.

And then, just when the family thought things couldn't get any worse, they did just that. As it turned out, George had been so convinced that he had a winning case that he had used the cinder block factory and the family's house as collateral for the Ghc60,000 loan.

The family hadn't just lost the court case. They'd lost pretty much everything they had.

Two months later, Princess took the all-important West African Secondary School Examination. Remarkably, her results were outstanding.

But Princess had no money, and lacked the connections she would need to get a scholarship, so attending full-time university in Ghana was out of the question. Her applications to overseas universities came back with acceptances—but no support monies. As it was, the family was scraping by on the slim earnings of her oldest brother.

More rapidly than Princess could have imagined, she went from having her dreams within her grasp to discovering that her options had slipped away.

Reframing— and Developing New Talents

In previous chapters, we've learned about the vital importance of reframing, which, for example, Adam Khoo uses to see problems as opportunities.

Princess, too, discovered the value of reframing. Her final years in high school had been hard on her. With her father's death and the financial ruin of her family, she'd fallen into a depression and her grades had suffered. However, she'd picked herself up as best she could, and she performed exceptionally well on the final high school examination. For Princess, it was her religion that helped her reframe. Her family is Catholic, and she found that her faith and the values that go with it—such as the call to aid the less fortunate—were supportive in getting her through the difficult times.

Instead of ruminating on her own problems, Princess reframed her thinking by looking outside of herself—thinking about how she could help others with *their* problems. She began volunteering as a teaching assistant in less-endowed elementary and middle schools. Here, among impressionable children, she shared her excitement and enthusiasm for math. She wanted to help all the kids, but she especially wanted to set an example for girls. In Ghana, it's more acceptable for boys to be into math than girls—in fact, it's still more acceptable for boys to attend school.

Most of the kids she taught couldn't afford math books, which made it difficult for them to study, practice, and reinforce what they were being

taught in school. So Princess came up with Project Arithmas, to put together a library of math books at the school to help the kids prepare for their Basic Education Certificate Examinations. She enlisted eight friends and ginned up a budget of Ghc700 (about \$175), which they scraped together from their own pockets and from a few kindly supporters. Their plan was to purchase a few key books and ask authors of various math books to donate copies. (This is how I came to meet Princess—she wrote to me to request a copy of *A Mind for Numbers*. What especially impressed me, however, was her follow-through. She didn't just write to get the book—she wrote to express her appreciation once she'd received it. During my own previous visits to Africa, I'd seen firsthand the challenges experienced by African school children—Princess was tackling those issues in one of the most direct ways imaginable.)

Princess went on to found and become the executive director of an organization called Kids and Math, to encourage appreciation of mathematics. Her work required travel to many different schools, where she talked to the kids to excite them about math. To raise funds for Kids and Math, she gave speeches to various agencies, companies, and groups. She also coordinated fund-raising through the sale of trash bags. She bought the trash bags in bulk, and sold them individually at a slightly higher, but very affordable price of Ghc0.80 (about U.S. \$0.20). Such bags, which were customized for medium and small kitchen-type dustbins, are rarely sold in Ghana—customers bought them not only because the bags were attractive and handy, but also to support Kids and Math.

Princess has become an entrepreneur—a social entrepreneur. That is, she now uses the techniques of business to solve social problems. And, to her amazement, she has become something else—step by step, presentation by presentation, she has become a polished public speaker. When she and her team were invited to give a speech on Kids and Math at a meeting of the Toastmasters Club at Ghana's Ministry of Foreign Affairs and Regional Integration, Princess saw the opportunity to get an evaluation of her presentation skills. After the club meeting, a Toastmaster congratulated her, saying, “Your speech was great—the presentation was just like a TED talk!”

Princess began to be get noticed. She was asked to do an interview about Kids and Math on the popular television show *GH Today*, cohosted by

popular star Kafui Dey. When she went on the show, she kept wanting to see if someone else was behind her—after all, she herself couldn't really be speaking with Kafui Dey!

She had to laugh when she realized she felt like an imposter.

The interview went beautifully.



Princess's ability to reframe and see challenges as opportunities hasn't (yet) allowed her to achieve her dream of getting a university degree so she can get formal training in being a math educator. But her reframing has done something else. It has given her a powerful sense of purpose. It's allowed her to overcome her feelings of being an imposter. And coincidentally along the way, she's managed to overcome one of her greatest challenges—learning to be a public speaker.

In this chapter, we met a young woman with a love of math who overcame her feelings of imposterhood, whose dream included a highly nonanalytical skill—public speaking. In the next chapter, we'll meet a techie type who has escaped high tech altogether.

★ Now You Try!

Embrace Your Inner Imposter

Do you sometimes feel like an imposter? Do you feel as if others in your situation are somehow better than you, and by comparison, you're a bit of a faker? If so, you're not alone. In fact, you'd be surprised at how many secretly feel the same way you do, even though they may put on confident airs. (Sometimes overly confident—the person who told you, for example, that he aced the midterm might have in reality only gotten a C.)

Feeling like an imposter can lead to discomfort and doubt, but is not all bad. It can help you to look with the dispassionate eye of an observer at what's going on around you. It can also help you avoid the arrogant overconfidence that can lead to bad decision making and poor leadership skills.

Take out a piece of paper and, below the word "Imposter?" with one sentence at the top, describe a situation where you are feeling like an imposter. Below your sentence, draw a vertical line to make two columns. On the left, write about the

positive aspects of feeling like an imposter. On the right, write about the negative aspects.

Then write two or three sentences (or more) to synthesize your feelings about imposterhood.