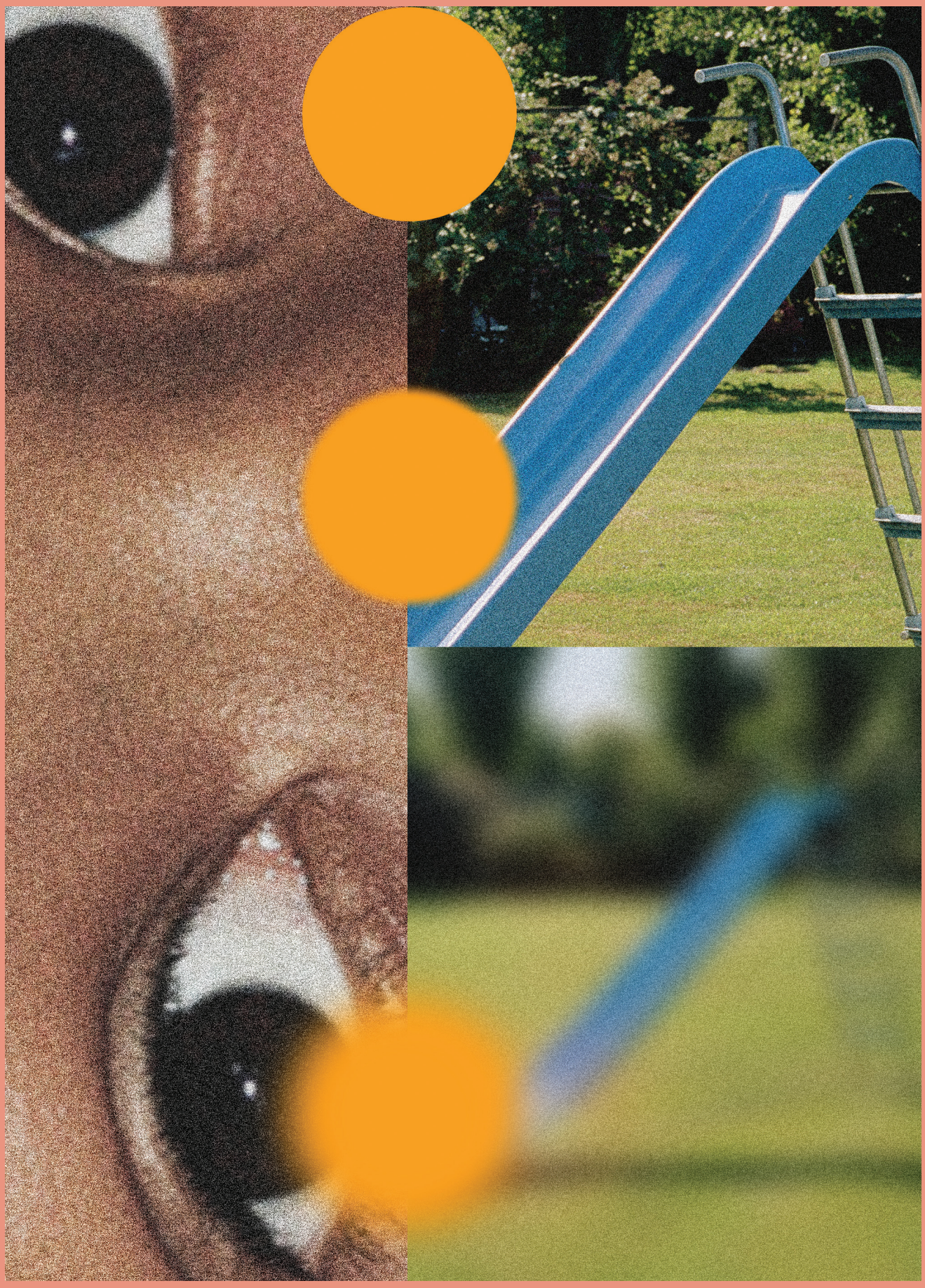
# The Myopia Generation

Why do so many kids need glasses now?

*By Sarah Zhang*



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A decade into her optometry career, Marina Su began noticing something unusual about the kids in her New York City practice. More of them were requiring glasses, and at younger and younger ages. Many of these kids had parents who had perfect vision and who were baffled by the decline in their children's eyesight. Frankly, Su couldn't explain it either.

In optometry school, she had been taught—as American textbooks had been teaching for decades—that nearsightedness, or myopia, is a genetic condition. Having one parent with myopia doubles the odds that a kid will need glasses. Having two parents with myopia quintuples them. Over the years, she did indeed diagnose lots of nearsighted kids with nearsighted parents. These parents, she told me, would sigh in recognition: *Oh no, not them too.* But something was changing. A generation of children was suddenly seeing worse than their parents. Su remembers asking herself, as she saw more and more young patients with bad eyesight that seemed to have come out of nowhere: "If it's only genetics, then why are these kids also getting myopic?"

What she noticed in her New York office a few years ago has in fact been happening around the world. In East and Southeast Asia, where this shift is most dramatic, the proportion of teenagers and young adults with myopia has jumped from roughly a quarter to more than 80 percent in just over half a century. In China, myopia is so prevalent that it has become a national-security concern: The military is worried about recruiting enough sharp-eyed pilots from among the country's 1.4 billion people. Recent pandemic lockdowns seem to have made eyesight among Chinese children even worse.

For years, many experts dismissed the rising myopia rates in Asia as an aberration. They argued that Asians are genetically predisposed to myopia and nitpicked the methodology of studies conducted there. But eventually the scope of the problem and the speed of change became impossible to deny.

In the U.S., 42 percent of 12-to-54-year-olds were nearsighted in the early 2000s—the last time a national survey of myopia was conducted—up from a quarter in the 1970s. Though more recent large-scale surveys are not available, when I asked eye doctors around the U.S. if they were seeing more nearsighted kids, the answers were: "Absolutely." "Yes." "No question about it."

In Europe as well, young adults are more likely to need glasses for distance vision than their parents or grandparents are now. Some of the lowest rates of myopia are in developing countries in Africa and South America. But where Asia was once seen as an outlier, it's now considered a harbinger. If current trends continue, one study estimates, half of the world's population will be myopic by 2050.

The consequences of this trend are more dire than a surge in bespectacled kids. Nearsighted eyes become prone to serious problems like glaucoma and retinal detachment in middle age, conditions that can in turn cause permanent blindness. The risks start small but rise exponentially with higher prescriptions. The younger myopia starts, the worse the outlook. In 2019, the American Academy of Ophthalmology convened a task force to recognize myopia as an urgent global-health problem. As Michael Repka, an ophthalmology professor at Johns Hopkins University and the AAO's medical director for government affairs, told me, "You're trying to head off an epidemic of blindness that's decades down the road."

THE CAUSE OF this remarkable deterioration in our vision may seem obvious: You need only look around to see countless kids absorbed in phones and tablets and laptops. And you wouldn't be the first to conclude that staring at something inches from your face is bad for distance vision. Four centuries ago, the German astronomer Johannes Kepler blamed his own poor eyesight, in part, on all the hours he spent studying. Historically, British doctors have found myopia to be much more common among Oxford students than among military recruits, and in "more rigorous" town schools than in rural ones. A late-19th-century ophthalmology handbook even suggested treating myopia with a change of air and avoidance of all work with the eyes—"a sea voyage if possible."

By the early 20th century, experts were coalescing around the idea that myopia was caused by "near work," which might include reading and writing—or, these days, watching TV and scrolling through Instagram. In China, officials have become so alarmed that they've proposed large-scale social changes to curb myopia in children. Written exams are now limited before third grade, and video games are restricted. One elementary school reportedly installed metal bars on its desks to prevent kids from leaning in too close to their schoolwork.

Spend too much time scrutinizing text or images right in front of you, the logic goes, and your eyes become nearsighted. "Long ago, humans were hunters and gatherers," says Liandra Jung, an optometrist in the Bay Area. We relied on our sharp distance vision to track prey and find ripe fruit. Now our modern lives are close-up and indoors. "To get food, we forage by getting Uber Eats."

This is a pleasingly intuitive explanation, but it has been surprisingly difficult to prove. "For every study that shows an effect of near work on myopia, there's another study that doesn't," says Thomas Aller, an optometrist in San Bruno, California. Adding up the number of hours spent in front of a book or screen does not seem to explain the onset or progression of nearsightedness.

A number of theories have rushed to fill this confusing vacuum. Maybe the data in the studies are wrong—participants didn't record their hours of near work accurately. Maybe the total duration of near work is less important than whether it's interrupted by short

breaks. Maybe it's not near work itself that ruins eyes but the fact that it deprives kids of time outdoors. Scientists who argue for the importance of the outdoors are further subdivided into two camps: those who believe that bright sunlight promotes proper eye growth versus those who believe that wide-open spaces do.

Something about modern life is destroying our ability to see far away, but what?

Asking this question will plunge you into a thicket of scientific rivalries—which is what happened when I asked Christine Wildsoet, an optometry professor at UC Berkeley, about the biological plausibility of these myopia theories. Over the course of two hours, she paused repeatedly to note that the next part was contentious. "I'm not sure which controversy we're up to," she said at one point. (It was No. 4, and there were still three more to come.) But, she also noted, these theories are essentially two sides of the same coin: Anyone who does too much near work is also not spending much time outside. Whichever theory is true, you can draw the same practical conclusion about what's best for kids' vision: less time hunched over screens, more time on outdoor activities.

By now, scientists have moved past the faulty assumption that myopia is purely genetic. That idea took hold in the '60s, when studies of twins showed that identical twins had more similar patterns of myopia than fraternal ones, and persisted in the academic world for decades. DNA does indeed play a role in myopia, but the tricky factor here is that identical twins don't just share the same genes; they're exposed to many of the same environmental stimuli, too.

Glasses, contacts, and laser surgery all help nearsighted people see better. But none of these fixes corrects the underlying anatomical problem of myopia. Whereas a healthy eye is shaped almost like an orb, a nearsighted one is more like an olive. To slow the progression of myopia, we would have to stop the elongation of the eyeball.

Which we already know how to do. Treatments to slow the progression of myopia—called "myopia control" or "myopia management"—exist. They're just not widely known in America.

OVER THE PAST TWO DECADES, eye doctors—mostly in Asia—have discovered that special lenses and eye drops can slow the progression of nearsightedness in children. Maria Liu, a myopia researcher who grew up in Beijing, told me that she first became interested in nearsightedness as a teenager, when she began watching classmates at her school for gifted children get glasses one by one. In this intensely competitive academic environment, she remembers spending the hours of 6:30 a.m. to 10 p.m. on schoolwork, virtually all indoors. By the time she finished university, nearly all of her fellow students needed glasses, and she did too.

Years later, when she started an ophthalmology residency in China, she met many young patients who wore orthokeratology lenses—also known as OrthoK—a type of overnight contact lens that temporarily alters the way light enters the eye by reshaping the clear front layer of the eyeball, thus improving vision during the day. Liu noticed, anecdotally, that those who wore OrthoK seemed to have better vision down the line than those who wore glasses. Could long-term use of the lenses somehow prevent elongation of the eye, thus impeding myopia's progression? It turns out that other scientists and doctors across Asia were noticing the same trend. In 2004, a randomized controlled study in Hong Kong of OrthoK confirmed Liu's hunch.

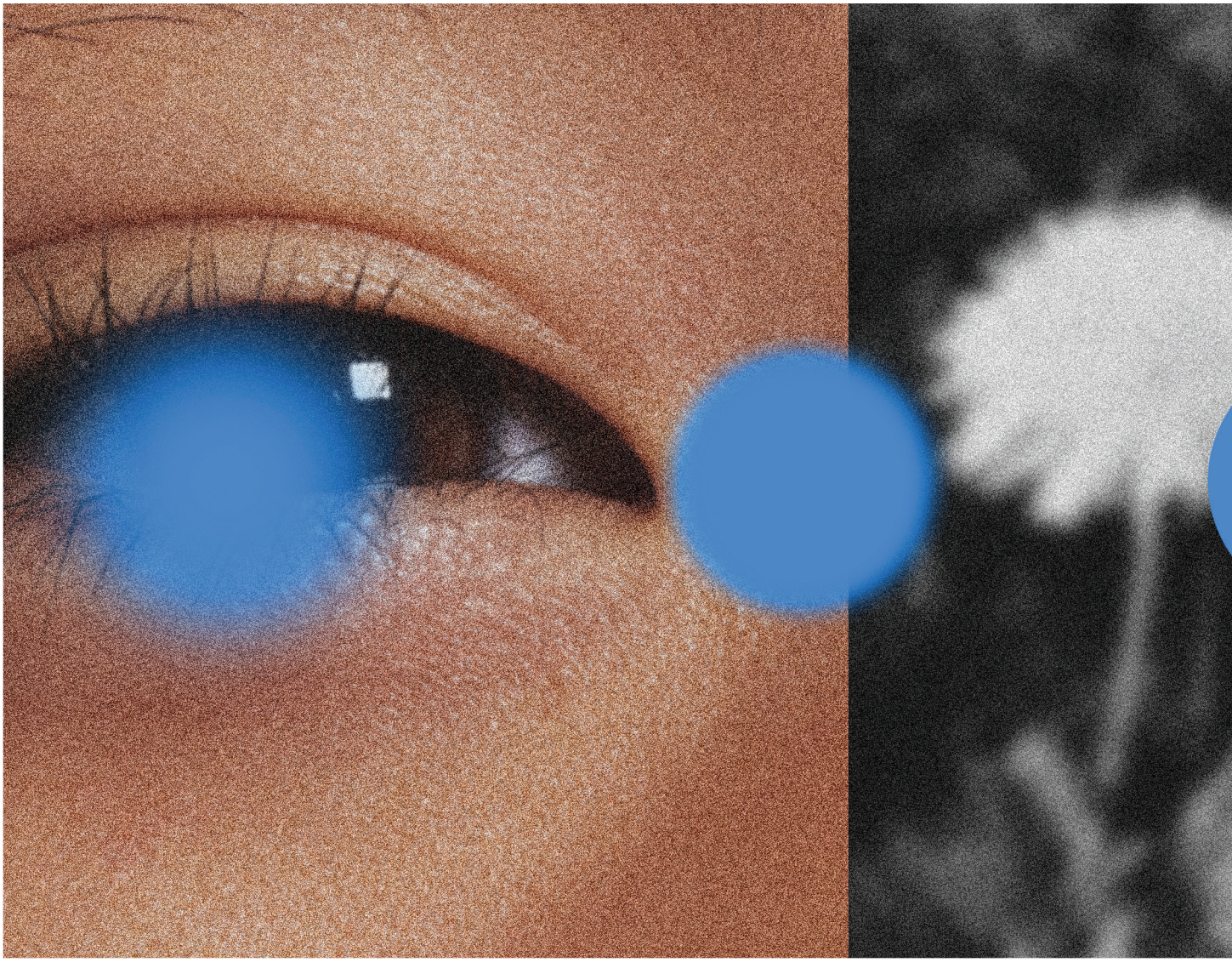
By then, Liu had moved to the U.S., and she soon began a doctoral program in vision science at Berkeley to study myopia. Her classmates, she recalls, were tackling exotic-sounding topics such as gene therapy and retinal transplants and wondered why she was studying "something that's so boring." She ended up working in Wildsoet's lab, researching the development of myopia in young chick eyes.

In humans, the majority of babies are born farsighted. Our eyes start slightly too short, and they grow in childhood to the right length, then stop. This process has been finely calibrated over millions of years of evolution. But when the environmental signals don't match what the eye has evolved to expect—whether that's due to too much near work, not enough outdoor time, some combination of the two, or another factor—the eye just keeps growing. This process is irreversible. "You can't make a longer eyeball shorter," Liu said. But you can interrupt growth by counteracting these faulty signals, which is what myopia control is designed to do.

Something about modern life is destroying our ability to see far away, but what?

When Liu became a professor at Berkeley after receiving her Ph.D., she started envisioning a myopia-control clinic—the first of its kind in the U.S.—that could bridge the gap between research and practice. By then, she knew that many doctors in China were already successfully using OrthoK for myopia control.

The school administration was skeptical. Liu says that the clinical director didn't see how the clinic would benefit optometry students, or how it could attract enough patients to be worthwhile financially. But in 2013, Liu started it anyway, as a one-woman operation. She began seeing patients on Sundays in borrowed exam rooms with no extra pay and without relinquishing any of her teaching or clinical duties. Within months, her schedule was full. The Berkeley Myopia Control Clinic now runs four days a



week and has 1,000 active patients—some of whom drive hours through Bay Area traffic to get there. Liu was one of the only people at the school who anticipated the clinic's massive success. Jung, who is also an assistant clinical professor at Berkeley, told me that Liu's knowledge of the latest myopia-control treatments made it feel like she came "from the future."

WHEN I ARRIVED at the clinic at 8 a.m. on a Saturday morning this past spring—an hour at which the rest of the campus was still quiet—it was already filling up with optometry students and residents who work there as part of their training. Liu, who is petite with neat, wavy hair, moved through the clinic with frightful efficiency. One moment she was examining eyes, the next talking down a parent whose son's contact-lens shipment had gone missing, the next warning staffers about a malfunctioning printer.

The clinic offers three different treatments: OrthoK, multifocal soft contact lenses, and atropine eye drops. The first two both work by tweaking how light enters the eye, producing a signal for the eyeball to stop lengthening. Atropine, in contrast, is a drug that seems to chemically alter the growth pathway of the eye when used at low doses. (It also dilates the pupil; Cleopatra reportedly used it to make her eyes more beautiful.) These treatments slow myopia progression on average by about 50 percent. The original clinical trials validating them were mostly conducted in Asia starting in the mid-2000s. And the American Optometric Association's evidence-based committee published a report advising its members on how to use myopia control last year. Until quite recently, though, none of these treatments had been approved by the FDA for myopia control. Any optometrists who wanted to offer them had to go off label. And any patient who wanted to use them had to find the right doctor.

It's not a coincidence that Liu's clinic found early success in the Bay Area, which has a large Asian population. Eye doctors I spoke with in multiple cities across the U.S. said it was usually Asian parents who came in asking for myopia control. The parents I met at the clinic skewed Asian and, on that Saturday, particularly Chinese—first-generation immigrants who speak Mandarin seek Liu out on the days she is personally in the clinic. Many of them heard about myopia control from fellow immigrants or friends in Asia. George Tsai, whose 8-year-old son was at the clinic for an OrthoK appointment, told me that his wife, who grew up in China, had learned of myopia control through WeChat, the messaging

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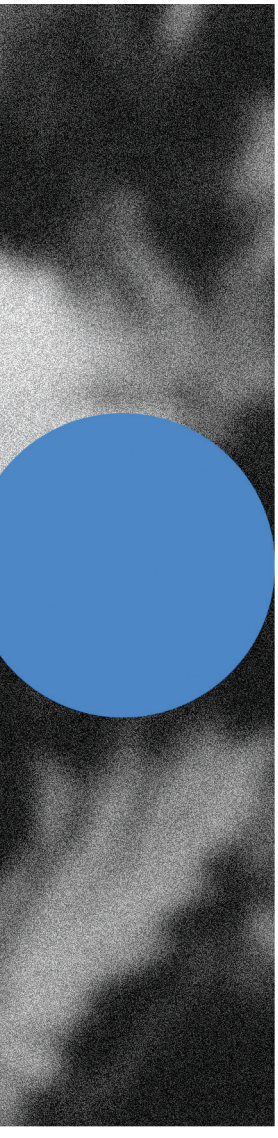

app popular in the country and among the Chinese diaspora.

Liu has a second phone, which she uses to manage three WeChat groups full of parents with kids in myopia control across North America. The questions flood in day and night. "First thing in the morning, I look at this WeChat group. Who has lost a lens? Who has red eyes? Who has other problems?" she said. "And again, before I go to bed." She started the first group with a parent of one of her patients. When it hit the maximum number of members allowed on WeChat, they created a second, and then a third. The groups now contain a total of 1,500 parents.

In general, Liu told me, Asian parents tend to be a lot more motivated because myopia "is much better perceived or accepted as a disease in Asian culture." I know this firsthand, as the child of Chinese immigrants. Distressed about my worsening vision in elementary school, my mother would regularly admonish me, standing my pencil case upright to measure the distance between my head and my desk. She also made me do eye exercises developed in China, which I was vindicated to finally learn, in the course of reporting this story, do not work. This was the late '90s, when there really was nothing to be done about myopia progression. But in the parents I met at the Berkeley clinic, I saw the same determination I once saw in my own. They had uprooted their lives and come to a foreign country and now here they were, hoping to bestow upon their kids any advantage, any edge that modern science could give.

THERE IS ANOTHER reason that the Bay Area, with its high median income, has been fertile ground for myopia control: The treatments are expensive. Many of the parents I met at the clinic were engineers or doctors. At Berkeley, OrthoK costs more than $450 for one pair of lenses, plus $1,600 for the initial fitting, not including the fees for several follow-up appointments a year. Soft contact lenses can run from several hundred to more than $1,000 a year. And a year's supply of atropine eye drops costs hundreds of dollars. Kids are typically in myopia control until their mid-teens to early 20s. Vision insurance does not cover any of these treatments.

Multinational eye-care companies now see myopia control as a hot potential market. They're vying for FDA approval of new lenses and improved formulations of atropine, which can be patented rather than sold as a cheaper generic. The business case is obvious: If half of the world is myopic by 2050, that's a huge pool of would-be customers. "How often do you have an opportunity to have an impact on a condition that will affect one out of two people? There's nothing else on the planet that I'm aware of," says Joe Rappon, the former chief medical officer of SightGlass Vision, a small California company whose myopia-control technology was jointly acquired by the eye-care giants CooperVision and Essilor.

In November 2019, the FDA green-lighted the first—and currently only—treatment specifically designed to slow the progression of myopia in the U.S., a soft contact lens from CooperVision called MiSight. Many more treatments, though, are in trials in the U.S., including several types of spectacles that tweak the way light enters the eye in order to slow its growth. Some are already on the market in Europe and Canada.

Once those glasses get approved in the U.S., "that's going to open the floodgates of myopia management," Barry Eiden, an optometrist in Deerfield, Illinois, told me. The earlier you can start slowing myopia progression in kids, the better the outcome, he explained, but parents sometimes balk at the idea of putting drugs or contacts into the eyes of their young children. They don't have the same problem with glasses.

In the future, Liu told me, she hopes FDA approvals will spur vision insurance to cover myopia control at least partially, making the treatments affordable to more parents. Meanwhile, CooperVision has already revved up its MiSight marketing machine. It's targeting exactly the parents you would expect: In my own Brooklyn neighborhood of Park Slope, where you regularly see toddlers in $1,000-plus Uppababy strollers, an optometry shop recently hung a big banner advertising MiSight with two smiling kids. An optometrist in downtown San Francisco told me that parents who have seen MiSight's ads are now coming into her office asking for it by name. The word-of-mouth era of myopia control is ending; the mass-advertising era is beginning.

Within the optometry business, myopia control often gets compared to braces—another treatment for which middle- and upper-class parents who want the best for their kids will dutifully shell out thousands of dollars. This comparison feels apt in a different way, too. Braces are also a modern solution to a relatively modern affliction. The teeth of cavemen, anthropologists have marveled, were incredibly straight. Crooked teeth appear in the archaeological record only when our ancestors transitioned from chewing raw meat and vegetables to eating cooked and processed grains. Our jaws are now smaller and weaker from disuse, our teeth more crowded and crooked. Today, braces are the way we retrofit our ill-adapted bodies for contemporary life.

We may not know exactly how ogling screens all day and spending so much time indoors are affecting us, or which is doing more damage, but we do know that myopia is a clear consequence of living at odds with our biology. The optometrists I spoke with all said they try to push better vision habits, such as limiting screen time and playing outside. But this only goes so far. Today, taking a phone away from a teenager may be no more practical than feeding a toddler a raw hunter-gatherer diet.

So this is where we've ended up, for those of us who can even afford it: adding chemicals and putting pieces of plastic in our eyes every day, in hopes of tricking them back to their natural state. *A*

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