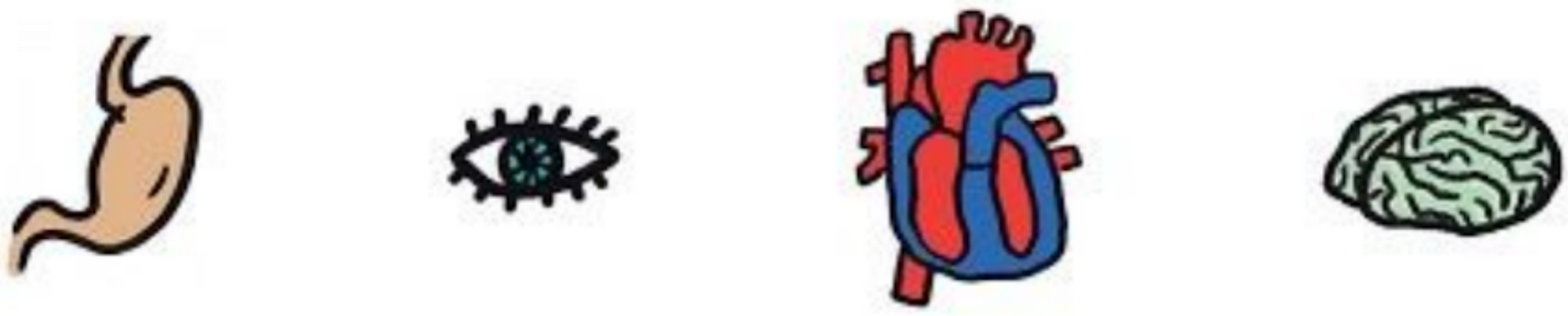
IF OUR BODIES COULD TALK

Operating and Maintaining a Human Body



JAMES HAMBLIN, M.D.

"If you want to understand the strange workings of the human body, and the future of medicine, you must read this illuminating, engaging book." —Siddhartha Mukherjee, author of *The Gene*

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About the Author

PROLOGUE

My medical school roommate became an ophthalmologist and moved to Texas. He encouraged me to address here the most common question that people ask him in conversation when they learn his occupation:

If I lose a contact lens in my eye, can it get into my brain?

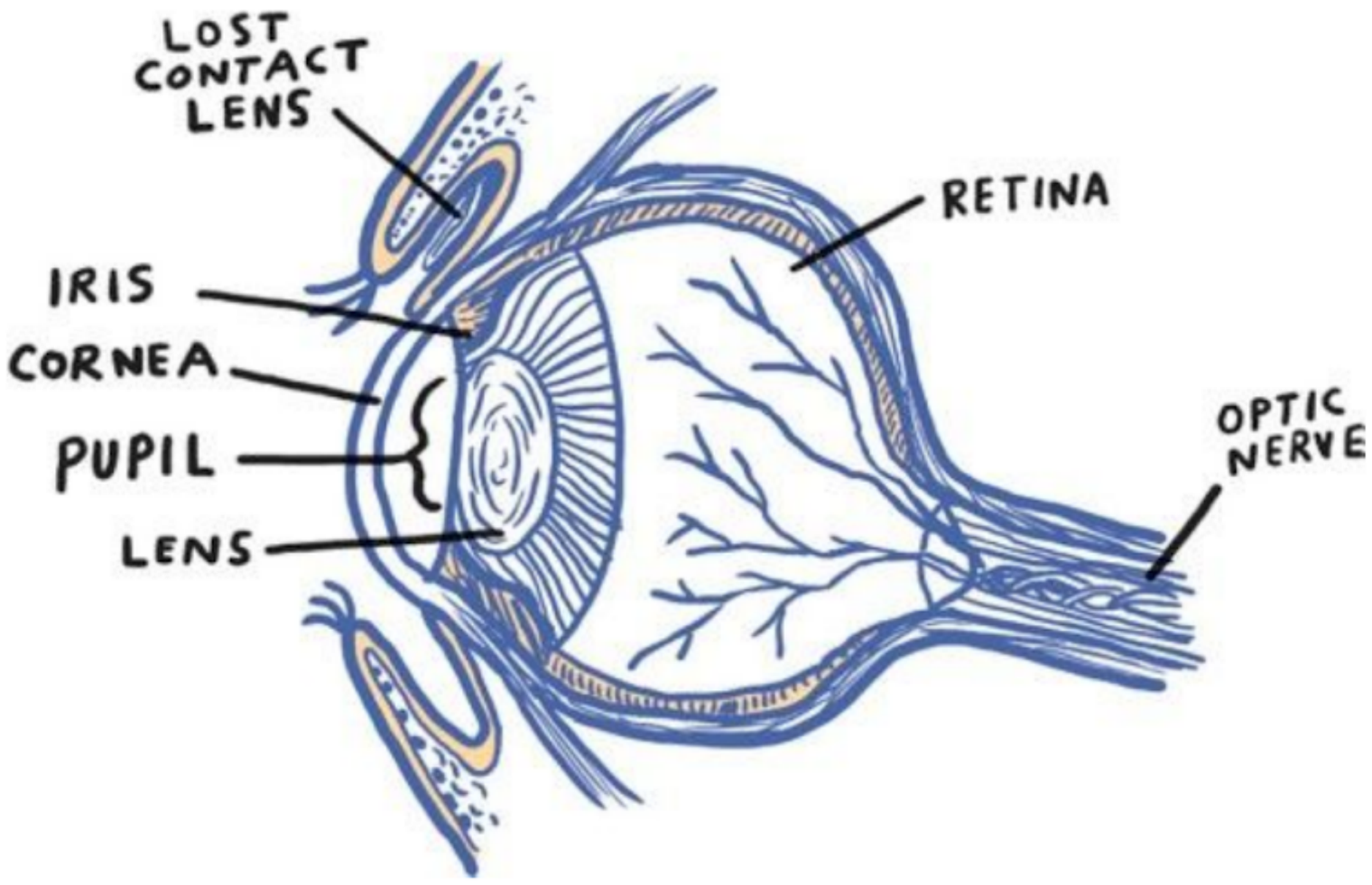
I laughed. He didn't. The question has lost its humor to him.

There are common, debilitating eye diseases that people could be asking him about—like macular degeneration, or night blindness, or glaucoma, which will affect 112 million people by 2040, leaving many without sight.

That last one resonates with me because I have it. The pressure inside my eyeball is higher than it should be. My eye won't explode—though that image does absurdly haunt me. The decline in most glaucoma is, rather, insidious. I'm told I won't even notice as my eyes "fail"—a term that doctors use commonly, unthinkingly, until we're the ones whose parts are failing. It's more accurately the case that the pressure inside my eyes will gradually damage the dense focus of nerves in the retina at the back of my eye. I stand to slowly lose vision at the peripheries of my field of view, and then entirely.

This won't happen for *years*.

Which is all to say that we have our reasons for concerns about our eyes and other parts. Every one is valid. Sometimes it helps to put them in the context of other people's problems—of how bad things could be. But sometimes it doesn't. So, to the question at hand: The space under our eyelids does not connect to our brains. It's a cul-de-sac that ends about halfway over our eyes. Our brains are safe from contact lenses.



This anatomy is something you might have seen if you were among the forty million people who experienced the most popular traveling museum exhibition of all time: Body Worlds. Though you may have missed the cross sections of human heads if you were too distracted by the corpses that were posed having sex. That element of the exhibition shocked many attendees, as did rumors about dubious procurement of the bodies. Maybe most shocked was the art world, though, by the very fact of the enormous and enduring popularity of an exhibit that might have been alternatively titled Actual Corpses.

Of all the art bestowed to us throughout history, why should what is essentially a glorified biology lab be so successful and adored? Especially as most of us are otherwise so averse to discussing so much of what our bodies do, and considering death, in any realistic way?

Body Worlds is the brainchild of the German anatomist Gunther von Hagens, who invented the "plastination" process that allows bodies to be preserved without decomposing. While most exhibits come and go, Body Worlds has now been appearing around the world for more than two uninterrupted decades. It even stays open on Friday nights to accommodate couples who want to make a date of it.

The marketing professor Kent Drummond at the University of Wyoming surmises that Body Worlds speaks to people because it manages to juxtapose our distaste for the abject with our desire to live forever. The displays draw on the sublimity of our mortality without leaving us feeling consumed by it. Drummond

came to this understanding by studying not only the corpses but also living people as they move through the exhibition. He writes in a field note, "In one oft-repeated pattern of interaction, a man points to a body part in a casement, then explains to a woman how that part functions. He does so by showing her where it is on his body."

This masculine exhibitionism may be more sobering than the corpses themselves. It's also in keeping with the grand vision of Von Hagens, who identifies as a "medical socialist." He believes that health information should be a social good: the constellation of factors that go into picking up a cigarette should include an abiding familiarity with a black, necrotic, emphysematous lung, which should not be exiled to textbooks and morgues. Inside Body Worlds, we can clearly see and contemplate our organs and their mortality, if only for one date night. Placards scattered throughout the exhibition urge self-reflection, such as Kahlil Gibran's "Your body is the harp of your soul."

I don't think that means anything, but Von Hagens's philosophy does. Democratizing health information has become the norm well outside the walls of his exhibit. A past world in which doctors were the keepers of all medical knowledge—whose job was primarily dispensing directives—is gone. Most of us are rather awash in information now—so much so that it can be difficult to know what to make of it.

Googling bodily concerns isn't always helpful. Anonymous people in forums can be found debating all things—including the great dilemma of the contact lens. (Can it get far into my eye to my brain and cause damage? What if it goes down my spine and into my shoe? Is it still safe to wear again?) And even when you find a reliable-looking source of health information, there is almost always a ready conspiracy theorist who writes with passion and anecdotal logic to warn everyone not to trust that source. Usually it's a guy on Reddit named Gene. Gene personally lost five hundred contacts in his brain, and he had to have them surgically removed. He has the mass of desiccated contact lenses sitting in a jar on his desk.

While contact lenses can't get into our brains, they can in rare

cases get stuck in the cul-de-sac above or below the eyeball. Like most anything that gets stuck in our bodies, this can be a source of infection. The pus around the contact lens can drain into a person's sinuses and spread into their pharynx. This has happened to me. I thought my contact had just fallen out, but no. Six days later, it came out. In the interim, I got pretty sick.

So, do seek medical attention if you have a trapped contact that is refusing to come out. (I hope everyone read this whole answer and not just the beginning.)

At Stanford University, the gaunt, bespectacled professor Robert Proctor teaches a course called "History of Ignorance." If he believed ignorance were simply the absence of knowledge, cured by imparting facts, his course would be dull. Instead, he argues that ignorance is the product of *active cultivation*. It spreads through marketing and through rumor, and it spreads much more easily than wisdom.

Contrasting his idea with the study of knowledge, epistemology, Proctor has named the study of ignorance *agnotology*. The word is still not in the *Oxford English Dictionary,* though it is relevant to the dictionary's most recent Word of the Year, 😂.

In 1977, a wide-eyed Proctor left home in Indiana to pursue a graduate degree in the history of science at Harvard. There he found himself "disturbed and puzzled" at the apathy that his professors had for "what ordinary people think." He saw it partly as elitism; the rest was a darker sense of futility. "At the time, half of the country thought Earth was six thousand years old," he recalls. That's off by about 4.6 billion years. But more puzzling to Proctor than the discrepancy itself was the apathy toward it on the part of his colleagues in academia. So he decided that someone should study "what people don't know and why."

The classic example of purposeful ignorance is that created by the tobacco industry. Ever since tobacco was clearly proven to cause lung cancer in the 1960s, the industry has attempted to cultivate doubt in science itself. It cannot refute the facts of

cigarettes, so it turned the public opinion against knowledge. Can anything *really* be known?

The strategy was brilliant. Proctor calls it "alternative causation," or simply, "experts disagree." Tobacco companies didn't have to disprove the fact that smoking causes cancer; all they had to do was imply that there are "experts" on "both sides" of a "debate" on the subject. And then righteously say that everyone is entitled to their belief. The tactic was so effective that it bought the industry decades to profit while reasonable people were uncertain if cigarettes caused cancer.

As Proctor put it, "The industry knew that a third of all cancers were caused by cigarettes, so they made these campaigns that would say experts are always blaming *something*—brussels sprouts, sex, pollution. Next week it'll be something else."

Once you start looking for this tactic, it's hard to miss. It's nowhere more common than in the messages about our bodies. Proctor rattles off examples: vaccine agnotology, clitoral agnotology, food agnotology, milk agnotology. He likes to say we live in "the Golden Age of Ignorance." Because of the way information flows, "powerful agencies are able to create ignorance and spread lies through more vehicles than there have ever been in history."

Proctor is not alone in this thought: There's undeniably more scientific misinformation and marketing-based "facts" about our bodies coming at each of us daily than in entire lifetimes of generations past. And as we increasingly read only the articles that appear in our inboxes and curated social media feeds, "it's easier and easier," Proctor says, "to silo yourself into a tunnel of ignorance."

To allow ourselves to be challenged—to welcome it, and to seek it out—is to guard against the purposeful cultivation of ignorance. To be a doctor today is ever closer to its Latin root, *docere* ("to teach"), which I take to mean sharing habits of thought. The challenges for doctors and patients alike are in contextualizing, separating marketing from science, finding the lines between known and unknown, and discerning the motives of the people who attempt to define and redefine health and normalcy. If we all equip ourselves accordingly, we might

reckon with the onslaught of bodily messages and maintain a solid understanding of ourselves that allows us to relate productively to one another and move cogently, even happily, through the world.

So this book is a practical approach to understanding our bodies, predicated on the idea that memorizing facts is less important than developing insight. This is also a corrective to the approach that drove me away from practicing medicine. In premed courses, throughout medical school, and in the three years that I spent in residency, I memorized roughly infinity facts. During that time, it wasn't uncommon for people teaching me to admit that I just needed to memorize these things to pass a test, that no doctors in the real world actually remember all this stuff—all the structures of amino acids, and the names of the small arteries that supply the elbow, and every possible minor side effect of every known medication. These are things that can be easily looked up at any moment. But still, on the exams that propel a person to success in the field, minutiae are currency.

After years of memorization, the overall effect was one of jumping through hoops with the explicit purpose of getting to the next hoop. My mentors advised me that if I didn't love the process by that point, I probably wasn't going to love the end result. So in 2012 I went on leave from the radiology residency at UCLA. I got the opportunity to take a job as editor of the health section of *The Atlantic*'s digital magazine—a publication I had always read and loved. I was happier and more engaged, learning in a way that made sense to me.

So I resigned from UCLA. I justified leaving a very stable, lucrative career for a very unstable industry by the fact that there are not enough science journalists or doctors working in public health. I wanted to have an impact on the roots of problems more than the symptoms, to question the textbooks rather than memorize them, and, ideally, to make people laugh. Journalism allows me to have some hand in public scientific literacy, and that might be, I mean to suggest with this book, the most valuable tool in pursuing health and happiness.

I've yet to regret my decision for any extended period of time.

The book began as a collection of straightforward answers to common questions about bodies, because, professionally and personally, I get a lot of those. It grew to interrogate those questions—why we care, or don't, about how our bodies work, and how our understandings of our bodies shape how we come to believe what's to be done about ourselves. At the root of the most virulent diseases and violent mistreatment of one another is ignorance, and much of that begins with fundamental misunderstandings of our differences—understandings of ourselves and others that begin with our bodies. The questions in this book often began with little more than minor bodily curiosities, which, looked at more closely, are not at all minor.

Many of the answers are, rather, stories about why we don't have concrete answers. Sometimes the most interesting thing is knowing why we don't know, and the point is in the considering, and being comfortable in not knowing. Health is a balance between acceptance and control.

What is normal?

Too many daily decisions about what to put into our bodies—how to put what in where, and what to do with that body once it's full of things—come down to vague ideas of what is good or bad, healthy or unhealthy, natural or unnatural, self or other. In a world of inordinate complexity, we instinctively attempt to put things into these binary categories.

University of Pennsylvania psychologist Paul Rozin believes that we do this to help maintain a sense of order. He calls this instinct "the monotonic mind." Even though we know better, we tend to resist the idea that most things are beneficial in some contexts or amounts, and harmful in others. It's easier to regard things as simply bad or good, to be adored or avoided.

In that tendency to seek order and control, an abiding theme among bodily questions and concerns is the concept of *normal*. The word tends to mean different things to scientists, who use it in every other sentence, with statistical deviation in mind, and nonscientists, who are more likely to hear in it judgment.

Is it normal that I can bend my finger all the way back until it touches my wrist? Statistically, no. That doesn't mean it has

implications for your health.

Maybe more consequential than its normalcy is the simple fact that if you're able to do that, you probably also know that people don't like watching it. The Canadian psychologist Mark Schaller argues that we're wired to be averse to looking at things like people flipping their eyelids inside out—to say nothing of injuries like bones broken or blood outside of vessels—because of a concept called the "behavioral immune system." We're repelled because on some level we sense a threat to our health.

Clearly, if our reactions to eyelid flipping or finger flexibility are an indication, our behavioral immune system is far from perfect at acting on only credible threats. Schaller has implicated this faulty self-preservation instinct in all sorts of behaviors, which lead us to isolate ourselves into cliques and communities based on the appearances and functions of our bodies.

At a grander scale, then, the system he proposes can be seen to be involved in many of the world's fundamental divides (racism, ageism, xenophobia). It stems from our understanding of ourselves—which, again, begins with our bodies. Understanding oneself as *abnormal* can register anywhere between liberating and suffocating.

Or the idea of "normal" can be rejected altogether. A central tenet of the Deaf community, for one, is that deafness should not be considered a disease to be treated or cured. The community does not consider people to be hearing "impaired" and rejects any reference to hearing "loss." The same is true for some other communities long marginalized by some bodily process.

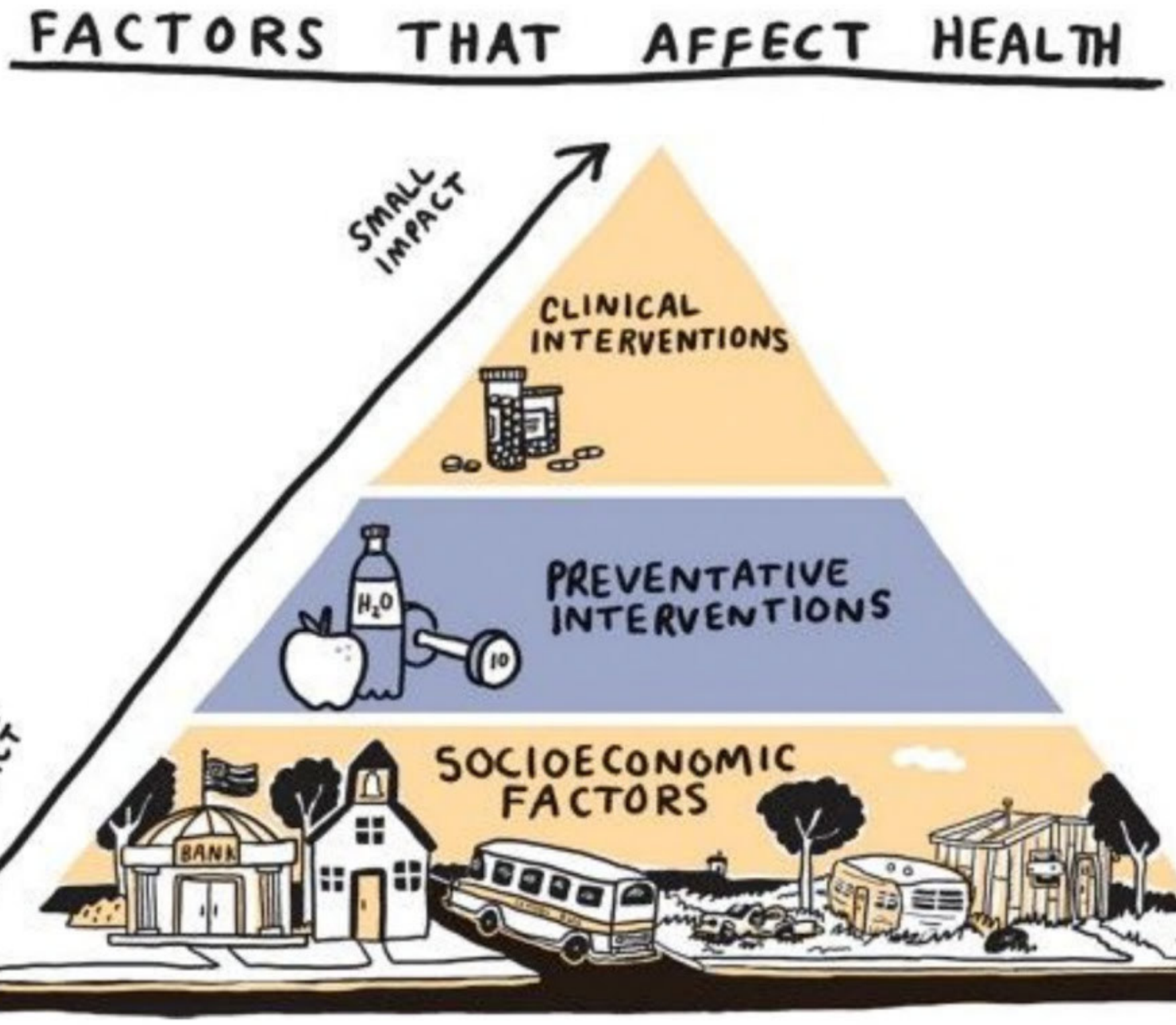
Still, even as normalcy is a loaded concept, it's sometimes a necessary lens through which to understand disease and, ultimately, to reduce suffering. Identifying outliers is central to the study and improvement of health. Science can't skirt the concept of normalcy, and neither can this book. But I do my best here to separate statistically common ways of being from judgments of value, of right or wrong, of implying that there is some ideal way to operate, look, feel, or be.

What is health?

At the founding of the World Health Organization in 1948, the group's constitution defined *health* in a way at once obvious and radical: "A state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity."

With that, the World Health Organization hoped to inspire a new purview for the medical profession.

It failed. In much of the world, "health care" systems still today focus exclusively on the absence of disease or infirmity. More specifically, they focus on treating disease after it already exists. In the last few years, though, an upheaval has begun.



The spring of 2015 saw the swearing-in ceremony of Vivek Murthy, who was quickly among the most controversial U.S. surgeons general. Conservative politicians attempted to block his appointment because of a tweet three years prior. Murthy had written, "Tired of politicians playing politics [with] guns, putting lives at risk [because] they're scared of NRA. Guns are a health care issue."

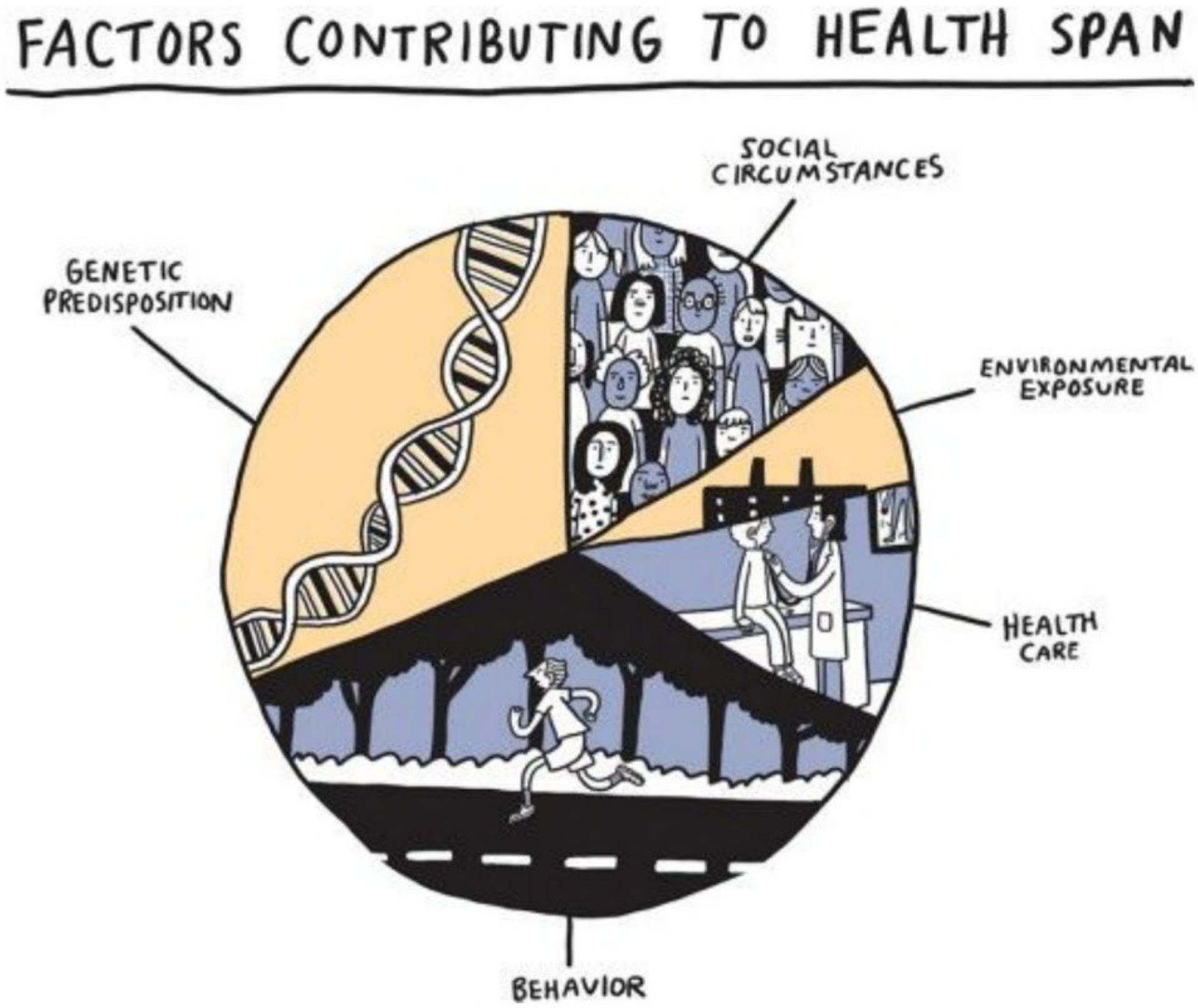
It wasn't even an especially revelatory tweet. Homicide and

suicide are perennially among the leading causes of death in the country, a fact that has recently led the American Medical Association and other physician bodies to recommend that doctors ask all patients as a standard screening question—just as they should ask if patients wear seat belts and have fire extinguishers—if they keep guns in their homes. But it was the sort of tweet that can keep a person out of political office, in a country where the National Rifle Association and its elected officials have forbidden the Centers for Disease Control and Prevention from even studying gun violence.

After a harrowing welcome to politics, Murthy ultimately made it through confirmation. When he took the podium to be sworn in, he spent little time talking about the traditionally paradigmatic doctorly pursuits—treating pancreatitis, performing colectomies or cardiac ablations. Actually, no time on those things. He underscored instead how preventable illness influences and is influenced by education, employment, the environment, and the economy. He called for the building of "the great American community" that will approach health as a unified endeavor.

His words build on a growing movement in the medical profession. While the United States spends the most money per person on health care of any country, it ranks forty-third in life expectancy. And more important than longevity, the United States is near the bottom of the ranking list among wealthy countries in personal health status. In a pivotal 2007 paper in the *New England Journal of Medicine,* physician Steven Schroeder argued that medical care accounts for only about 10 percent of what determines a person's likelihood of dying young. Genetic factors might account for another 30 percent or so. The remaining 60 percent came down to social and environmental circumstances and behaviors. These are necessarily rough estimates, but they serve to push back against the way of thinking that leads us to think about hospitals, pills, and procedures when we think about improving health. Schroeder argues in the journal, "Even if the entire U.S. population had access to excellent medical care—which it does not—only a small fraction of [premature] deaths could be prevented."

This is not to say that modern health care cannot accomplish amazing things in treating diseases, some of which I'll get into in these pages, but that we rely too heavily on a mind-set where our system fixes problems, and not heavily enough on creating systems where these problems do not arise.

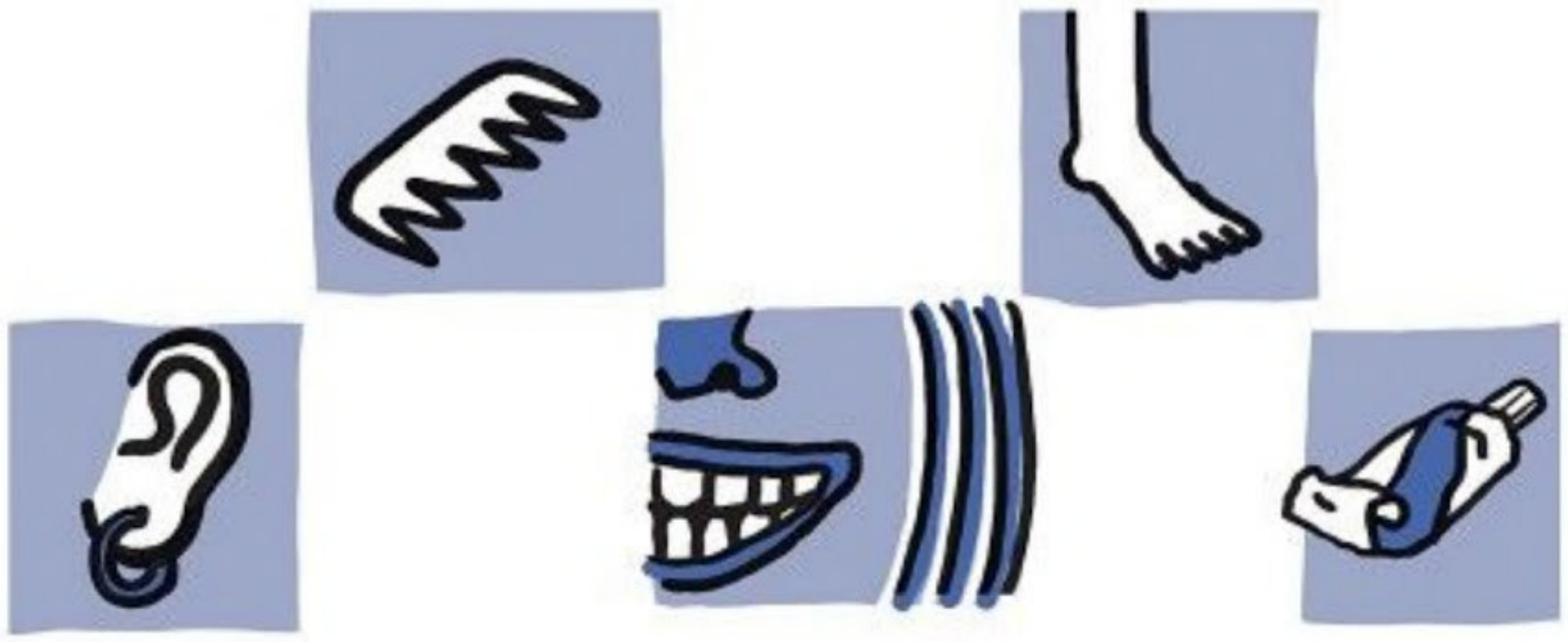


Over the decades, physicians have tended ever more toward specialties (and subspecialties, and sub-subspecialties) that treat discrete organ systems—dermatologic oncology, pediatric autoimmune gastroenterology, neuro-oncology, and so on—which has been critical to managing the wealth of information as science advances. But it has also left behind comprehensive approaches to the conditions that sicken and kill most people, first among them being the disease that we vaguely call "metabolic syndrome." This manifests as a combination of obesity, diabetes, and cardiac death. This is primarily a disease of society, a disease of life.

As patients, the concept can be liberating: Our control over our health is great. And, more interesting, our ability to improve the health of others is great.

A typical textbook of anatomy and physiology is still today broken down by organ systems, based on physical structures. But when it comes to health and disease, organ systems are rarely affected in isolation. Distinctions like "heart health" and "brain health"—the sort still made on everything from cereal boxes to infomercials to ranking of academic medical centers—are outdated. So I divided this book not by traditional organ systems, but by categories of use. Most of the entries can be read in isolation but make the most sense in the context of the others, as read sequentially.

Overall, the book is predicated on something closer to the 1948 definition of health. It is drawn from my experience as a physician and journalist, and the people I've had the opportunity to meet throughout the course of my career so far, and whatever wisdom I gained from knowing them.



PART ONE

APPEARING

THE SUPERFICIAL PARTS

"Butterfly children" are so called because their skin is like butterfly's wings. The name is meant to convey extreme fragility. But the weakness in butterfly wings is only a product of the fact that we are some one hundred thousand times larger than butterflies. In terms of biomechanics, these wings are actually paradigms of efficiency: light enough to be operated by a flying worm a fraction of their size, yet strong enough to hold up under the intense shear force of the wind and torrential rain that would be for us like standing under Niagara Falls.

The skin of a butterfly child, on the other hand, is rather an abject failure of biomechanics. Because of one detail. The formal name of the disease is dystrophic epidermolysis bullosa, or DEB. It's traditionally considered a pathology of the skin, the domain of the dermatologist, because it renders the skin like tissue paper that has been left in the sun. Such skin falls apart at the lightest touch. The condition has no cure. It is the worst disease you've never heard of. I write that without presuming which diseases you have heard of. The trademarked motto of the Dystrophic Epidermolysis Bullosa Research Association is "the worst disease you've never heard of." Its current executive director, Brett Kopelan, coined the phrase in earnest.

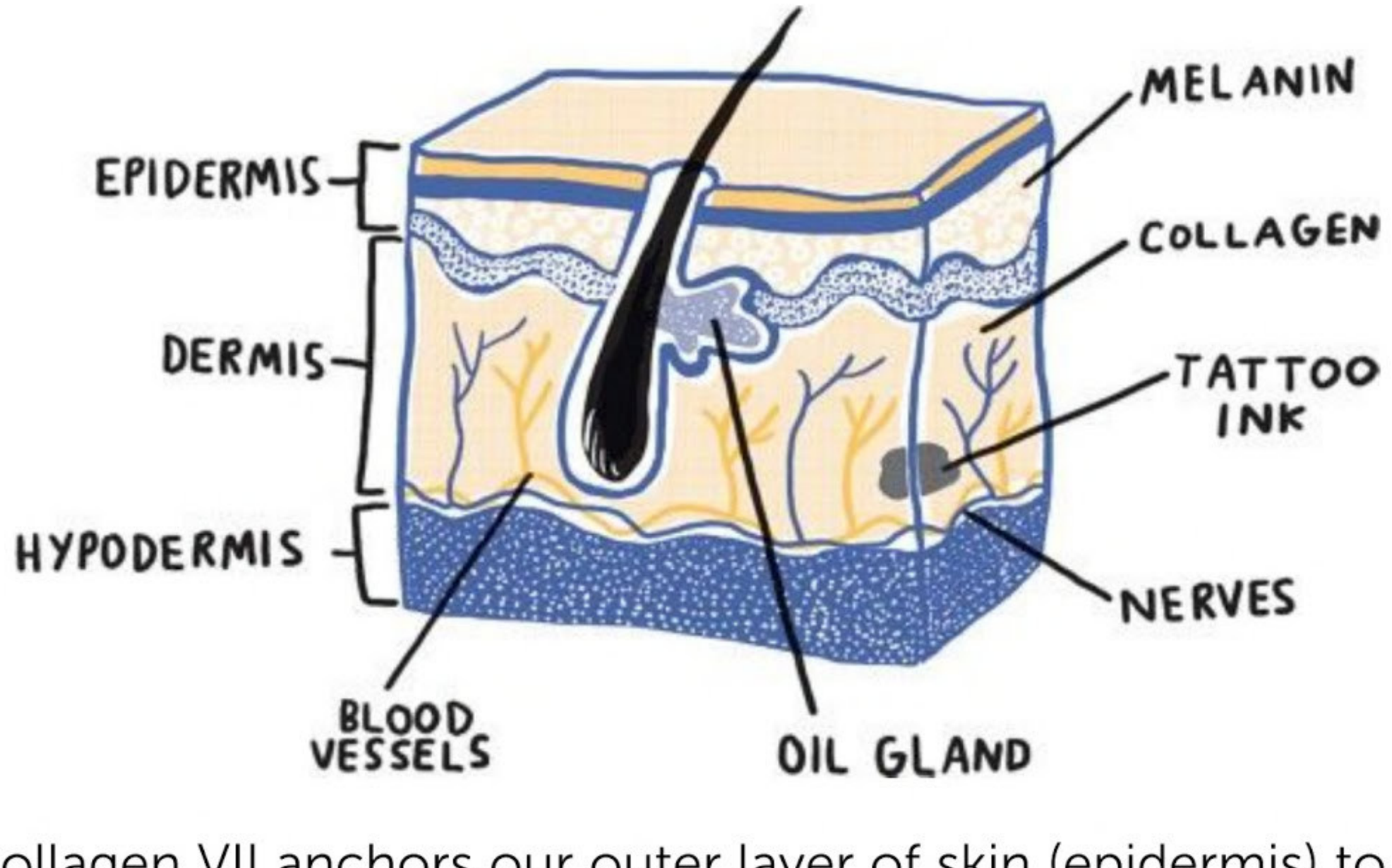
His daughter Rafi was born in a Manhattan hospital on November 19, 2007. Her mother, Jackie, was more than a little concerned that patches of skin were missing on their newborn's hands and feet. She had been two weeks past due, and the doctors initially reassured Jackie and Brett that their baby had been "overcooked." But the casual dismissal proved too casual when over the next few hours Rafi began bleeding. Nurses rushed her to the intensive care unit. There she would spend the first month of her life in complete isolation, undergoing a battery of tests, unable to be touched by her parents. After two weeks the doctors came to the Kopelans with a potential diagnosis, a name that would become their lives.

"They think it's something called *epi-dermo-lysis…bullosa*?" Brett recalls saying in a harried phone call with his brother, who

is chief of surgery at a hospital just across the river in New Jersey, to which the surgeon replied, "Oh, shit." Brett ran to Google and read about DEB. His first thought was that it was the worst disease he'd never heard of.

On the short arm of the third of your twenty-three chromosomes sits a gene called *COL7A1*. It is responsible for the production of the protein that assembles collagen VII. Collagen proteins constitute all of the connective tissue in our bodies, and a third of our total protein. From the Greek for "glue," collagen holds together everything from skin to ligaments and tendons. It comes in several known types (of which collagen VII is one).

Epidermolysis bullosa is a rare disease in several ways, not least in that much of the problem traces to a discrete gene. Most diseases are far more complex than any single gene can explain. But mutations in the *COL7A1* gene seem to be responsible for all three major forms of dystrophic epidermolysis bullosa, of which Rafi's is the most severe.



Collagen VII anchors our outer layer of skin (epidermis) to our base layer (dermis). Without it, the layers separate and the skin crinkles and blisters, coming off at the slightest provocation. When Rafi reflexively scratches an itch, she wounds herself. The seams on her shirt cause blisters. Many mornings she wakes up with her pajamas pasted to her skin in multiple places by dried blood. The extrication is grueling.

And because collagen VII provides structure throughout the organs of her body, this affects not just the skin, but the internal organs as well. Blisters and scars within her mouth and esophagus make it difficult to chew and swallow food. She has eye inflammation that can lead to blindness. She has a very high risk of developing an aggressive type of skin cancer at a young age. She has osteoporosis, syndactyly (fusion of the fingers), and mild heart failure.

Rafi's form of epidermolysis bullosa affects fewer than one in a million infants. For those who survive, life does not involve much interaction with other people. So it is a disease of people whom we are not likely to come to know. The spectrum of what most of us consider normal in our day-to-day lives is skewed strongly away from conditions like DEB, and toward small blemishes. If it weren't, we might be more appreciative of the skin that we have, and the simple fact that it adheres to our bodies.

The average person has about six pounds of skin. Like most (though not all) organs, it's essential to life. If you woke up one day and your skin had vanished, you would quickly die. In what remained of your short life, there would be problems socially. It's the largest and most dynamic organ in the human body, constantly turning over and regenerating. Skin, along with hair, is unique among body parts in that it is dead cells we carry around. In any other organ, dead cells are discarded. But the cells in skin and hair stay along with us for a while and serve important functions, not least of which is social identity and thus the foundation on which the understanding of ourselves is built.

The skin we had last year—last season, even—is not the skin we have today. Most of the cells that compose our bodies are constantly dying and being replaced. Around 8 percent of our genes are not even human, but viral. We are born with viruses woven into our DNA, and we contain trillions of bacteria that are responsible for, among other things, the appearances of our faces, our body weights, and our states of mind. Our bodies are dynamic networks of genetic information shaped by experience, and microbes that change who we are in every moment. We are

born with signals that will tell us to go bald when most people would appraise us more favorably if we had hair, and to be anxious when we needn't be, and to get cancers that we tried hard to avoid. The doling out of years and health and happiness will not be fair.

The seemingly superficial parts, and the way they are perceived by ourselves and others, accumulate into how we understand ourselves, and then into how we move through the world and treat one another.

How can I tell if I'm beautiful? I mean in the purely superficial physical way that I know I shouldn't care about but do because I am a person who exists in the world.

In 1909, Maksymilian Faktorowicz opened a beautification establishment in Los Angeles. Under the name Max Factor, he would become famous for his cosmetic products, which he sold as part of a pseudoscientific process of "diagnosing" abnormalities in people's (mostly women's) faces. He did this using a device he invented called the "beauty micrometer." An elaborate hood of metallic bands held in place by an array of adjustable screws, the micrometer could be placed over a woman's head and, as one of his ads at the time claimed, flaws almost invisible to the ordinary eye would become obvious. Then he could apply one of his "makeup" products, a term coined by Factor, to correct the flaw in this person: "If, for instance, the subject's nose is slightly crooked—so slightly, in fact, that it escapes ordinary observation—the flaw is promptly detected by the instrument, and corrective makeup is applied by an experienced operator." Even if putting on a metal hood that could tell people exactly why they're not beautiful didn't seem wrong on infinite levels, there was also the problem that Factor's micrometer was contingent on an empirical definition of beauty. A device that tells people what's wrong with them is predicated on an understanding of what is right. Max Factor's approach is a textbook example of the sales tactic that is still so successful in selling body-improving products: convince people that there is a deficit in some concrete way, and then sell the antidote.

In the case of facial symmetry, some evolutionary biologists do believe that we are attracted to symmetric faces because they might indicate health and thus reproductive viability. From a strict perspective of evolutionary biology, someone with a prominent growth spiraling out of the side of their eye, for instance, might be viewed as a "maladaptive" choice for a mate. Instincts warn that this person may not survive through the gestation and child-rearing process, possibly not even conception. Best to move on.

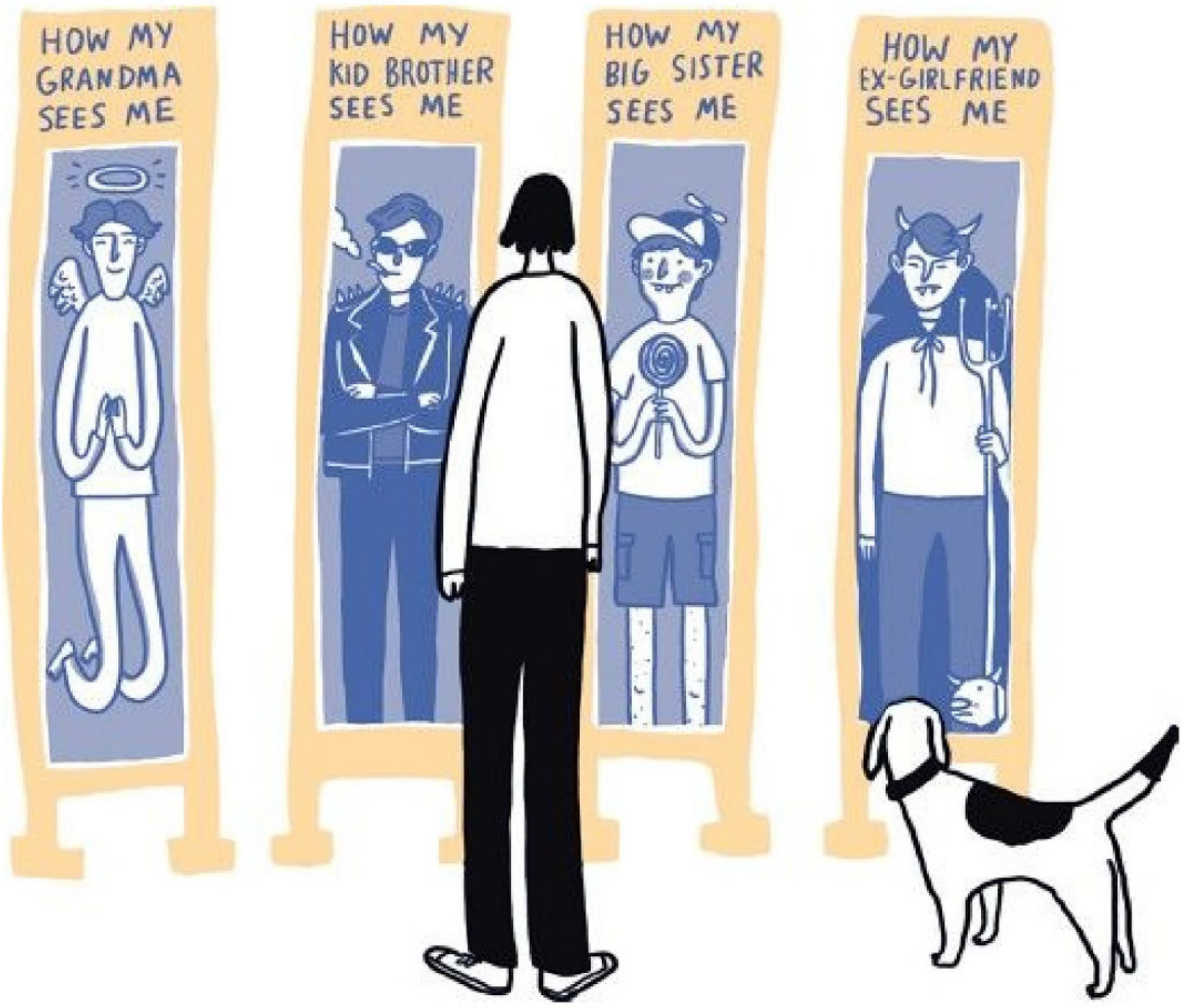
But today most people survive long enough to reproduce and care not just for children, but grandchildren, great-grandchildren, and even domesticated cats. We can be less calculating about who to mate with. We can and do afford ourselves attraction not to some standard of normalcy, but to novelty and anomaly.

While Factor was convincing everyone that they were empirically inadequate based on a standard of normalcy that he created to sell products, the University of Michigan sociologist Charles Horton Cooley proposed a more nuanced approach, called "the looking-glass self." The idea was that we understand ourselves based not on some empirical idea of what is right or wrong about us, but from how others react to us. It's difficult to believe you're physically attractive when the world treats you otherwise, and vice versa. "The thing that moves us to pride or shame," he wrote in 1922, "is not the mere mechanical reflection of ourselves, but an imputed sentiment, the imagined effect of this reflection upon another's mind."

Cooley repopularized the timeless idea that other people are not just part of our world, or even merely important to our understanding of ourselves: They are everything. Technically there are individual humans, just as technically coral is a collection of trillions of tiny sessile polyps, each as wide as the head of a pin. Alone in the sea, the polyps would be nothing. Together they are barrier reefs that sink ships.

The idea of a looking-glass self could seem disempowering, in that our understandings of ourselves are subject to the perceptions of others. A less devastating way of thinking about a world of looking-glass people, I think, is the idea that

everywhere we go, not only are we surrounded by mirrors, but we are mirrors ourselves. It's not the face in the Max Factor machine that matters, but the way that face is received. We can't always choose our mirrors, but we can choose the kind of mirrors we will be—a kind mirror, or a malevolent mirror, or anything in between.



Why do I have dimples?

The muscle that pulls the corners of your mouth up and back (a "smile") is called the zygomaticus. In people with dimples, that muscle is shorter than in the average person and may be forked into two ends, one of which is tethered to the dermis of the cheek, which then gets sucked inward when the person smiles. This is one way that beauty happens.

It's an anatomical anomaly, sometimes even referred to as a "defect." That understanding comes from an oft-cited theme in biology: that form necessarily correlates with function.

gives her a handheld mirror and marks the places where she'd like her dimples. "It's fun to take these people and give them basically what they've always wanted," he says, tonally betraying that he was less than enamored of himself in that moment. A few minutes later he finishes the procedure. Felicia looks in the mirror and says, "Oh my God, I have dimples." And it's true, she does. She looks happy. Though it's hard to say for sure.

Today Aharonov advertises the procedure as safe and effective, even though there is, he acknowledges, "usually a period of time after the dimple creation surgery is done where the dimple is present even when you are not smiling," which could be unnerving. But for people who are jealous of people with dimples, I suppose it's reassuring to know that they're a lunchtime procedure away.

That and, of course, a couple thousand dollars. In Britain, where the procedure had a moment in the wake of Kate Middleton's dimpled ascension, it costs the equivalent of $1,200 to $2,500. Aharonov charges $4,000.

Of course, when there is expensive cosmetic surgery to be had, there is inexpensive cosmetic surgery to be found. On the other side of the planet, the surgeon Krishna Chaudhari of the Cosmetic Laser Surgery Center in Pune, India—where Bollywood films helped spawn dimpleplasty's demand—practices an alternative approach to the procedure, which he demonstrates on his YouTube channel. Even though it's still pretty straightforward as surgeries go, watching it happen there is a surreal experience that I recommend to no one. Chaudhari's video is a montage of still images taken over the course of the operation, first as eight-millimeter holes are punched all the way through a young man's cheeks, and then as a suture is run through the dermis to anchor it to the buccinator muscle. It doesn't help that the lighting makes it look like it's being done in a basement or a cave, or maybe the basement of a cave, and it's set to transcendental instrumental music that could pass for a deep cut from *Dark Side of the Moon*. (If you have to have surgery, and you want to watch a video of the procedure beforehand, ask your surgeon to recommend one before you venture too deeply into the world of Internet surgery videos.)

Many cosmetic surgeons performing dimpleplasty today are doing so by a technique of their own invention. Abdul-Reda Lari, M.D., who practices in Kuwait, spurns the full-penetration approach. He invented a technique that has gained such acclaim that surgeons come all the way from India to learn from him.

"I used to put scissors in and split the muscles," Lari told me. "Now I tend not to do that. I put a knife inside the mouth and scratch the dermis inside the cheek in a vertical manner, and the bolsters [a shaping device Lari designed] keep it in position for up to two weeks. If she's complaining, I can remove it earlier."

He let the pronoun slip there. Almost all dimple clients in Kuwait are women. The same is true elsewhere.

Lari's technique is more complex than most. It involves not one but multiple sutures, and a bolster that must be tied into the inside of the cheek and left there for two weeks. Because using a single suture can leave the dimple looking like an unnatural pinpoint, he believes he gets much better results than others: a vertically oriented dimple that appears only when the person is smiling. His method isn't as popular because the procedure requires a follow-up appointment and a little more discomfort. He has done fewer than one hundred cases. Most people choose the simpler technique because they prefer instant gratification. Plus, Lari says, "I charge on the expensive side, $1,000 for both sides. It takes me two minutes to do it," he says, laughing.

"How much does it cost in the U.S.?," he asked me. He seemed a little disheartened when I told him.

Virginia cosmetic surgeon Morad Tavallali likens the anatomy of a dimple to that of cellulite, which is created by fat infiltration into the skin. There is some potential space that can be filled by fat that has no other place to go except into our skin. But there are fibrous bands within the dermis that resist expansion, so they appear as dimples. Tavallali can do procedures to eradicate this dimpling in a person's thighs, and he can do procedures to create it in a person's face.

Beauty is only ever about context.

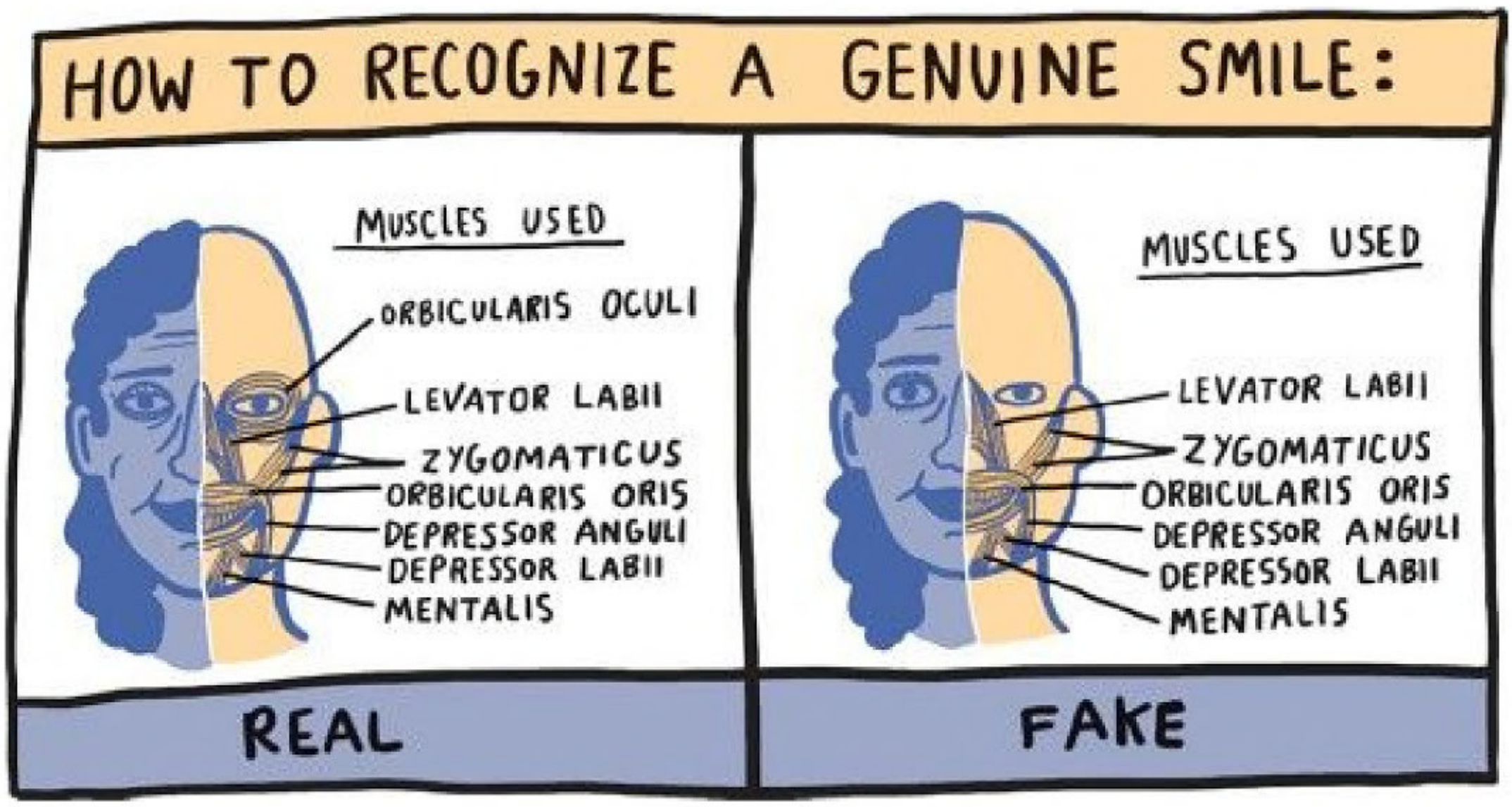
Though they're easy enough for him to create, Tavallali has reservations about surgical dimples. "In some cases, a board-certified cosmetic plastic surgeon may invent a new procedure," he writes on his blog, detailing how a dimple procedure can be performed, but he offers a disclaimer: "It is a surgery that not many plastic surgeons perform, and it's cute but can be problematic! Been there, done that! I no longer perform it!"

Any procedure that's undertaken at cost and risk to patients purely for purposes of conforming to societal norms of beauty "can be problematic." So Tavallali is less likely referring to the massive cultural implications than to the fact that the surgery doesn't always come out looking great. Or at least that it doesn't wear well over time. The long-term appearance of synthetic dimples is unpredictable because they depend on scar tissue. Everyone scars differently. As a spokesperson for one British plastic surgery group said, "Designer dimples could become designer disasters within a matter of years."

A more lucid case against getting dimples comes from Beverly Hills surgeon Aharonov. A decade after ushering in the trend, the creator of dimple creation is contrite.

"There was a period where I was like, 'This is great. This is *my thing*,'" he told me. And indeed, other surgeons still contact him, wanting to learn. It's low risk, high profit, and high demand—Aharonov still gets, by his estimate, twenty to thirty requests for the procedure a day. But, like Tavallali, he has almost completely stopped doing the procedure. He's less than happy with the results. By his estimate, 90 percent of the cases came out well. In 10 percent the dimples were maybe asymmetric, one deeper than the other, or they were too deep and didn't flatten out quite right when the patient wasn't smiling. "To me," he said, "90 percent is just not high enough when it comes to messing with your face."

Aharonov delves into the existential questions of cosmetic surgery. Why do people want an anomaly? Why do people get tattoos and piercings? "It's a desire to be different. A desire to be unique." Or the opposite: a desire to be like someone else they want to emulate.



In that way, these trends are not simply ridiculous, and these surgeries are not dumb. They are matters of social identity. But in the words of Spider-Man's uncle, with great power comes great responsibility. Cosmetic surgeons are arbitrators of motives. "I have to think, am I doing the right thing for this person?" Aharonov told me. "Do they want this surgery for the right reasons?"

Right reasons are difficult to articulate—perhaps undertaking the procedure for the sheer joy that the entire experience would bring to a person's life. But there are definitely wrong reasons. The number one rule of cosmetic surgery is not to aspire to perfection. Even the YouTube commenters—the most judgmental, barbaric people on earth and perhaps elsewhere—on Chaudhari's apocalyptic instructional video seem to empathize. As one described his takeaway, "It's painful and may damage your face but i mean if that's what y'all want I won't hate after all it's your body."

Why don't tattoos wear off?

On a sunny morning at my favorite coffee shop in Fort Greene in Brooklyn I met a woman who was covered in tattoos, and we chatted. She was working on a children's book about why people get tattoos. Some of her tattoos were on her eyelids. Every time she blinked and squinted into the sun, I got to read the words NO FEAR. And then all I could think about was the

thought process behind that tattoo. It's the kind that she will see only when she's looking at herself in a mirror with one eye closed. The eyelid is the most painful place to be tattooed. Is that worth the money and pain? I will have to read her book.

Like plastic surgeons, serious tattoo artists discourage or refuse to leave their mark when they feel it is ill advised or hastily undertaken—especially if that tattoo is in a place as prominent as the neck or face. The philosophy is that tattoos should be undertaken for oneself, and not to impress or make a point to others. An eyelid tattoo walks that line. In this case, it tells everyone she meets about her. Such an ostentatious sentiment tells me that she probably has at least SOME FEAR, if not VERY MUCH FEAR. Why else go to such lengths to advertise fearlessness?

Tattoos also tell me that a person might have hepatitis. One of the most interesting statistics in virology is that people with tattoos are six times more likely to have hepatitis C. Which is not to say that tattooing *causes* hepatitis C, of course. (But sometimes tattooing causes hepatitis C.) Any needle passing through the skin can do it. Tattoo needles go through the epidermis, the outer part of the skin that flakes off, and into the dermis, which is rich in blood vessels, nerves, and, after a tattoo artist is done with it, globs of dye.

White blood cells recognize that dye as an interloper, a potential threat, and attack it. But the globs are too large to be cleared. Futile attempts account for the visible inflammation that makes fresh tattoos red for a few days, during which reasonable people wait to Instagram them. If it stays red for longer than a couple days, then you probably have yourself a good old-fashioned tattoo infection. Every couple years there is an outbreak of infected tattoos in the United States that's traced back to infected ink. Because it's being injected so deeply into the skin, it needs to be a sterile product, like the saline solution that a hospital would inject into your veins. That's why the Centers for Disease Control and Prevention recommend going to parlors that "can confirm that their inks have undergone a process that eliminates harmful microbial contaminants." There's no regulation of that standard, so how you define it is

allowed them to hunt and eat animals, whose calorie-dense meat required less chewing. Once meat came to compose a third of their calories, that meant every year they chewed two million fewer chews. Combine that with the effect of stone tools on the "processing" of food—crudely chopping and grinding it—and the necessary force and stamina of our chewing apparati plummeted.

Then as now, when you don't use something, it leaves you. Many anthropologists believe that it is because we chew very little today relative to ancient humans that so many people need braces. Over generations, humans spent less time chewing as they were able to cook and farm; in the process, our jaws have slowly receded and shrunken, leaving our mouths crowded with teeth. Few of us have room for the third molars ("wisdom teeth") today. So they crowd in at an angle and push our other teeth into disarray. The need to prevent this by having the wisdom teeth extracted from our heads is a relatively recent phenomenon.

As smaller facial features began to arise, Zink and Lieberman argue, they may have actually been selected for as well. That is, our distant ancestors may have had preferences for smaller jaws. So it does seem that it is due to its relative rarity today, rather than any functional logic, that people seem to appreciate the appearance of Brad Pitt's face for his thorough jaw. Maroon 5's Adam Levine was almost certainly not named *People* magazine's "sexiest man alive" because of his musical prowess. Some have argued that Western attraction to angles probably comes from the association with a high-testosterone state, which signals virility and therefore reproductive viability.

If your mandible *did* continue to grow significantly as an adult, it would mean you had the serious hormone imbalance called acromegaly. This was the condition of the French actor and 1988 World Wrestling Federation champion André "the Giant" Roussimoff. His pituitary gland produced an abnormal amount of growth hormone as a child, and continued to produce growth hormone as only a child's should into adulthood, expanding him to more than seven feet and five hundred pounds. Even after the growth plates in his arms and

legs closed, his facial bones continued to grow, giving him the bulky appearance of a storybook giant. Such characters were likely themselves modeled off of people who had acromegaly. Shrek, an "ogre," also had the classic structural features of someone whose life was defined by an excess of a natural, necessary hormone.

Not everyone with acromegaly becomes a giant; the subtler cases manifest as large hands, a large nose, and a prominent jaw. These effects are seen in athletes who take growth hormone as a performance enhancer, a potentially serious risk to continued existence. André the Giant grew until his heart could no longer support his body, the walls of his ventricles so thick and muscular that they could not be easily supplied with blood, and he died at forty-six.

Relative to taking growth hormone, then, chewing gum is benign. And possibly even beneficial to those who value being perceived as a strong-jaw brah. Our mandibles do tend to shrink throughout our lives, and that can be prevented. Just as osteoporosis can be stemmed with physical exercise, involution of the jawbone can be prevented by chewing often. (And the masseter muscle that goes around the mandible at the corners should, like any muscle, get at least a tiny bit bulkier with exercise.)

This is all most relevant as a reminder that we're adapted to eat high-fiber foods. With a concerted effort to chew gum or leather or foliage often, and to teach your children to do so, and to repeat that process for generations, you may eventually see a result.

But what about my chin? Can I make it more attractive?

We are the only hominids with true chins. If they evolved in the process of creating speech or chewing, they wouldn't be expected to vary much in size and shape between males and females. But they do. The evolutionary concept of sexual dimorphism explains that chins evolved as they did because of mating preferences. Fret not for the shallow superficiality of the day; we've been shallow for millennia.

In the case of chin shape, or the lack thereof, the term used

among doctors is "submental fullness" ("sub" meaning below; "mental" being derived from *mentum,* meaning "chin" in Latin; "fullness" meaning fat). As the Harvard-trained dermatologist Omar Ibrahimi explained it when we spoke, "The submental area plagues a lot of men and women."

Ibrahimi practices in the affluent coastal city of Stamford, where he runs the Connecticut Skin Institute. He explained that submental fullness is an equal-opportunity focus of anxiety. "It doesn't just happen in overweight people," he told me. "As you age, you lose bone mass, and fat can collect in stubborn pockets."

The first step toward ameliorating submental fullness is the same as when trying to eliminate all bodily fullness: Eat well and move. (This is not part of the Hippocratic oath, but it might be added: *Make sure everyone is eating reasonably and being active, always, even if it means you sound pedantic and judgmental. Oh, yes, also: Do no harm*.) Still, a survey by the American Society for Dermatologic Surgery found that 68 percent of consumers are bothered by submental fullness, which is slightly higher than the number of Americans who are overweight or obese. So explained George Hruza, president of the society, in a press release for the company Kythera Biopharmaceuticals in the spring of 2015. He added an optimistic endorsement: "Kybella provides physicians with the first non-surgical treatment option to satisfy this unmet patient need."

That spring, the U.S. Food and Drug Administration approved Kybella for the "treatment" of submental fullness in humans. It's a drug meant to be injected into the neck, where it causes adipocytes (fat cells) to lyse (explode). And it's not surprising that it works. The sole ingredient in Kybella is deoxycholic acid, which is a bile salt—the exact same acid that is produced by the gallbladder and released after a meal to help the body break down fats in the small intestine.

Ibrahimi was among the first American physicians to begin using Kybella in 2015. "Is a double chin ruining your selfie photos?" reads the consumer-facing copy on the website of Ibrahimi's medical practice. In the lower corner of the page is a

little animated GIF of the father of modern medicine, Hippocrates, spinning in his grave.* "Or do you work out and eat healthy but just cannot get rid of your double chin? Well, we have some very incredible news for you. The FDA just approved an injectable called Kybella that can eliminate a double chin with a series of quick injections."

When we first spoke, Ibrahimi was just about to fly to San Diego to be among the first 150 physicians trained by Kythera Biopharmaceuticals in how to use their product. Kybella is part of a larger trend that he's seeing in cosmetic surgery. People are moving away from surgical procedures and toward injections, a trend that he believes is related to several celebrities who had complications after cosmetic procedures. In a relative way, injecting bile into people's chins may be a step toward reason.

The concept draws on a storied tradition of humans injecting body-shaping substances. The practice of mesotherapy started in the 1950s and had a moment in the 1990s, when people just kind of mixed vitamins and injected them into their anywhere, based on claims that had no basis in reality. Southern California and Brazil gained reputations as hotbeds of experimentation in "noninvasive body contouring." There were complications, and nothing worked especially well.

But dermatologist Adam Rotunda and biochemist Michael Kolodney at UCLA saw something in the concept. They became interested in creating a type of mesotherapy that had an actual scientific basis and could be proven safe. By 2005 they had filed a patent for using deoxycholic acid.

Unlike its precursors, the product had commercial appeal because it was "natural," in that bile acid is naturally produced by the body. The importance of that angle—here and in so many health messages and products—cannot be overemphasized when it comes to its marketing. (Even if there is really nothing natural about injecting bile acids into one's chin.)

Ten years later, the technique had undergone Phase III clinical trials and was FDA approved. The most common complications from Kybella are swelling, bruising, pain, and "areas of hardness," the FDA warns, if the acid leads to internal scarring. And because the acid destroys fat, the injection can damage

nerves. (Nerves are coated in myelin, which contains fat.) The agency adds that this nerve injury can cause "an uneven smile or facial muscle weakness, and trouble swallowing." It costs around $1,500 per injection, and most people will need two to four injections before they see results.

But it's natural.

Why are some eyes blue?

Disassemble a blue human eye, and you will find nothing blue. The same with hazel or gray. All of our eyes contain the same pigment, a dark brown substance called melanin. It is the same pigment that gives skin and hair its color. We have this one pigment, which becomes an array of colors based on how and where it is concentrated.

The iris consists of two layers, the stroma in front and epithelium in back. Interplay between these layers results in a mix of absorbing and scattering incoming light and reflecting it in a way that produces eye color. It's a concept called structural coloration. The ultimate effect is produced only in the context of the entire eye as it exists.

What causes red eyes in photos?

Light reflects off the back of the eye, the retina, which is full of blood vessels. The retina is directly connected to your brain by way of the optic nerve. Some consider that nerve to be an extension of the brain. It's the closest most people get to photographing a friend's central nervous system.

What is a deviated septum?

Photographs of Eli Thompson spread over the Internet in 2015 after BuzzFeed published them under the title "Meet the Very Cute Baby Who Was Born Without a Nose."

The celebrity Elizabeth Taylor had at least one extra row of eyelashes on each eye (known as distichiasis), often the result of a mutation on a gene called *FOXc2*. In Taylor, people generally found it captivating. Like most genes, though, *FOXc2* doesn't affect just one bodily feature; it's involved with the development of the lungs, kidneys, heart, and lymphatic system—the lymph nodes and vessels that carry fluid and white blood cells to and from those nodes. People with an extra row of eyelashes may have a syndrome called lymphedema-distichiasis, in which the lymphatic system doesn't work properly, and the body retains fluid, and the heart can fail. In 2011, Taylor died of heart failure, which may or may not be related. It's easy to envy other people's eyelashes; it's not always the best use of our time.

Eyelashes do grow, they just fall out at a certain length. This topic was briefly addressed in a book by physician Beth Ann Ditkoff, *Why Don't Your Eyelashes Grow?* The hundred-plus similar questions in the book are the product of Ditkoff's young children, who remember to question what many of us take for granted about the oddness of human bodies. She explains that eyelashes simply fall out after about three months, unlike the hair on your head, which can grow for years without falling out.

Like all hair, lashes come from follicles, the smallest organs in the body. Hairs go through three phases. The length of all body hair depends on the length of the first phase, called anagen. When its time is up, anagen turns to catagen. The outer part of the root is cut off from its blood supply, and the hair stops growing.

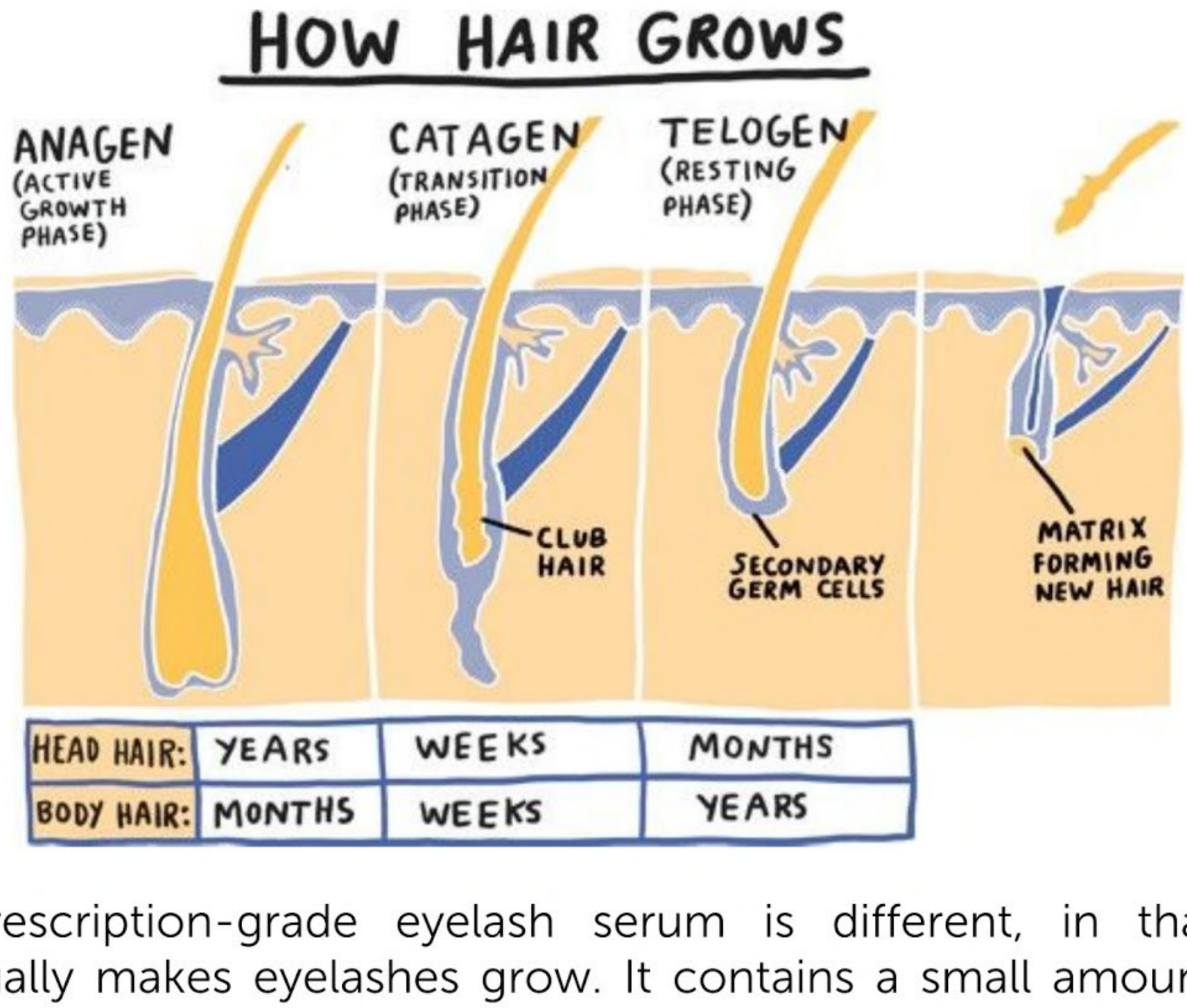
After a couple weeks of catagen comes telogen, wherein the follicle transitions into a resting state. For three months, then, the hair is called a "club hair." It is, like so many people in clubs, outwardly fine-looking but actually dead at its roots. It will either snap off or get displaced by new hair that rumbles up from below. For better or worse, each follicle is on its own time cycle, so we don't shed all our hair at once.

The real difference between head hair, arm hair, and eyelashes is the length of that anagen phase. On your head, it lasts a few years. Elsewhere it's more like a month. Were it otherwise, eyelashes and arm hair could grow to unwieldy

lengths.

Rare outliers have very long anagen phases on their heads, so they can grow their hair to the floor. Others have very short phases, so they are not bald, but they also never really need a haircut. Stress can signal anagen to end prematurely and, in extreme cases, can lead to near-complete short-term loss of hair. But it generally grows back.

Eyelash "growth serums" can be found in the cosmetics aisle at drugstores and Walmart. They're usually just mixtures of peptides (parts of proteins), and they can cost a lot. One, RevitaLash, is a proprietary blend of "natural botanicals" that *InStyle* magazine called "the Rolls-Royce of eyelash serums." I don't know what that means, but it costs $98 for two milliliters.



Prescription-grade eyelash serum is different, in that it actually makes eyelashes grow. It contains a small amount of the glaucoma medication bimatoprost, which came to market for eyelash enhancement after researchers noticed that people with glaucoma seemed to be developing more prominent lashes. It was serendipity in pharmacology, similar to the way Viagra was invented—when researchers testing it out as a blood pressure medication noticed an abundance of blood-engorged penises. Bimatoprost is sold under the product name Lumigan

when it's used for glaucoma, and a more gender-targeted Latisse when it's used for eyelash enhancement.

After cataracts, glaucoma is the second leading cause of blindness worldwide. It is about seven times more common in black Americans than white Americans; but black Americans are less likely to be treated and twice as likely to develop visual impairment, often because of lack of access to health care or basic screening for glaucoma.

Meanwhile, some people pay handily for the same product to have better eyelashes.

Could I get rid of my eyelashes? If I'm tired of the eyelash game and I just want out?

In 2015 a group of mechanical engineers at Georgia Tech set out to determine the purpose of eyelashes. "Eyelashes are ubiquitous," they note in the scientific journal *Interface,* "although their function has long remained a mystery."

And so they tested the aerodynamics of eyelashes in a wind tunnel.

Mystery no more, the engineers found that eyelashes effectively protected their sets of model eyes from airborne debris and surface dehydration by a factor of two. "Short eyelashes create a stagnation zone above the ocular surface," the researchers reported, "causing shear stress to decrease with increasing eyelash length." However, longer eyelashes also channeled air toward the surface of the eye, causing shear stress to increase. These competing effects result in a minimum shear stress for people with medium-length eyelashes.

Which is to say, in eyelashes, as in all things, moderation. The eyelash enhancement industry is predicated on arbitrary beauty standards that it created. Prescription eyelash-growth serum may have some functional benefit for people who are genuinely deficient of lash and spend a good amount of time in wind. But generally, my advice is to avoid serums. The same goes for elixirs and tonics. If you see a potion, take a chance.

What makes hair curl?