Chapter 3: Learning and Growing

> The happiest, most successful children have parents who do not do for them what they are capable of doing, or almost capable of doing, [or things that] satisfy [parents' desires] rather than the needs of the child… Allowing children to make mistakes is [essential]. …It is in the small daily risks – the taller slide, the bike ride around the block, the invitation extended to a new classmate – that growth takes place… [and] resilience is born. …"Successful failures" [are] failures your child can live with and grow from. To rush in too quickly, to shield them, to deprive them of those challenges is to deprive them of the tools they will need to handle the inevitable, difficult, challenging and sometimes devastating demands of life.[1]

This chapter covers holistic child development. The next chapter, "Developing Talent," addresses the science of developing deep talent in a specific field.

Happiness + Earned satisfaction = A great childhood

Before we can define great parenting, we must consider what constitutes a great childhood.

Happiness matters, and every child deserves a true childhood. In the "Chips All In Parenting" chapter, we'll meet famous, "successful" people who were miserable as children because their parents forced them to do one activity all day, every day to the exclusion of all else. Many such "successful" people – and many more who never achieved "success" despite similarly awful childhoods – despise their parents. Many desperately sought emotional escape through self-destructive activities, like abusing drugs and attempting suicide. Such an intense, unbalanced life is wrong for anyone, especially a child.

Conversely, a childhood spent playing video games and watching TV while eating Doritos and chugging Pepsi is a recipe for a miserable adulthood. Children who fail to learn and develop a sense of responsibility destroy their future self's ability to earn an honest living – let alone hold a job doing interesting, creative work – and earn the self-respect that derives from leading a productive life.

An ideal childhood involves a healthy mix of happiness plus effort to acquire useful knowledge and skills. Ideally, children will enjoy activities that expand their knowledge and skills. Parents, teachers and coaches greatly impact how pleasurable children perceive learning/growth activities to be. We've all had teachers who made "dull" subjects fun and other teachers who made "fun" subjects boring. So find ways to make learning fun and engaging. And seek out teachers who do the same. A child happily engaged in an activity will learn faster. Just ask Olympic all-around silver medalist Shawn Johnson and

Olympic all-around gold medalist Gabby Douglas about their gymnastics coach, Liang Chow:

> Chow vowed to keep that youthful passion for the sport part of his teaching style, even with elite athletes. A typical day at his gym sees dozens of gymnasts of all ages cycling through their sessions, with Chow providing encouragement and eliciting the occasional giggles as he picks up a youngster in a handstand and swings her around, or playfully swats gymnasts practicing vault sprints with a foam bat to speed them up. Always ready with a smile and a joke, Chow laughs more than he scowls. That's what kept Shawn Johnson… with him for nearly two decades…
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> It's also what drew Gabrielle Douglas, who was living in Virginia Beach, to him. Watching on TV the hugs and smiles and genuine support Chow gave Johnson during the Beijing Games, Douglas could practically feel the warmth travelling all those miles and reaching through the screen. "I wanted to be there," she says…
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> In Chow's gym, it's all about pushing athletes to not only win, but to win and be satisfied with the journey to the podium.[2]

Effort produces personal growth, which leads to achievement and a powerful sense of earned satisfaction. Training to run a marathon isn't inherently fun, though it can be quite fun if you train with the right friends or listen to something enjoyable on your iPhone while training. But *finishing* a marathon is deeply satisfying because one has struggled and achieved a very difficult goal. Parents should allow children to be happy while engaging in difficult activities that allow them to earn self-satisfaction by accomplishing difficult things.

Letting children earn satisfaction and become more capable requires allowing – even encouraging – them to take risks, to fail, and to learn from failure. Ken Finch argues passionately that kids should play in nature and that our "risk paranoid" culture is paranoid about tree climbing when many more children are injured and killed in car accidents or falling down stairs:

> [Risk] is a powerful catalyst for growth that helps [kids] develop good judgment, persistence, courage, resiliency, and self-confidence. "Can I make it across the stream on that log?" "Should I climb one branch higher than I did yesterday?" "Can I jump from that boulder to the next one?" "Why yes, I can – because I've tried it and succeeded!" Remove risk from children's lives, and parts of their growth may stagnate. As adults, we face risks every day – most routine, but some bigger. To deal with these risks, we use judgment which we've honed through years of practice, success, and failure. In effect, we go through our days making an enduring series of minor risk/benefit analyses, ranging from whether or not to eat that tempting donut to whether or not to slide through the bothersome yellow light.
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> However, kids are not born with the gift of informed judgment, nor with awareness of their own abilities and weaknesses… [A] child can practice and learn good judgment by climbing trees at age eight, or that can wait until they are 16 and behind the wheel of a car.

> For countless generations… kids grew up with nature as a source of adventure and challenge. For many, it was their first sanctum and testing ground: a special place away from adult rules and structure, where they could create and act out their own worlds of challenges, conquests, and fantasy. …If kids aren't allowed to play in the yard or at the local park, what will they do instead? Probably more mind-numbing, plugged-in play.[3]

Psychologist Amanda Gummer says children raised in protective bubbles "have little concept of risk. They are trying drugs, drinking and driving, and doing so because they have never had to face the consequences of their actions. What would you rather – that they fell down a few stairs or off a climbing frame now, or had no concept of risk when they are older?"[4]

Help your child develop a sense of purpose

Achievement and growth are more enjoyable and rewarding when they're connected to a larger purpose of some kind. Some find greater purpose by helping others. Some from religion. Some by repaying past kindnesses. Some in keeping Earth healthy for the next generation. Some by learning about their immigrant family's native history, language, and culture. Some by bringing people in different countries or cultural communities closer through music, dance, or art. Some by working with others in a team, company or organization toward a common goal. Some in keeping a multi-generational family business strong and passing it to their children. Some by avenging a past defeat or triumphing where one has failed before. Some by pursuing an urge to do something no one has ever done before.

New England Patriot rookie Dont'a Hightower says "My dream has always been to get to the point in football where [my mom] doesn't have to work in a factory anymore. I wouldn't be in this situation today if it wasn't for my mom and my sister being my backbone. The reason that I do what I do is because of them, to take care of my family."[5] Running a marathon is a significant accomplishment. Running a marathon to raise $3,000 to fight cancer after your grandfather dies of cancer feels even more meaningful. Training for the Olympics is probably easier when you have a cause, which also makes winning more meaningful. The Dominican Republic's Felix Sanchez won a gold medal in 2004, but in 2008, his grandmother died just before he was scheduled to compete, and he ran horribly. Afterwards, "I made a promise that I was going to win a medal for her." In 2012, he raced wearing a photo of the two of them under his race number "so she could run close to my heart" and "'Abuela' – Spanish for 'Grandmother' – written on his yellow spikes."[6] On the podium, Sanchez choked up with a flood of tears streaming down his face.

Many kids feel school's boring because it's disconnected from their lives. Perhaps that's one reason many private schools emphasize public service. Beyond public service's character-building and resume-building powers, kids enjoy getting out of their classrooms to help others and contribute to their communities because "A compelling purpose energises life. Without a compelling purpose, we live life as a fairly haphazard experience, being easily swayed by the latest fad, temporary pressures, or the most recent advice on what others think we ought to be doing with our lives."[7] With a storm approaching, my son eagerly joined me in picking up loose objects outside our house and moving them to our garage. Cleaning up toys is seldom fun, but when it's protecting our house and cars from a storm, it's enjoyable.

Meaning can come from anywhere, even a personal commitment to achieve an otherwise arbitrary goal. As a youngster, all-time Olympic medal champion Michael Phelps nearly quit swimming, but "my mom would ask me 'Are you sure that's the best decision?' And I'd think, think, think. And I'd realize that actually it wasn't the best decision. At a very young age, I wrote down the goals that I had so I could always see what I wanted to accomplish. And I would look at that goal sheet and think 'I still want to do this.' So I'd decide 'I'm not quitting.'"[8] 100-meter hurdles gold medalist Sally Pearson spent twelve years chasing a goal she set after watching a countrymate win gold:

> "I remember in 2000 when Cathy Freeman won the 400m gold medal for Australia. From then on I was like: 'I want that as well. How do I do that? How do I train to be the best athlete in the world?'" Pearson recalled.
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> "I didn't know what event I was going to do it in when I was 13, but it was a matter of knowing that was what I wanted and that I had to work hard for it."[9]

Being responsible for others is a powerful motivator: "You've got a family to feed. Any man, if he's got kids on the way or a wife, he should be wanting to provide. So that just makes me want to play [pro football] harder. …[E]verybody should have something that drives them, something that motivates them, something that pushes you. If you don't have that… what are you living for?"[10] But your child shouldn't wait till they're married with kids. Help them identify causes worth striving for and people worth helping. If your child sings, perhaps their choir could sing at nursing homes. If your child likes animals, maybe they would like to volunteer to help the local vet or animal shelter. Or maybe they could pick up trash around town, remove overgrowth on local nature trails, or write a letter to the editor about an issue they care about. There are many ways to help in your community.

Effort builds talent: Everyone was lousy when they started

When my son was 3, I watched his skating lessons. This was important because skating was something we signed him up for, and he needed encouragement. As he got older, better and more comfortable, I watched less of his lessons. Recently, he asked why I don't watch his tennis lessons. He's six now, so I told him it's boring to watch someone who's not very good at something learn how to do it, adding that I'd enjoy practicing with him on weekends and that if he keeps improving I'll enjoy watching him play. (I do watch him play hockey, because he's competent at that.) I wasn't afraid about hurting his feelings because *he* chose to play tennis. It's something *he* wants to do, so he shouldn't need his parents to watch. Also, he shouldn't grow up thinking the world revolves around him.

Telling an unskilled child they're "good" or "talented" is, at best, confusing and unhelpful. I frequently explain that greatness takes many years of hard effort but that each practice session you get a bit better than you were before. The kids beating my son at chess camp this week have played a lot of chess. At least one kid has been playing longer than my son's been alive. But, I tell my son, they all lost many matches when they were starting out, and even his camp counselors would lose, badly, if Magnus Carslen showed up. What matters is learning from your mistakes and not getting frustrated. Everyone's lousy when they begin. When Michael Phelps was seven, he was scared of the water and refused to get his face wet, so he swam only backstroke. I'm the same way, but I still can't swim freestyle at age 43. Phelps has won 18 gold medals. So when my son's feeling especially good or bad about his ability, I'm always honest. I tell him he's a good skater for his age – and much better than anyone else in our house – but that NHL hockey players skate much faster. He's a good swimmer for his age – better than Phelps was at his age – but that top swimmers are much faster. I also say that, if he chooses to keep improving at something, he can become great but that no one can become great at more than a few things because becoming great is extremely difficult.

Honest feedback is always most helpful. Consider this frank response from author F. Scott Fitzgerald to a college student who sent him her story:

> I'm afraid the price for doing professional work is a good deal higher than you are prepared to pay at present. You've got to sell your heart, your strongest reactions, not the little minor things that only touch you lightly, the little experiences that you might tell at dinner. This is especially true when you *begin* to write, when you have not yet developed the tricks of interesting people on paper, when you have none of the technique which it takes time to learn. When, in short, you have *only* your emotions to sell.

> You wouldn't be interested in a soldier who was only a little brave…
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> If you ever decide to tell *your* stories, no one would be more interested than [me].[11]

Though not the response the woman was hoping for, it's – potentially, depending on her reaction – the most helpful advice he could give.

My amazing mom has always been extremely encouraging, but occasionally she would say I was great at something she *wanted* me to be great at (and possibly believed I was) but that I felt I wasn't. When kids sense parents are either over-critical or over-fawning, they can feel manipulated, even if that's not at all what their well-meaning parents intend. Everyone likes honest praise. But no one likes a flatterer who constantly praises others or a critic who always berates others. Similarly, kids don't like feeling pressured to live up to someone else's expectations. Praise can damage kids, especially when they feel the praise is undeserved or that they may be unable to duplicate their accomplishment. Give kids your honest assessment of their performance (or say nothing at all) and remind them they can do better with more practice and experience. What matters most is not winning versus losing but participation and enjoying the experience. If a child is happy and sticks with an activity, they'll keep improving.

Your actions speak louder than words, so model a love of learning

Children who see their parents reading will be attracted to books and magazines. Children who see their parents jogging will be attracted to jogging. (My boy jogs a bit with me every weekend.) Children who see parents being thoughtful and polite are more likely to behave thoughtfully and politely. We teach our children more by example than through our words. Children see our bad behaviors, like my annoyance at slow and/or bad drivers, so try to *be* a better person. The power of our actions is demonstrated by gymnastics coach Liang Chow. After arriving in Des Moines, Iowa from China, Chow's lousy English proved an asset because it forced him to show, not tell: "Unable to communicate with the students, he ended up demonstrating most of the gymnastics skills himself. Nothing, it seemed, got lost in translation since five of the men he trained ended up on the national team his first year in the program."[12]

Children watch and emulate parents. So live a life of growth and learning. Watch TED.com and Charlie Rose. Read ScienceDaily.com. Study Spanish. Re-learn math, chemistry or biology at KhanAcademy.org. Subscribe to *Scientific American Mind*. Whatever excites you. You learning will

motivate your kids, and it's good for you: "'Education seems to be an elixir that can bring us a healthy body and mind throughout adulthood and even a longer life,' says Margie E. Lachman, a psychologist at Brandeis University who specializes in aging. For those in midlife and beyond, a college degree appears to slow the brain's aging process by up to a decade."[13]

The same applies to other healthy behaviors. Whenever I see vegetables, I make sure to say "Mmm, Spinich!" or "Yes! I love broccoli!" And then I eat them eagerly. My kids still aren't much into vegetables, but my displaying honest enthusiasm about healthy eating can only encourage them. Similarly, whenever my son complains about having to do his Chinese homework, I truthfully tell him I wish *I* could be studying Chinese and point out that whenever I have free time to relax I choose to study Chinese.

Encourage a struggling child; control a successful child's ego

Emotions can also be more powerful than words. When we lose or feel frustrated, we feel lousy. For example, playing on a losing team can suck the joy out a sport. Parents can change their child's perspective by helping them see the big picture. But before children can see the big picture, they must be in a receptive emotional state. Since emotions are contagious,[14] parents must control our emotional responses to our children's successes and failures. If we react to our child's defeat with an "Oh well. You can practice some more and come back and try again next time" attitude, our children are more likely to bounce back than if we console and comfort them, validating their negative feelings or scold them for losing. Similarly, if we react to every win as if our child has just summitted Mount Everest, they'll get the message "Mommy and Daddy love me more when I win, and winning is very important." When they inevitably lose, they're likely to respond poorly. Moods are contagious, so it's best to stay on an even keel, win or lose. Even better is when we can cheer up our defeated child by noting some good things from their performance and deflate our victorious child by noting some errors and mistakes. The best coaches never let players feel too good or too bad because cocky players miss opportunities to correct mistakes while depressed players lose interest in practicing and competing.

"Broad and deep"

This chapter and the next complement each other because the ideal child – at least in the eyes of top university admissions offices – are "broad and deep." "Broad" means they have had a wide variety of experiences and developed competence in a wide range of endeavors. "Deep" means they've focused

intensely for an extended period of time on developing one or a few skills and honed those skills to a very high standard.

Being a world-class pianist won't get a child admitted to Stanford if their grades are lousy and they don't participate in sports, drama or other extracurriculars. Conversely, getting straight As and participating without distinction in a wide range of extracurriculars may also not get a child admitted to their dream school. Every year, Harvard rejects thousands of high school seniors with perfect GPAs. What Princeton and Yale find irresistable are well-rounded students with good character and one or a few exceptional talents.

You're free to reject the idea that "broad and deep" children are "ideal." Perhaps you reason that all a person needs is one world-class skill. Who needs math when they're traveling the world playing sold-out concert halls or authoring best-selling novels? Who needs science when they're earning millions on the tennis circuit or singing pop songs? Or you might believe that dabbling with some success in a broad range of activities is a fulfilling lifestyle, even if one never becomes great at anything. Those are reasonable views, but that's not how top universities assess applicants.

I love the ideal of "broad and deep." Broad knowledge is both intrinsically valuable and useful. It enables us to participate more fully and productively in society, cast more informed votes, and be better parents. Someone who doesn't understand math, statistics, history, and science may earn a fat salary playing an instrument or swinging a racket, but they will be blind to much that makes life worth living. Similarly, someone who knows math, stats and science but can't write well can't transmit the potentially useful implications of their knowledge to the rest of us. Deep knowledge has different value. The world needs experts, and people with deep knowledge are experts. Perhaps more importantly, deep knowledge represents intense, sustained effort and dedication. It demonstrates one is capable of great things. Developing deep knowledge in any field requires discipline and tenacity, skills that grow stronger the harder we work to develop deep knowledge. A child who has developed deep knowledge of, say, chess may well become a young adult with deep knowledge of engineering and a middle-aged CEO with deep knowledge of entrepreneurship and management. Once someone has developed deep knowledge in one field, they're equipped to develop deep knowledge in other areas and then perhaps to generate novel ideas based on their unique multidisciplinary perspective.

Help your children pursue their passions, not yours

How do parents encourage and enable children to become broad and deep? We expose them to

different activities then watch carefully before deciding what comes next. At any moment, a child will be uninterested in some activities, willing to try others, and excited about others.

Our 5-year-old's summer camp let him choose an optional activity. He chose guitar and initially enjoyed it. I researched guitars but didn't buy one, luckily, because his interest waned after a few days. The same summer, he agreed to our suggestion he attend a one-week tennis camp. We bought him an inexpensive racket. After the session, he said he wanted to continue, so we signed him up for a weekly lesson, which he continues to enjoy. Last fall, he was excited to join a soccer league. But he never wanted to practice and only somewhat enjoyed games, so he decided to stop after one season.

Becoming "broad" isn't just about organized activities. Be spontaneous at home. One Sunday, I read five books with my daughter while my wife did Chinese homework with our son, and then the kids "ran" a diner together. They stuffed their parents and grandparents with pancakes, sandwiches and coffee, then stuck us with the imaginary bill, even giving us change. Another Saturday, our kids wanted to work on their age-appropriate math books with my wife and me, and then our son wanted to play "suicide chess" with me while my daughter watched "Dinosaur Train." And then they both helped me do the laundry before heading off to a tennis lesson. We let the kids set the agenda.

Exhausting your kids (and yourself) with formal activities does no one any good. An endless stream of activities where one follows directions isn't fun. That's work. But certain activities require coaching; a child can't easily teach herself violin. And exposing kids to different activities, esp. activities they've expressed interest in trying, is good. So, a balance between structured, adult-organized events and unstructured, child-directed activities is ideal. It's OK for kids to be bored sometimes. Being bored will help them find that unread book on their bookshelf or the bug in the backyard or the boy down the street. But you should also expose them to some activities involving teamwork and communication and/or requiring sustained effort and coaching. Each child will find some such activities interesting and others boring. Just as gardeners trim and prune to grow healthy trees, so too parents must trim and prune their children's activities so they don't become exhausted or stick with activities they don't enjoy. The more your child enjoys an activity, the faster they will learn and improve.

To do something well, start doing it and don't stop

It's said "You are what you eat" but, actually, "You are what you do" because everything you do changes you. Every time you think a thought, your brain restructures itself. And every time you exercise, your body restructures itself.

You are not the product of your genes or your environment. You're a product of the interaction of your genes and environment. The "nature vs. nurture" debate was misguided. Each of us is the product of nature interacting with nurture. What works for one child may not work for another because different children have different temperaments, interests, strengths, and weaknesses. And different kids have had different experiences, even if they've grown up under the same roof.

Our bodies and minds reshape themselves in response to what we do. After we exercise, our muscles grow back a bit stronger. That's why lifting weights is called "body building." The same happens in our brains. Every time we think a thought, we strengthen particular neural pathways and connections (synapses). When we regularly repeat a thought or action, those brain pathways strengthen. Strong neural pathways create habits, vivid memories, language abilities, and ingrained instincts (like how to drive a car or recite a poem "learned by heart").

The next chapter, on developing talent, will show that we overrate the influence of genes on outstanding performances and underrate the influence of practice. If you're a lousy tennis player or guitarist or artist or chef, that's almost certainly not because you have lousy genes but because you haven't had quality training or practiced enough. When we see a Mozart or a Ted Williams, we attribute their success to genetics because we observe the finished product of decades of hard work and conclude no normal person could perform so well. But most great people achieved greatness only after taking up their activity when young and training intensively for many years.

Evidence strongly suggests most people can become pretty darn good at most things with sufficient effort and training. Our bodies and minds are remarkably "plastic," and we reshape them every time we do anything. Sitting on the couch watching TV shapes our minds and bodies one way; learning a foreign language on our iPhone while jogging shapes us differently. Genes play a role, primarily by nudging us toward certain activities rather than others, and perhaps giving some people greater stick-to-it-iveness. (A study of over 27,000 identical twins and 47,000 fraternal twins in seven countries found that genetics accounts for approximately 62% of variation in exercise participation.[15]) But your present self is largely the cumulative outcome of the activities you have engaged in and the personal interactions you have had throughout your life. And everything you do today – including read this parenting book – is shaping your future self.

Epigenetics: "Potential" is worthless unless you unlock it

One key nature-nurture interface is epigenetics. Every cell in your body contains identical DNA.

Your DNA is the complete recipe for building and operating your body. Yet each cell is specialized for a specific function. White blood cells look and behave completely differently than nerve cells. Even different kinds of nerve cells look and behave completely differently from one another. Most cells are microscopic, while some motor neurons are over four feet long. This differentiation happens through epigenetics, a fancy word for the mechanism by which each cell selectively turns on and off the production of proteins by blocking or uncovering the protein blueprints stored as genes in our DNA:

> "The genetic instructions themselves are influenced by other inputs," Shenk writes. "Genes are constantly activated and deactivated by environmental stimuli, nutrition, hormones, nerve impulses and other genes." That means there can be no guaranteed genetic windfalls, or fixed genetic limits, bestowed at the moment of conception. Instead there is a continually unfolding interaction between our heredity and our world, a process that may be in some measure under our control.[16]

You may possess the genetic potential to win an Olympic gold medal in rowing, but if you've never picked up an oar, you'll never realize that potential because "the epigenome, is very likely as important as the DNA itself in determining the phenotype [physical structure and behavior] of individuals. It is becoming increasingly clear that epigenetic signals can be altered by the environment. This partly explains why monozygotic ['identical'] twins progressively become different from one another as they grow older."[17] Rowing changes your body, but if you never try rowing, you'll never discover how efficient and powerful a rower you could have become.

The study of epigenetics is in its infancy, but there are strong hints that parents' epigenetics and behaviors shape their children's and even grandchildren's epigenomes:

> Epigenetic changes can be passed on to future generations because epigenome proteins are inherited along with DNA in chromosomes from parents. …[B]abies of rat mothers who are unusually nurturing are likely to have altered expressions of the genes involved with stress responses. These changes allow them to handle stress better as adults. It is thought that a similar connection occurs in humans.[18]

Brain plasticity & your "connectome"

The second key nature-nurture interface is our "plastic" brain. Every time you do or learn something new, your brain changes. Your brain has roughly 100 billion nerve cells linked together by about 150 trillion synapses! By contrast, your 23 chromosomes have 3.2 billion DNA base pairs. Less than 1.5% of your DNA holds recipes ("genes") that create the roughly 21,000 proteins that make up our bodies.[19] When you compare your 21,000 proteins – many of which have nothing to do with your

brain – against your 150,000,000,000,000 synapses, you'll realize why the memories, thoughts, beliefs, dreams, and fears stored in the physical structure of your brain – your "connectome" – likely shapes your behavior far more than your genes.

You may possess the genetic potential to win Olympic gold in skeet shooting, but if you've never picked up a shotgun, you'll never realize that potential because your brain hasn't learned to take information about a flying target's trajectory and translate that into commands for your muscles to aim the gun and squeeze the trigger.

Our brains come with a general wiring pattern – internal wiring, wiring from our sensors (skin, eyes, ears, etc.) to our brain, and wiring from our brain to muscles (mouth, fingers, legs, eyelids, etc.). Technologies for peering inside brains as they "run" is improving rapidly: "research teams have devised ways to make magnetic-resonance brain scans seven times more quickly and analyze neural connections 50 times faster than a year ago."[20] Such advances have helped neuroscientists better understand our brain architecture and function.[21] You can even download free software that lets you "View a fully interactive version of the Allen Human Brain Atlas in 3D," "View gene expression data in 3D" and "View expression data from different donors side-by-side."[22]

Brain studies prove our brains are not "blank slates" (*tabula rasa*).[23] Nor are people's brains identical, partly due to genetics:

> From personality to neuropsychiatric disorders, individual differences in brain function are known to have a strong heritable component. Here we report that between close relatives, a variety of neuropsychiatric disorders covary strongly with intellectual interests. We surveyed an entire class of high-functioning young adults at an elite university for prospective major, familial incidence of neuropsychiatric disorders, and demographic and attitudinal questions. Students aspiring to technical majors (science/mathematics/engineering) were more likely than other students to report a sibling with an autism spectrum disorder ($p = 0.037$). Conversely, students interested in the humanities were more likely to report a family member with major depressive disorder ($p = 8.8\times10^{-4}$), bipolar disorder ($p = 0.027$), or substance abuse problems ($p = 1.9\times10^{-6}$). A combined PREdisposition for Subject MattEr (PRESUME) score based on these disorders was strongly predictive of subject matter interests ($p = 9.6\times10^{-8}$). Our results suggest that shared genetic (and perhaps environmental) factors may both predispose for heritable neuropsychiatric disorders and influence the development of intellectual interests.[24]

But your basic architectural blueprint hardly constrains what you can learn. Though our brains have many quirks, biases and limitations, they're astonishingly flexible and powerful, enabling us to learn anything and imagine things – whole imaginary worlds, in fact – that don't exist. As a 2-year-old, my daughter said she and I were ducks flying together. Some physicists believe there are many universes,

including ours.[25] Other physicists believe our universe is a hologram![26] Others suspect our universe is a massive computer simulation![27] (Now my 2-year-old's flying duck idea sounds less crazy.)

Our "plastic" brains evolved to reshape themselves into various forms based on our experiences. Neuroscientists have observed brain regions that grow larger with learning. To become a London taxicab driver, you must first memorize each of London's 25,000 roads and use that knowledge to find the fastest route between any two locations. Acquiring "the Knowledge" takes 3-4 years, and only half who seek to become London taxi drivers succeed. A taxi driver's brain scan can tell whether they've passed or not, based on the size of their posterior hippocampus. Before studying, prospective cab drivers have normal-sized posterior hippocampuses. After studying, taxicab trainees outperform untrained people on memory tests related to London landmarks. But trainees who failed to become London cab drivers have normal-sized posterior hippocampuses whereas "trainees that qualified as taxi drivers had a greater volume of grey matter in the region than they had before they started their training."[28]

Even more interestingly, "the qualified [taxi] trainees – but not the trainees who failed to qualify – were worse at the other [memory] tasks, such as recalling complex visual information, than [untrained people]."[29] Acquiring a comprehensive knowledge of London's 25,000 streets makes it *harder* to remember other things! Knowledge of London's streets occupies precious brain real estate that might otherwise store other information. This partially explains why so many profoundly gifted musicians – Art Tatum, Blind Willie Johnson, Stevie Wonder, Jose Feliciano, Ray Charles, Lennie Tristano, George Shearing – are blind. I especially love Derek Paravicini and encourage you to learn more about him because he can improvise, play a song perfectly after hearing it just once, hear ten notes simultaneously and reproduce them exactly, hear dozens of sounds simultaneously and play them on a piano as if it were a harp, make up entirely new songs based on a riff someone asks him to incorporate into the song, remember forever songs he has heard just once, play two pianos simultaneously, play with emotion, and change key and musical style in the middle of a song at will.[30] Derek has great difficulty with ordinary life, quite possibly because he uses for music parts of his brain the rest of us use to function. Rex Lewis-Clack, who has performed with Derek, shares Derek's blindness, difficulties with ordinary life, and musical genius.[31]

Another example: musicians' brains differ from non-musicians' brains in ways visible in brain scans. The $40 million Human Connectome Project – www.humanconnectomeproject.org – is scanning over 1,000 human brains to compare and contrast brain structures and relate structural differences –

including connection patterns – to behavioral and medical histories of the people those brains belong to. “Already, researchers are finding hints that the brain’s electrical signals are relayed through a series of central hubs on their way to more-specialized regions, in a system organized like an airline’s routes.”[32]

Help children develop good habits

Brains hold two classes of memories: Procedural/implicit memories are programs for doing things you can do without conscious thought or attention, like tie shoelaces or walk up stairs. Your brain automatically plays back these programs without your conscious attention. Declarative/explicit memories record information you can consciously talk and write about. Declarative/explicit memory has two subcategories: Semantic memory – information about facts, definitions, concepts, relationships, and abstract ideas – and autobiographical/episodic memory, which records events we have experienced.

Procedural/implicit memory plays a gigantic – and underappreciated – role in our lives because it takes over whenever we’re not deliberately weighing the relative merits of possible actions. Consider these cliches: “I wasn’t thinking,” “We’re creatures of habit,” “I’m in a rut,” “I was on auto-pilot.” It’s often claimed we use only a small fraction of our brains. That’s untrue. What’s true is that we’re only *consciously aware* of a small fraction of what our brains are doing. Much of what our brains do happens subconsciously, partly through habits and partly through emotions.

We usually make quick, instinctive decisions, often unaware we’re even making a decision. Unconscious action is our default behavior, though we can choose to make a decision slowly and deliberatively.[33] Unconscious action *must* be our default behavior because if we tried to consciously analyze everything we do we would be paralyzed by indecision. It’s much simpler to let habits and emotions guide us. In *Descartes’ Error*, neurobiologist Antonio Demasio demonstrated the critical role of emotion – not pure reason – in decisionmaking through an intelligent, creative, well-informed, funny patient paralyzed by indecisiveness because a tumor had forced the removal of part of his prefrontal cortex critical to emotions. Without emotions, Demasio’s patient could spend hours debating where to eat lunch or whether to put on his right shoe or his left shoe first.

The more often you do something, the easier it becomes to do that thing again and the more likely you are to do so instinctively, rather than consciously. Athletes and coaches say repetition builds “muscle memory.” I learned to type in junior high school and am typing all the letters in this book

without conscious thought or looking at the keyboard. Pianists and violinists can similarly perform complex pieces without straining to remember each note or where to place each finger.

But habits don't always produce the best actions. I've flicked the bathroom light off after brushing my teeth, even though I knew my wife was taking a shower. Have you ever… Flipped a light switch during a power outage? Taken a wrong turn because you normally take one route but are headed somewhere else? Eaten bite after bite while watching TV only to discover you ate far more than you intended? Opened your mailbox only to laugh at yourself for forgetting it's a holiday? Rented a car and felt like you needed to learn to drive all over again, though the controls were only slightly different than in your car? Even worse are repetitive behaviors like biting nails, twirling/pulling hair, grinding teeth, and biting lips that – once ingrained – often require professional "habit reversal training"[34] to eliminate.

Habits form and strengthen through repetition.[35] The more you repeat a behavior – or thought pattern – the more likely you are to do so automatically and subconsciously in the future. Scientists have even found which cells create our habits:

> A brain cell type found where habits are formed and movement is controlled has receptors that work like computer processors to translate regular activities into habits…
>
> NMDA receptors on dopamine neurons in the brain's basal ganglia are essential to habit formation. These receptors function like gateways to the brain cells, letting in electrically charged ions to increase the activity and communication of neurons. Their pivotal role reminds neuroscientist Dr. Lei Phillip Wang of a computer's central processing unit. "The NMDA receptor is a commander, which is why it's called a master switch for brain cell connectivity," said Wang.[36]

Researchers created two types of mice: mice who pushed a lever only when they were hungry and mice who couldn't stop themselves from pushing the lever, even when full. The first group of mice successfully learned to push the lever purposefully to acquire food. The second group also learned to push the lever to acquire food but formed a habit of doing so. Most interestingly, the normal mice were the ones who developed the lever-pushing habit! The mice who stopped pushing the lever when full were created artificially in the lab by turning off the dopamine neurons' NMDA receptors, which prevented them from developing the habit. Our default behavior is to develop habits and addictions. We must work hard not to. And breaking a habit is even harder, requiring a conscious, sustained effort to *not* do what feels comfortable and natural in favor of something uncomfortable and unnatural.

Whether habits affect our lives positively or negatively depends on whether they align with our

goals. “Hacking” means programming a computer. A growing movement seeks to “hack” our minds in positive ways. Websites like LifeHacker.com and LifeHack.org are popular because they help people replace self-defeating habits with helpful habits. Because unexamined habits rule so much of our lives, there’s great potential to improve oneself by upgrading one’s habits. Parents should think hard about the habits their children are forming and how to help them break bad habits and develop good ones.

Real learning requires “spaced repetition”

Desperate students know you can cram knowledge into your brain a day or two before a test and do well. But crammed-in knowledge is quickly forgotten. Real learning occurs through “spaced repetition.” After you learn something, you want to review it with decreasing frequency. Because this technique is so effective, many software programs implement flashcard-style learning systems that re-test knowledge at increasingly long intervals.[37] The better you grasp a concept, the less frequently you must refresh/test that knowledge.

Spaced repetition can also be viewed as “interleaving”: don’t focus too long on one thing before moving to the next thing. You’ll learn and retain information more easily by studying X, then Y, then Z, then cycling back to X again. Soccer players shouldn’t practice headers one day and penalty shots the next. They should practice headers five minutes, penalty shots five minutes, corner kicks five minutes, dribbling five minutes, passing five minutes, *then* return to headers. Scientists have proven that you improve faster when you frequently switch training activities:

> If you focus on learning motor skills sequentially… you will acquire each fairly quickly, but are more likely to forget them later. However, if you split your time up between learning multiple motor skills… you will learn them more slowly but be more likely to remember them later.
>
> This phenomenon, called the “contextual interference effect,” is the result of a showdown between your short-term and long-term motor memory, Schweighofer said. Though scientists have long been aware of the effect’s existence, Schweighofer’s research is the first to explain the mechanism behind it.
>
> “Continually wiping out motor short-term memory helps update long-term memory,” he said.
>
> In short, if your brain can rely on your short-term motor memory to handle memorizing a single motor task, then it will do so, failing to engage your long-term memory in the process. If you deny your brain that option by continually switching from learning one task to the other, your long-term memory will kick in instead. It will take longer to learn both, but you won’t forget them later.

> "It is much more difficult for people to learn two tasks," he said. "But [when tasks were mixed up during] training there was no significant forgetting."[38]

Other scientists found this effect studying stroke victims who had lost their ability to use their short-term ("working") memory. Stroke victims who had to rely on long-term memory found learning harder but retained their learning far better than those who with functioning short-term memory.[39] To retain information, we need to circumvent our brain's tendency to rely on short-term memory. Spaced repetition does exactly that.

Another study found the biochemical process underlying this phenomenon:

> The "spacing effect," first discovered over a century ago, describes the observation that humans and animals are able to remember things more effectively if learning is distributed over a long period of time rather than performed all at once. The effect is believed to be closely connected to the process of memory consolidation, whereby short-term memories are stabilized into long-term ones…
>
> Studying HOKR in mice, they found that the long-term effects of learning are strongly dependent on whether training is performed all at once ("massed training"), or in spaced intervals ("spaced training"): whereas gains incurred in massed training disappeared within 24 hours, those gained in spaced training were sustained longer…
>
> [T]he spacing effect was impaired when mice were infused with anisomycin and actinomycin D, antibiotics which inhibit protein synthesis. This final discovery suggests that proteins produced during training play a key role in the formation of long-term memories, providing for the first time a neurological explanation for the well-known benefits of spaced learning – as well as a great excuse to take more breaks.[40]

The HOKR mouse study also found that "the transfer of the memory trace of adaptation occurs within 4 h[ours] of spaced training."[41] This suggests another technique for stimulating learning: studying before bed or napping after studying. Our brains transfer what we've learned to long-term memory quickly, and we know that dreaming helps us retain information. Sleep studies find that adults who take a daytime nap after learning retain new knowledge better when retested hours later than adults who take no nap.[42] Dreaming about what we have just learned is especially beneficial:

> non-nappers showed no signs of improvement… even if they had reported thinking about the maze during their rest period. Similarly, the subjects who napped, but who did not report experiencing any maze-related dreams or thoughts during their sleep period, showed little, if any, improvement. But, the nappers who described dreaming about the task showed dramatic improvement, 10 times more than that shown by those nappers who reported having no maze-related dreams.

> "These dreamers described various scenarios – seeing people at checkpoints in a maze, being lost in a bat cave, or even just hearing the background music from the computer game"... These interpretations suggest that not only was sleep necessary to "consolidate" the information, but that the dreams were an outward reflection that the brain had been busy at work on this very task.[43]

Spaced repetition works. In the 18 years I've been learning Chinese, I've re-learned thousands of characters. Every time I re-learn a character, it becomes a bit more solidified in my long-term memory. My son attends a weekly Chinese class this summer that isn't teaching new characters but reinforcing characters learned during the school year. Without reinforcement, kids quickly forget. Twenty minutes of Chinese homework a day really helps retain knowledge. Combining spaced repetition with studying right before you go to bed is especially powerful.

Young brains are more plastic than older brains

Though my written and spoken Chinese vocabulary is much larger than my son's, he has a better ear for rapidly spoken household Mandarin than I do. Depressingly, for me, he learned this in one-third the time! Watching a child learn faster than you're capable of learning is humbling.

Young brains are more plastic than older brains, partly because they've formed fewer habits and partly because their biochemistry is amped up for learning whereas older brains are more resistant to change and more likely to trust existing beliefs and habits than adopt new ones.

Mice and rats have been genetically engineered (as embryos) to have super-normal levels of the NR2B gene, which helps brain cells communicate. These "supermice" form more powerful memories: "Hobbie-J, named after a Chinese cartoon character, can remember objects for three times longer than other rats and is better at finding its way through mazes.... 'Hobbie-J can remember information for longer. It's the equivalent of me giving you a telephone number and somehow you remembering it for an hour.'"[44]

Researchers hope to create drugs that enhance learning and memory, but learning too easily could be harmful because: 1) Being selective about what we learn helps us remember important things while sparing us the burden of remembering unimportant things; and, 2) Relying on established knowledge and habits accumulated over decades may be superior to replacing them with whatever beliefs and habits today's experience suggests. Evolution has tweaked us to learn faster in youth and slower as we age:

> Your brain has a set of receptors known as NMDA which help with memory formation and

> learning. When you are younger, the NR2B gene helps control these receptors, but after puberty, the NR2A gene tends to take over. The difference between the two is slight: NR2B helps receptors stay active for just milliseconds longer, but that's enough to have a noticeable effect. The switch between expressed genes is part of the reason why we seem to learn so quickly and easily in our youth, but have difficulty with new concepts as we age.[45]

Because kids are learning so much so quickly, it's especially important parents help them develop good habits and expose them to quality learning opportunities.

Praise effort and perseverance, not intelligence or talent

85% of American parents praise their children for being smart.[46] (And, I'm guessing, 100% of grandparents.) Research suggests this is unwise. Children praised for being smart (or "talented" at math, etc.) – rather than for learning diligently and enthusiastically – come to believe intelligence is fixed and not improvable via learning. Kids saddled with this false belief react in a variety of self-destructive ways.

Some "smart" kids figure they can lazily slide by because they're inherently smart. Other "smart" kids become dysfunctional, miserable perfectionists always struggling to live up to their "smart" label. Others become hyper-competitive jerks, viewing learning as a contest against one's classmates rather than a process of self-improvement.

Other "smart" children struggle to learn something and think, "I'm actually *not* smart" and stop studying so hard because they believe education is about smart-versus-dumb rather than diligent-versus-lazy.

The final category of "smart" children is perhaps saddest of all. Many "smart" kids shun learning opportunities that might demonstrate they're not as smart as parents, teachers and peers believe. Kids think, "If I try and fail, then I'm not really smart. Better to not try than try and fail." (Willfully harming one's performance to rationalize failure is called "self-handicapping.")

> Students for whom performance is paramount want to look smart even if it means not learning a thing in the process. For them, each task is a challenge to their self-image, and each setback becomes a personal threat. So they pursue only activities at which they're sure to shine—and avoid the sorts of experiences necessary to grow and flourish in any endeavor. Students with learning goals, on the other hand, take necessary risks and don't worry about failure because each mistake becomes a chance to learn.[47]

Many such kids even resort to lying to protect others' positive images of them: "40 percent of those

whose intelligence was praised overstated their scores to peers. 'We took ordinary children and made them into liars,' [Stanford professor Carol] Dweck says."[48]

Dweck has conducted many studies showing the dangers of praising intelligence and talent – rather than effort, perseverance, and an adventuresome spirit. For example:

> [R]esearchers observed, and coded, praise from parents with children 14 months old to 38 months old to see if it was more person-based ("you are really smart") or process based ("you must have tried really hard"). When the kids were 7 and 8, they checked back to see how they felt about taking risks and whether qualities like intelligence were fixed or malleable.
>
> The process kids won. "The parents who gave more process-praise had children who believe their intelligence and social qualities could be developed and they were more eager for challenges," Dr. Dweck [said]…
>
> Kids who are told they are smart care more about performance goals and less about learning. Kids praised for their efforts believe that trying hard, not being smart, matters. These kids are "resilient" and take more risks… "If your whole goal is to look smart, you can't enjoy something when you are not looking smart," Dr. Dweck told me.[49]

We should praise our kids for enjoying learning and for persevering when confronted with challenges. Dweck recommends focusing your child on effort and the positive outcomes effort produces. I suggest encouraging comments like these:

- "That book is long and uses many difficult words, yet you read the entire book. Good job."
- "I know you were frustrated when you got stuck on some of those math problems, but you kept working and found the answers. Super."
- "I'm impressed you've learned so much about dinosaurs. And thanks for teaching me things I didn't know."
- "You're playing the new song more fluidly than last week. All that hard work is paying off. I'm enjoying hearing you improve a bit each practice session."
- "I remember when you first skated holding on to an orange traffic cone. And now look at you, skating backwards on one skate! All that hard work has really paid off."

You don't want your child to feel you're manipulating them. So praise must be honest and heartfelt and based on your child's real achievement. Empty, false praise is harmful, as former D.C. schools chancellor Michelle Rhee explains:

> We've lost our competitive spirit. We've become so obsessed with making kids feel good about themselves that we've lost sight of building the skills they need to actually be good at things…
>
> I have two girls, 8 and 12, and they play soccer. And I can tell you that they suck at soccer! They take after their mother in athletic ability. But if you were to see their rooms, they're adorned with ribbons, medals and trophies. You'd think I was raising the next Mia Hamm.
>
> I routinely try to tell my kids that their soccer skills are lacking and that if they want to be better, they have to practice hard. I also communicate to them that all the practice in the world won't guarantee that they'll ever be great at soccer. It's tough to square this, though, with the trophies. And that's part of the issue. We've managed to build a sense of complacency with our children.[50]

When everyone gets an award just for showing up, awards lose their significance and motivating power.

Dweck especially hates professors' frequent use of "hard working" in recommendation letters as a polite way to say a student isn't bright: "'Hard working' is what gets the job done. You just see that year after year. The students who thrive are not necessarily the ones who come in with the perfect scores. It's the ones who love what they're doing and go at it vigorously."[51]

To encourage a learning/growth mindset, deemphasize performance

> People with performance goals, [Dweck] reasoned, think intelligence is fixed from birth. People with learning goals have a growth mind-set about intelligence, believing it can be developed.[52]

In Silicon Valley, "IC" doesn't stand for "integrated circuit" but "Indians and Chinese" because people from these nations are so prevalent. Americans tend to think of Chinese and Indians as smart. But they consider themselves hard working: "A college physics teacher recently wrote to Dweck that in India, where she was educated, there was no notion that you had to be a genius or even particularly smart to learn physics. 'The assumption was that everyone could do it, and, for the most part, they did.'"[53]

Many Americans attribute academic performance to intelligence, and many studies have shown that many African-Americans suffer from "stereotype threat," i.e., fear of reinforcing the stereotype that African-Americans are less intelligent. Just as kids labelled "smart" are afraid to try because failure would imply they aren't smart, so too many African-Americans are afraid to try because failure would reinforce the stereotype that African-Americans aren't smart. An interesting study had Stanford students write encouraging letters to "at risk" student "penpals." Some students were further instructed

to emphasize "that intelligence is not a finite endowment, but rather an expandable capacity that grows —"like a muscle"—with mental work" and that "Because intelligence is malleable, humans are capable of learning and mastering new things at any time in their lives."[54] Relative to other letter-writing students, those who emphasized the malleability of intelligence changed their own attitudes and boosted their future academic performance:

> African American students, after just three sessions of advocating the malleability of intelligence, created an enduring and beneficial change in their own attitudes about intelligence. This change improved their academic profile to a significant degree: compared to their counterparts in either of the two control conditions, they reported enjoying and valuing academics more and they received higher grades. The intervention had some of the same positive effects for White students, though not to the same degree.[55]

Hugely successful people understand that hard work drives success. Ordinary people tend to think success comes from genetics. Jeremy Lin doesn't "look" like a basketball player, let alone a quality NBA player, but he became one through his passion and incredible work ethic:

> Lin's perfectionist tendencies came out in a 3-point-shooting drill called "beat the ghost," in which Lin earned 1 point for every shot he made at the arc and the "ghost" earned 3 points for every shot Lin missed.
>
> On one occasion, Lin made 17 3-pointers but lost 21-17, then kicked the ball in anger, Scheppler recalled with a chuckle. He refused to stop until he beat the ghost. It took 14 games. When Scheppler tallied up all of the scores for the day, Lin had converted 71 percent of his shots from the arc. "That's the beauty of Jeremy Lin," Scheppler said. "It's not about moral victories. It's 'I have to win.' "
>
> …He was the first to arrive every day, and the last to leave. He sought and devoured game tapes. When he requested his own [film] clips, Lin asked to see his turnovers and missed jumpers, not his assists.[56]

Many criticize NBA teams for not drafting Lin after he graduated from Harvard. The "obvious" explanation is that scouts overlooked him because he was Asian-American, but:

> The New York Knicks sensation is thriving not because his skeptics were wrong. Lin is thriving because he realized they were right.
>
> He really was too willowy to survive the muscled forest of an NBA defense. He really was lacking a consistent jump shot. So Lin rewrote his scouting report, reinventing himself shot by shot and pound by pound.
>
> "That's the lesson here: If you don't like the way things are going for you in a sport, don't cry

> about it. Don't whine to the coach. Do something about it," said Doc Scheppler, who helped Lin refine his shooting fundamentals.
>
> Over the span of more than three body-transforming months, Lin doubled the amount of weight he could squat (from 110 pounds to 231 pounds), nearly tripled the number of pull-ups he could do (from 12 to 30) and abandoned the shooting form he'd been using since eighth grade (he's now among the most accurate point guards in the NBA).[57]

Lin's story is about the power of believing in oneself and always pushing to become better and to overcome all obstacles. Ability/talent isn't something you either were or weren't born with. It's something you develop.

Dweck has shown that those with this growth mindset outperform because they consider failure proof they haven't yet worked hard enough, not proof they lack ability.[58] After Lin went undrafted, he didn't blame racism. He also refused to accept that he wasn't NBA material. He listened to his critics and improved everything they complained about.

Other researchers have found that people who dwell on their failures – rather than commit to improving and doing better next time – are miserable and that their self-pity (or self-hatred or self-doubt) and unhappiness set the stage for future failure:

> Our three studies provide evidence that dwelling on negative achievement-related information can trigger a host of adverse outcomes. Unhappy individuals were found to be keenly responsive to unfavorable social comparison feedback, perhaps relying too much on other people as standards for self-evaluation. The consequence is that they suffered in their moods and appeared to be plagued with negative, invasive thoughts (e.g., Why did I do so badly? Maybe I did deserve that C after all). Such thoughts are likely to intrude during important activities… [T]he dwelling on negative experiences that appears to characterize unhappy people has some dire consequences —for their functioning at school, work, and social settings—and, ultimately perhaps, for their levels of enduring well-being.[59]

Creativity

> If you teach children what you know, they may remember enough to follow in your footsteps, but if you teach children how to learn, they can go anywhere.[60]

Educated, socioeconomically advantaged parents seem obsessed with getting their kids admitted to top colleges, partly because global competition, software and robotics are destroying traditional middle class jobs. They want to give their children the best opportunity to become innovators, rather than be innovated out of a career. I believe they're overly optimistic about the value of a prestigious university

degree as a ticket to employment nirvana.

What's truly valued – and immeasurably enjoyable – is creating amazing new things. An elderly gentleman in a Portland cafe sat next to a young man working on a MacBook and complained:

> [Apple's] trying to get everyone to use iPads, and when people use iPads they end up just using technology to consume things instead of making things. With a computer you can make things. You can code, you can make things and create things that have never before existed and do things that have never been done before.
>
> That's the problem with a lot of people. They don't try to do stuff that's never been done before, so they never do anything, but if they try to do it, they find out there's lots of things they can do that have never been done before.[61]

The elder gentleman, Russell Kirsch, continued: "I created the world's first internally programmable computer. It used to take up a space about as big as this whole room and my wife and I used to walk into it to program it. I also created the first digital image. It was a photo of my son. …[N]othing is withheld from us what we have conceived to do."[62] The secret to life, advises Kirsch, is to dream big and make your dreams reality. No textbook will help you imagine and create something that doesn't exist.

As creativity and innovation grow increasingly important, doing well in school is an increasingly uncertain path to career success. Kids dropping out of college to pursue personal projects – like Bill Gates and Mark Zuckerberg – are striking it rich while many recent college grads find themselves unemployed and back home with mom and dad.

Billionaire Peter Thiel cofounded PayPal and was Facebook investor numero uno. He makes a surprisingly strong argument that college has become an overpriced luxury because what really matters is creativity and stick-to-itiveness. The average student leaves college $24,000 in debt,[63] and "more than three million households now owe at least $50,000 in student loans."[64] Some students, especially after grad school, are hundreds of thousands of dollars in debt before taking their first job... if they can find one: 29% of 25-to-34-year-olds are living with mom and dad.[65] Thiel spent $2 million to encourage students to drop out of top colleges and become entrepreneurs by offering them $100,000 to jumpstart innovative businesses. Thiel argues college is absurdly expensive and provides little of professional value that could not be acquired working: "Talented, motivated, creative people tend to earn more than their peers throughout life. In today's world, they're also more likely to complete college. Colleges, for obvious reasons, claim that *they* make all the difference. There's a similar

difference in earnings between Brooklynites who work in Manhattan and Brooklynites who work in Brooklyn. Anyone who thinks that crossing the Brooklyn Bridge makes people more productive should think about buying it."[66] The jury's still out on his experiment, and Thiel himself has undergraduate and graduate degrees from Stanford, so he has been criticized for hypocrisy. And college should broaden minds, not just train employees. But Thiel's argument has found a receptive audience and resonates more today than in decades past.

Even in the pre-Internet world, innovation and creativity were more valuable than transcripts and diplomas, says the founder of Atari:

> Nolan Bushnell once almost destroyed his family's garage. As a youngster in Utah, he went tooling around with a liquid-fuel rocket on a roller skate and things went awry. He (and the garage) survived, and Bushnell went on to be a lifelong innovator — from Pong to Chuck E. Cheese's…
>
> Bushnell's philosophy is about having hobbies that bear fruit, like tech whizzes tinkering in garages and dorm rooms. By some reckonings, bachelor's degrees won't be worth much in the future, because they will be so common…
>
> "When I hired engineers and people on the creative side, I never looked at their grades," he said, referring to the teams he built at Atari and beyond. "I interviewed them strictly on their hobbies, and if they did not have a hobby in technology I wouldn't hire them… Kids, when they make, are actually preparing themselves better for the jobs they'll have in the future than [they are by] getting straight A's."[67]

School rewards generalists who absorb a fixed body of material to pass tests. But life isn't about digesting mountains of prepackaged facts. Real life rewards people who do one or a few things really well, ask provocative questions, and work well with others to design and execute innovative solutions. Deeply developing a few – hopefully related or combinable – skills and combining them in clever ways gives you a good chance to succeed, as *Dilbert* creator Scott Adams explains:

> It's unlikely that any average student can develop a world-class skill in one particular area. But it's easy to learn how to do several different things fairly well. I succeeded as a cartoonist with negligible art talent, some basic writing skills, an ordinary sense of humor and a bit of experience in the business world. The "Dilbert" comic is a combination of all four skills. The world has plenty of better artists, smarter writers, funnier humorists and more experienced business people. The rare part is that each of those modest skills is collected in one person. That's how value is created.[68]

Much formal learning – especially in primary school – is deductive. There's one correct answer. 2 + 2 can only equal 4. Problems with one right answer are "closed questions." Answering them requires

"convergent thinking." So we train students to converge on *the* answer. But, while students certainly must learn 2 + 2 = 4, convergent thinking is insufficient. Divergent thinking – a skill gained by grappling with "open questions" – is also essential. But standardized tests test only convergent thinking.

Every day, you make many decisions that have no "right" answers. What food should I buy? Where should I live? Who should I marry? What career should I pursue? Should I have kids? How should I raise my kids? Few of life's big questions have true/false answers. That's also true of life's little questions: Which toothpaste should I buy? Should I go for a run or skip it to work longer? And divergent thinking was essential to every scientist who added to human knowledge and to every entrepreneur/inventor who created an innovative product or service.

Figuring out "the answer" is often the easy part. Finding the right question is harder and more important, yet our schools don't even try teaching kids to ask great questions. Kids who don't learn to question, think independently and trust their judgment grow up to be adults so stressed about pressing tasks at work that they fail to realize they'd be happier at a different employer. Instead of finding a job with reasonable expectations, they pour time and energy into surviving a job that's driving them mad. Or they fail to appreciate how much healthier and happier they could be if they committed to an exercise schedule. Or their health is deteriorating but so slowly they never schedule a doctor's appointment. Because real life demands people skills, skepticism, creativity, sound judgment, etc., kids must learn more in school than which bubbles to fill in with a #2 pencil. They need practice identifying interesting research topics. They need practice listening to and expressing their emotions and identifying sources of anxiety and devising plan to address them. They need practice imagining and creating things. They need practice analyzing issues and debating them thoughtfully.

Instead of growing more creative as we age, our minds develop tunnel vision. Kids are much freer thinkers and do astonishingly better on open-ended questions like "How many uses can you think of for a paper clip?" In one study, 98% of kindergarteners, 32% of 10-year-olds, 10% of 15-year-olds, and just 2% of adults were rated "divergent thinking geniuses."[69] Why? As we age, censor our thoughts more. We worry more about what others think of us. We develop a much clearer sense of "the box" and develop a habit of staying within it. But another reason our minds close is schooling's fetish for convergent thinking.

The dominant model of a teacher standing at a blackboard (or today's equivalent, a "Smartboard")

filling students' brains with knowledge deserves derision because children taught didactically fail to question or engage with the material. At best, kids memorize and regurgitate whatever the teacher or textbook says and believe the subject matter contains little else worth investigating, exploring, questioning, or discussing. Here's proof: Kids were introduced to an unfamiliar toy in different ways. Kids who had an adult show them a feature of the toy didn't bother exploring it further and didn't discover it had several other interesting features. Kids given the toy with no explanation found many more of the toy's features.[70]

If your entire education is based on formal classroom instruction, you'll never learn to explore and discover for yourself. That's pretty much the traditional Chinese educational process. I've seen "successful" Chinese students complain angrily that they can solve thousands of math problems but never learned to think for themselves or be creative. The Chinese government, realizing this is a huge problem, is looking for ways to develop more creative students. China's educators have been looking to America to become more like us, even as we look to China's students – who would score extremly well on our standardized tests – with a jealous eye. Educational reformers urge us to replace the "sage on the stage" with a "guide on the side," i.e., a teacher who doesn't lecture but helps students learn more organically, motivates kids, helps them collaborate, suggests projects, provides one-on-one help when a student is struggling, etc. Americans judge our schools based on math and English test scores when we should care much more about which schools are teaching mind-expanding subjects like art, music, debate, programming, chess, and foreign language.

Teach your children the scientific method

The amazing technologies, inventions, and discoveries of recent centuries wouldn't exist without the scientific revolution. The key principle underlying science is so simple it can be understood by children: theories must be tested against evidence. Even babies are natural scientists, playfully testing which toys float in the bathtub and which sink. Less playfully, kids naturally search for the optimal strategy to use on their parents, like testing whether daddy will buy me that that toy if I cry and scream, which is why you really don't want to reward bad behavior. Scientific progress is a scaled-up, humanity-wide version of playing in a bathtub wherein new knowledge builds atop existing knowledge, year after year, decade after decade. To test an idea, run an experiment. Kids can be taught to do this. Think up your own or Google "science experiments for kids." Teach children that when they think, "What would happen if...," they can create an experiment. Figuring out how to test something is a

wonderful challenge. It can be simple or extremely difficult. Finding the Higgs Boson cost nearly $5 billion and a decade of hard work. Luckily, most experiments are cheaper and faster. But kids can also be inspired by stories of scientists running tests with space telescopes and supercolliders.

Teaching kids to test theories is hugely valuable, especially since American schools stink at teaching science as *an investigatory process*, rather than just piles of facts accumulated by dead people and compiled into static textbooks titled *Chemistry*, *Biology*, and *Physics*. Theories always stand open to challenge. Newtonian physics looked rock solid till Einstein noted flaws and made predictions – like the bending of light around stars – that new experiments validated.

Nearly 400 years ago, Galileo spent the last decade of his life imprisoned by the Pope for (correctly) saying the Earth revolves around the Sun and rejecting the Church's claim that the universe revolves around Earth.[71] Today, the Catholic Church owns an Arizona observatory run by priests[72] who accept the scientific consensus on "the Big Bang" but believe God caused it. Catholics now accept science's ability to explain more and more phenomena that humanity once found inexplicable (and tended to attribute to gods). But many other religious people remain intolerant of scientific discoveries – and even the scientific method itself – because some scientific conclusions contradict their religious beliefs. Religion-based hostility to science is a huge problem for American science teachers. Colorado environmental science teacher Cheryl Manning taught her students basic climate change facts proven in scientific studies and asked students to research further:

> three students came to class up in arms. They questioned whether the data was made up and if government scientists were part of a plot... "Peer-reviewed science is the Kool-Aid of the left-wing liberal conspiracy," they said, adding a warning: "Be on your guard."
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> Manning's superintendent backed her up, and the parents eventually pulled their kids out of school… "Lots of teachers I talk to just won't teach it," said Manning, a geologist before turning to teaching 16 years ago. "They'll teach about the historical changes but not current trends. Science teachers already get so much pushback on evolution vs. creation that they're reluctant to invite more controversy. And some teachers don't know that much about climate change themselves. They're not sure how firm the ground is they're standing on."
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> …[A]n online poll of [the National Science Teachers Association's] 60,000 members found that 82 percent had faced skepticism about climate change from students and 54 percent had faced skepticism from parents. Some respondents added comments: *Students believe whatever it is their parents believe*… In a recent survey of about 1,900 current and former teachers by the National Earth Science Teachers Association, 36 percent reported they had been influenced directly or indirectly to teach "both sides" of the issue.[73]

Everyone is entitled to their own opinions but not their own facts. Science hardly knows everything, but when science speaks clearly, valuing one's personal or religious opinions over scientifically proven reality is foolish and damaging to your kids.

Evidence for evolution is as close to conclusive as anything can be. Our planet is littered with billions of years of fossils consistent with the theory. Yet over half of Americans reject evolution in favor of beliefs science has proven false:

- 39% believe "God created the universe, the earth, the sun, moon, stars, plants, animals, and the first two people within the past 10,000 years"
- 60% believe "There was a flood within the past 10,000 years that covered all of the earth and was responsible for most of the rock layers and fossils that are seen across the world"
- 40% believe "Dinosaurs lived at the same time as people"
- 50% believe "The only reliable way to know for certain about what happened in the past is to have a reliable historic record written by someone who was an eyewitness"
- 35% believe "The theory of evolution is not supported by any confirmed facts"
- 60% believe "All people are descendants of one man and one woman — Adam and Eve"
- 50% believe "The Bible describes the creation of life exactly as it occurred in six days"
- 64% believe "All living things exhibit evidence of having been purposefully designed, which means there must be an Intelligent Force or a God"[74]

These have all been proven false, yet over 150 million Americans believe many of them. In all wealthy nations except America, two-thirds or more of citizens believe in evolution.[75] Given the lousy job US schools and religious institutions are doing with science, it's especially important to teach your children the scientific method and get them excited about science.

I'm not religious but was raised in a wonderful church with researchers and engineers who saw no conflict between religion and science. The scientific method – devising theories and rigorously and endlessly testing them against all relevant evidence – is the only logical foundation on which to build true knowledge. That many Americans reject peer-reviewed science as a conspiracy means our schools

have failed to teach the scientific method, without which we have no solid reason to believe anything. Science does not claim to understand everything, like what or who caused The Big Bang. And no evidence disproves God or Jesus being God's son. (There's also no evidence disproving Zeus or Thor or The Flying Spaghetti Monster. There actually are many "Pastafarians" around the world and a *Gospel of the Flying Spaghetti Monster*[76]). But if you insist every word in The Bible is literally true, you're rejecting science for magical thinking.

In high school, I deeply wanted to believe in God, but logic did not allow me to see the all-loving, all-powerful God I was told existed. "How," I asked, "could such a God allow horrible suffering?" I saw another logical problem in the variety of religions around the world; at most one religion can be true, right? Also, which religion you follow is usually determined by an accident of birth: your parents' beliefs and the society you're born into. Finally, though I have no clue what occurred before The Big Bang, I don't see how positing a deity who created the universe helps because that begs the question "Who created the creator?" But I respect religious people who embrace God (or gods), so long as they don't pressure schools to give "balanced coverage" to scientifically false beliefs. Religion is religion. Science is science. You're free to believe the world is just thousands of years old – in the face of an entire planet full of evidence to the contrary – but don't force my child's science teacher to falsely equate your magical thinking with evidence-based theories.

Science can be wrong: Beer is good for you. Beer is bad for you. Chocolate is good for you. Chocolate is bad for you. Eggs are good for you. Eggs are bad for you. Make up your minds, scientists!

Such flip-flopping occurs when it's hard to run a controlled experiment. Controlled experiments are the fundamental building block of science. Scientists first form two (or more) similar groups of people (or cells or animals) – either by randomly selecting individuals into groups or by pairing individuals into groups based on their characteristics – then give each group a different "treatment." One group gets a drug; the other gets a placebo. One group exercises 30 minutes a day; the other isn't allowed to exercise. And then you watch what happens to the groups.

Unfortunately, people and animals are complex, so studying, say, the long-term health effects of a substance like coffee is extremely difficult. It's hard to force one group of people to drink four cups of coffee a day for 40 years and force another group not to drink any coffee for 40 years. Even if you could dictate coffee consumption, you would need to wait four decades for results.

Instead, scientists cut corners. They cheat on the gold standard of a controlled experiment and

instead say, “OK, this group of people looks similar to this group, except these people have drunk a lot of coffee over the past 40 years while those people didn’t drink any. Let’s compare their health.” This is a worthwhile analysis, but it can’t prove cause-and-effect. A controlled experiment can potentially prove cause-and-effect if you ensure the two groups are similar in all relevant ways except that you’re forcing one group to drink coffee while preventing the other group from doing so.

A retrospective analysis is not a controlled experiment, so it can show only correlation, not causation. People who choose to drink coffee differ systematically from people who don’t: “decaf drinkers are more likely than other coffee drinkers to take care of themselves. They tend to take more vitamins, exercise more faithfully, and eat more cruciferous vegetables like broccoli. They’re even more likely to use seat belts when they drive. And heavy-coffee-drinkers generally smoke more, drink more alcohol, and eat more fatty foods than non-coffee-drinkers.”[77] So, any correlation between coffee consumption and health may be caused by other differences between coffee drinkers and non-drinkers, rather than coffee consumption.

Perhaps coffee lowers heart attack risk but hard-driving “Type A” personalities, people who stay up late partying, and smokers are more prone to heart attacks and drink more coffee. If so, the measured correlation between heart attacks and coffee consumption could be positive or negative, even though the direct effect of coffee consumption is to reduce heart attack risk. Some studies have found that “Heavy coffee consumption may increase heart attack risk,”[78] but more rigorous studies that try to control for differences between coffee drinkers and non-drinkers suggest coffee lowers your risk of death. A 2012 study that tracked 229,119 men and 173,141 women initially aged 50 to 71 for fourteen years concluded “In age-adjusted models, the risk of death was increased among coffee drinkers. However, coffee drinkers were also more likely to smoke, and, after adjustment for tobacco-smoking status and other potential confounders, there was a significant inverse association between coffee consumption and mortality.”[79] Specifically, men who drank 1 cup/day had 6% lower death risk than men who didn’t drink coffee, 2-3 cups/day drinkers had 10% lower death risk, 4-5 cups/day drinkers had 12% lower death risk, and 6+ cups/day drinkers had 10% death lower risk. Someone who understands science can sort through conflicting studies and understand that the most rigorous analyses suggest drinking coffee is probably healthful. That this little piece of information could lower your death risk 10%-12% demonstrates the value of understanding science.

The public is naturally frustrated by media reports of scientific findings that contradict previous findings. Many people respond to this confusion by ignoring science. Instead, we should all become

better informed about the scientific method, especially the inherent limitations of correlation-based analyses. Rather than being a reason to fear science, our frequent use of correlation studies is a reason to teach science more thoughtfully.

Schools should also teach statistics and logic. Deductive reasoning deduces conclusions logically from premises. For example, “If it’s raining, then the ground must be wet.” Inductive reasoning supports – but does not prove – one’s conclusion. For example: “The ground is wet, so it probably rained recently.” Wet ground does not *prove* it recently rained but suggests it’s likely. An inductive argument may be false. Maybe the ground is wet because someone watered the lawn. If you want your children to be successful innovators, worry less about the mountains of facts they know and worry more about their ability to be creative and think critically and logically, differentiating fact from opinion, deduction from induction, and correlation from causation.

Parenting shapes bodies and minds

Our lives sculpt our bodies and minds. Though Patriots quarterback Tom Brady looks nothing like the scrawny college kid pro scouts ridiculed, his NFL experience has bulked up his brain’s ability to process football patterns even more than his now muscular body. Brady’s success derives from striving every day to get a bit better than he was the day before. A quality life involves constantly expanding your knowledge and refining your habits to improve your abilities. Learning and growth is even more critical for children than for quarterbacks with Super Bowl rings.

Habits and instincts can be good or bad. Without proper training, you can teach yourself to play golf badly. An “experienced” golfer who must unlearn bad habits can take much longer to develop good habits than a novice. Children growing up in tough neighborhoods with abusive or neglectful parents develop the equivalent of a bad golf swing in many aspects of their lives. Conversely, good parents are skilled coaches for their children, teaching them directly and putting them in situations where they can acquire valuable skills and habits.

Good parenting exposes your child to useful ideas, facts and experiences and helps your child engage in activities that exercise their bodies and build desirable neural patterns in their brains. If your teen hangs out with kids who enjoy knocking down mailboxes and mocking teachers, her moral, social and intellectual brain development will be far different than if she hangs out with kids who study hard, respect teachers, and participate in extracurriculars.