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Joseph E. Aoun

The sounds of innovation

Music is a connector, a storytelling language, a shortcut to human emotion. And in times of crisis and change, music is a source of steadiness and hope. As I told 2021 graduates of Northeastern at their Commencement ceremony, I was struck by the power of music in the early days of the pandemic, when I heard the sounds of a jazz quartet playing outdoors in Boston's Roxbury neighborhood. I investigated, and found the source: a Northeastern music instructor and his bandmates, who were determined to carry on, even during lockdown.

The study of music weaves through the humanities and the sciences. It is a source of creativity, a key to psychology, a conduit for artificial intelligence, even a ticket to healing. It's exciting to see our faculty and students doing innovative work with music and sound across

disciplines. And Northeastern's merger with Mills College gives our university community the opportunity to work with Mills' world-renowned music department – which has trained talent ranging from jazz great Dave Brubeck to some of today's most prominent electronic musicians.

Several stories in this issue of *Experience Magazine* chronicle the spirit and practice of innovation in music. You'll read about an instrument that plays 512 notes, exploring sounds that transcend Western musical traditions; about new experiments in electronic music from Mills College alumna Laetitia Sonami; about the ways modern opera is drawing in new creators and audiences.

As we plan the upcoming celebration for the next innovative cohort of Northeastern graduates, we know that music will be part of the ceremony, as it will be an ongoing part of their lives – a way to make memories and connections and to experience our shared humanity.

Experience Magazine tells stories that chronicle innovations and new ideas about work, play, and relationships – and examine inspiring solutions to global problems. Visit us at expmag.com.



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Illustration by
Tim O'Brien



“It is of no help that just the rich countries vaccine their populations. None of us are safe until all of us are safe.”

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“Sports photography is about being in the moment. Sailing is the same — the water, the sun, the speed, the concentration, and the absolute sense of focus all come into play.”

Alyssa Stone

On her photograph of sailor Elizabeth Lonergan (p. 8)

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Music in this issue

Want to hear the sounds of Laetitia Sonami’s Spring Spyre (p. 10) or the 512 notes of the Infinitone (p. 60)? Interested in some music-in-progress from the upcoming opera *Travesty Generator*? Visit expmag.com/audio to listen to clips of the music featured in these *Experience* articles.

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FIRST WORD





BEHIND THE PHOTO

“On the water, there are no distractions”

Northeastern University photographer Alyssa Stone photographed sailor Elizabeth Lonergan on Boston's Charles River. Here's the story behind the image, in Lonergan's words.

This was practice for the Northeastern University Sailing Team, with 16 to 18 boats on the Charles River. It's a two-person boat and I'm with Caleb Niles, the skipper. You can see based on our sail trim that we're heading upwind, which is why we're leaning so far out of the boat. It's called "hiking." The stronger the wind gets, the more pressure there is in the sails. The fastest way to sail is to be as flat as possible, acting as a counterweight to the pressure. My main job is to tell Caleb everything that's going on outside the boat. My arm is out and pointed forward; I'm finding the wind and counting it down as to when it's going to hit our boat so Caleb is able to adjust his sails. Here, it's about five seconds away.

When you're sailing dinghies like this, you have to be in physical shape, but the physicality is secondary. The motion is all muscle memory at this point. My mind is focused on tactics, reading the wind, and communication. Off water, I'm more easygoing. On the water, you have to be incredibly focused; your mindset has to always be in a competitive state. There are no distractions. It's the only thing that matters. ■

Interview conducted and condensed by Jim Sullivan.

LETTER FROM OAKLAND

The musician in the machine

BY TONY REHAGEN

Laetitia Sonami invented the Lady's Glove, which plays music with the flick of a wrist. Now, the Mills College professor is searching for new sounds.

Electronic musician Laetitia Sonami has never had much patience for traditional forms or rigid boundaries. So, 30 years ago, after finding no musical instrument to match her artistic impulses, she invented one.

That's the story behind the Lady's Glove, a black Lycra evening glove that Sonami wired to respond to her hand motions. The instrument lets her control sounds and lights with a wrist flick or finger twitch, as though she's playing an ethereal orchestra by waving and plucking thin air.

The Lady's Glove has become synonymous with Sonami's name, drawing imitators and cementing her international reputation. Now, Sonami is ready to retire her invention and once again reach into the unknown. Her newest instrument takes electronic music into the latest technological frontier: machine learning.

It was the impulse to experiment that drew Sonami, a native of France, to electronic music in the first place. She encountered an early synthesizer in 1975, at age 17, while studying visual art in Boston. "It seemed like such an amazing transformation from pure electricity to expressivity through sound," she says. But the technology wasn't widely available, and most artists who were using synthesizers were playing conventional music.

Sonami's mentor, electronic musician Éliane Radigue, told Sonami that if she wanted to blaze a new path, she should go to California. Specifically, Radigue directed her to Mills College's Center for Contemporary Music, where faculty members Pauline Oliveros, Bernie Krause, and Morton Subotnick were creating new sounds with computers. The center was internationally renowned for musical innovation. John Cage had taught there in the 1930s and 1940s. Artists like Phil Lesh and Dave Brubeck had been students. Mills, which recently merged with Northeastern University, also housed one of the earliest computer science programs.

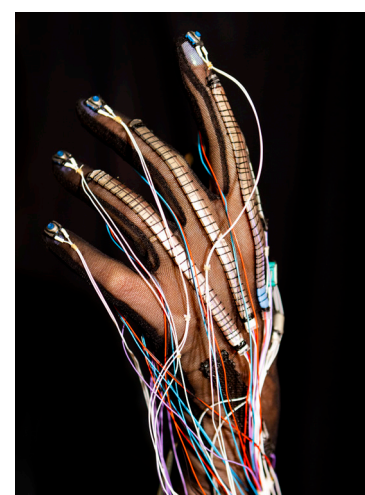


"At Mills, there was no distinction between engineer and musician," Sonami remembers. "If you needed something, you figured it out."

So she taught herself to solder, assembled synthesizers from kits, and squeezed the circuitry for new sounds. She loved to perform in front of audiences. Yet onstage, she was trapped behind a computer keyboard.

"How can you perform with a computer?" says Sonami. "That became central to my quest. How do you create expressivity and bring the body into the performance?"

The Lady's Glove started almost as a joke. At first, Sonami wore rubber kitchen gloves that triggered animal sounds, including that of pigs. It was a social comment on being a woman in a male-dominated field as well as a means to make music. But as the technology evolved, so



Left, Sonami with her new invention, the Spring Spyre. Above, The Lady's Glove was Sonami's answer to the question, "How can you perform with a computer?"

did the idea.

By the early '90s, Sonami had brought in the more elegant evening glove and rigged it to her elbow with micro-switches, pressure pads, accelerometers, sonars, and other sensors. These receivers send signals to Sonami's computer, which maps them into tones, samples, effects, and visual cues.

Over the next three decades, Sonami produced four iterations of the glove while composing and performing with it all over the world. But eventually, she ran out of room to explore. "My imagination was so tied to the instrument, I wondered what I could imagine if I didn't have it," she says. "I knew it was time to leave it behind."

Sonami, who returned to Mills in 2018 as a visiting adjunct professor, is now working on several new projects, including the Spring Spyre, a ring-shaped instrument

pieced together from found-metal materials. Its springs transmit signals from audio pickups into the computer. There, the machine analyzes each impulse, extracting certain features and using them to train the neural networks, which control and moderate the sound in real time. The result is a vast symphony of everything from a subtle snap or tweak to robust, sustained tones. "It can really be anything," says Sonami. "It all depends on the training."

The Spyre sits atop a table, so Sonami cannot dance as she did with the Lady's Glove. In one of her latest works, entitled "Magnetic Memories in the Age of the Oracle," she instead takes on the role of the titular Oracle, channeling new sounds from an unexplored, virtual dimension. "I feel like I'm back standing in front of a terrain that is mysterious," says Sonami. "That can be frustrating — but mostly, it's exciting." ■

This former athlete launched an energy drink company out of his dorm room.

FROM CO-OP TO CAREER **THE ENTREPRENEUR**

Tasting success

BY SCHUYLER VELASCO

Lamar Letts graduated in 2017 with a degree in finance and marketing from Northeastern University's D'Amore-McKim School of Business. While an undergraduate, he developed the energy drink Hylux out of his dorm room and received a \$10,000 grant from Northeastern's student-led venture accelerator, IDEA. Hylux is now sold across the U.S. at retail stores, Amazon, and Walmart.com — making Letts, 27, one of the youngest entrepreneurs to launch a product with the retail giant.

You're a former athlete. Was that the inspiration for Hylux?

Senior year of high school I had a heart condition. When I recovered and gradually started getting back into fitness, my doctor told me I needed to watch my diet. So I started taking a deeper look into the sports drinks I liked and found that they didn't provide any nutrition. It was all sugar and calories. I started making homemade drinks, but that became really tedious. Other athletes I talked to were having the same experience.

You didn't have the typical Northeastern co-op experience.

I did [Hylux] as my co-op. I was preparing to apply for finance and venture capital co-ops — getting my resume ready, talking with previous students about how they inter-

viewed. But when it came down to it, I had a lot of the pieces going for this drink. I had an early prototype, a bottle, an initial formula, everything. And I knew I wanted to see it through. I was going down that route, and [my advisers at Northeastern] supported it.

How do you make an energy drink?

I started off with a list of nutrients I saw missing in other drinks. I researched daily recommended dosages and built proportions off that. From there I went to a food scientist who helped create a drink with my nutrient profile. They introduced aspects like sweetener, color, and flavor. It's an art and a science: you could ask 10 different food scientists to give you a strawberry flavor and you'll taste 10 different strawberry flavors. From there, we sourced in-

gredients from vitamin and nutrient suppliers.

Were you interested in entrepreneurship when you were younger?

It's always been around my life. My parents are entrepreneurs — they came from Jamaica and opened two Jamaican restaurants in Brooklyn. My dad is an experimental chef; we had a lot of experimenting in the kitchen at home. But I didn't actually think I was going to go the entrepreneurial route until college.

Did you think you'd be a business major?

I was very much not a math student in high school. If my trigonometry teacher had heard that I was going to be studying finance, she'd probably laugh. But my high school had business classes, and that's where I connected the dots and saw that calculus was never going to interest me, but accounting did.

How did you go from selling Hylux out of your dorm room and fundraising on Kickstarter to selling it on Amazon and Walmart.com?

Before class I was going down to Boylston Street and pitching it to gyms and stores. Not telling them that I created it, but getting that direct feedback of, will someone actually buy this? That led to



ILLUSTRATION BY NABIL NEZZAR

changes: tweaks to flavors – more strawberry flavors, a general berry mix that became pomegranate raspberry – and a different bottle. Our first bottle reminded people too much of an existing [energy drink brand]. We wanted a [unique shape], so that when people saw it out in the wild, even without our label, they would associate it with our product. From there it was

getting it out to more people and getting on the radar of buyers, going to trade shows to meet people in the drink industry.

What's the next big thing in the beverage industry?

You're definitely going to see a focus on anti-inflammatory ingredients [found in certain fruits, vegetables, fatty fish, and nuts]. People live a

very inflammatory lifestyle, and beverages that can help alleviate that are around the corner.

What do your parents think of Hylux?

They started selling it in their restaurant! One time my mom called and she was wondering about case pricing; a customer had come in and wanted to buy the case. ■



TAKE 5 **HEATHER CLARK**

Small-scale science

BY SCHUYLER VELASCO

Nanotechnology is a new frontier in medical research. In her lab at Northeastern University, Heather Clark, a professor of chemistry and bioengineering, is developing microscopic sensors that could change the way diseases are detected and treated. We spoke with Clark about the future of medicine, the need for science education, and the work of her new institute, the Institute for the Chemical Imaging of Living Systems. Here are five takeaways.

1

TO MEASURE BIG PROBLEMS, GO SMALL. As an analytical chemist, what drew me to nano-sensor development was that the tools that we typically use in the field are large-scale lab instruments. But what we're trying to measure is very, very small. If we can couple tiny tools with some of this powerful instrumentation, we can make measurements in small spaces that weren't possible before.

2

NANOTECHNOLOGY COULD CHANGE THE FUTURE OF MEDICAL TREATMENT. The connection between the immune system and the neurological system is going to be a key to moving medical care forward. There's an emerging field called "electroceuticals": Electrodes implanted on nerves. Your brain talks to the organs in your body through the nervous system. So if the heart or the bladder aren't functioning appropriately, instead of taking an oral medication, you could implant one of these electrodes on the nerve as the therapeutic – and use that to keep the heart beating or stimulate regular bladder function. Eventually, this could be extended to other neurotransmitters, like dopamine and serotonin; then we could use these sorts of probes as the basis for therapies for neurological disorders.



3

FOR MORE TRANSFORMATIVE SCIENCE, ACADEMIA AND INDUSTRY NEED TO WORK TOGETHER. [Academic researchers] could discover the coolest new sensor, but if it doesn't have a real-world application, who cares? At the institute I'm starting, we're trying to bridge that valley of death between when you get a really cool paper out in a big scientific journal and when you get the fruits of that research to humans. We can't just be focused on writing papers. We're trying to partner with companies and not just rely on them picking up my paper, reading it, and repeating all the steps in their own drug discovery processes. We want to help researchers find funds and make connections so they can make the leap to the next stage.

4

TO GET PEOPLE COMFORTABLE WITH NEW MEDICAL TECHNOLOGIES, LET THEM SEE THE SCIENCE. The vaccine technology that led to the COVID vaccines was so well-studied, and it's been proven effective for a long time – it just never rolled out to that scale until COVID came around. It speaks to how important it is to fund basic science, because if that field hadn't been so mature, we wouldn't be where we are. There aren't any shortcuts, and we just have to do the work to show people that it is safe every time.



5

THERE ARE INNOVATIVE WAYS TO EXPAND SCIENCE EDUCATION. Educating adults – and especially kids – about the scientific process is important. Our institute has teamed with BioBus, a New York organization that puts microscopes and other lab equipment on buses and drives it to area schools. Our lab has designated a little space on the side with nine microscopes, and we're going to have students from [the] Roxbury [neighborhood of Boston] come in and learn about what we're doing. Little things like that, if everybody was doing them, could add up. ■

FROM LAB TO MARKET

An artificial voice that's still yours

BY CECI MENCHETTI

Many people associate artificial voice technology with Stephen Hawking's famously robotic timbre – countless pop songs, cartoons, and films have sampled his iconic monotone. For years, this one-note quality applied to most assistive communication devices: People of different ages and backgrounds, using similar speech synthesizers, all sounded alike. Now, advances in audio technology make it possible for individuals to “speak” in their own personally-tailored voices.

The Science

Creating a synthetic voice begins with a “voice donor” who reads into a microphone for hours, creating a database of malleable sounds. “We ask our volunteers, ‘Do you want to read about science fiction? The news? TED talks?’” says Rupal Patel, a professor of computer science and health science at Northeastern University and the cofounder of VocaliD, a company that creates voices for assistive devices.

VocaliD combines those donor sounds with the voices of people with health conditions such as ALS or throat cancer – who bank their voices in advance, or, if they've lost their ability to speak, record any sounds they're able to make. VocaliD trains a model that sounds like a combination of the two voices. The process grew out of Northeastern's Communication Analysis and Design Laboratory, where researchers from health sciences, computer science, and electrical engineering study the mechanics of voices – such as the patterns of rhythm and sound known as prosody, or “speech melody.”

The Product

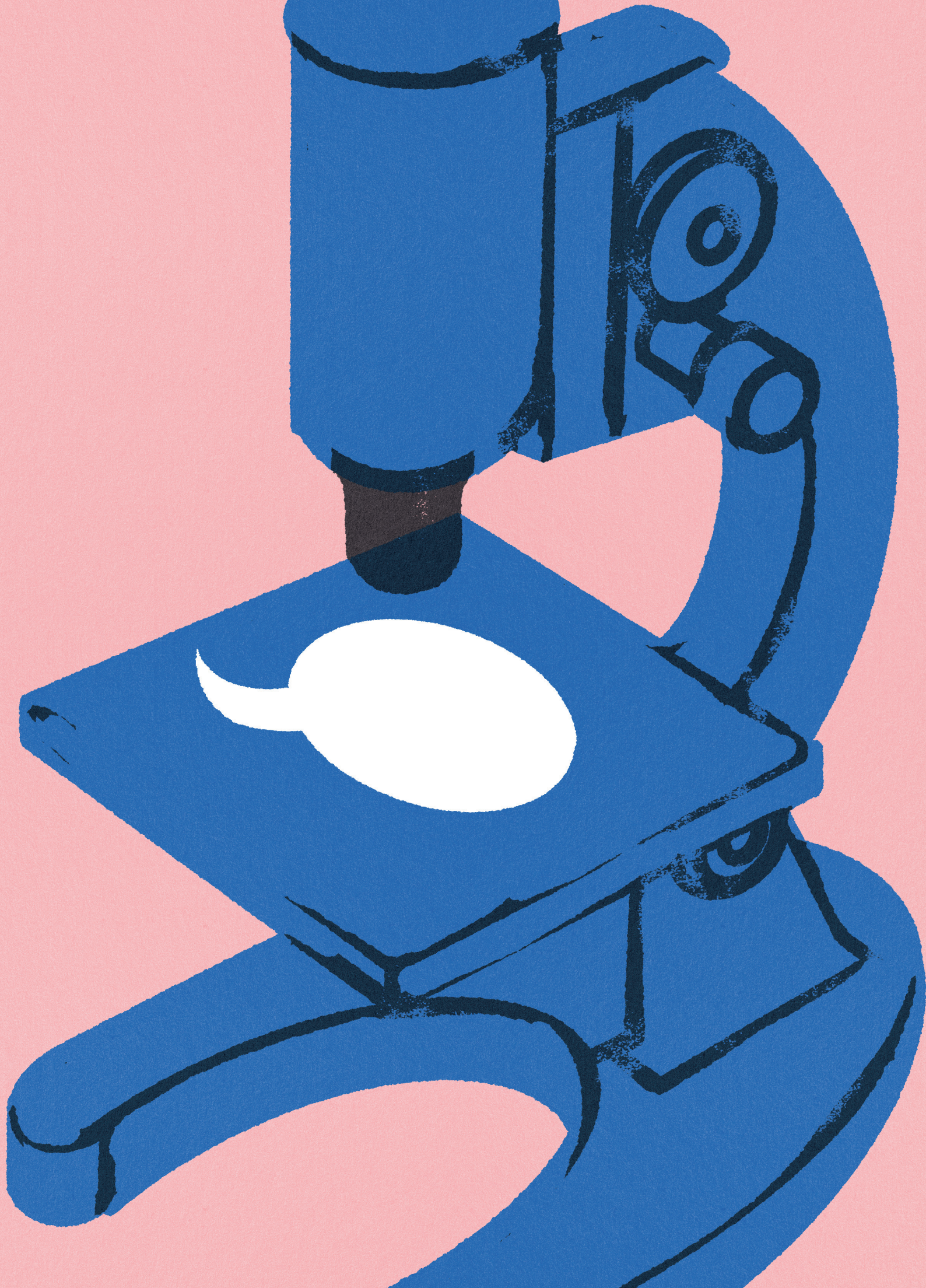
The final product is a voice file that can be downloaded onto a mobile phone app or assistive device. Users can type a sentence, press a button, and unleash a tailor-made voice that speaks those words. “It's been a game-changer in terms of having them continue to do their jobs [and maintain] social closeness with family members,” Patel says.



Rupal Patel

The Future

VocaliD has branched beyond health care into business – helping companies expand their phone-banking capabilities and creating voices to match their corporate personalities. Patel sees many further uses for personalized audio technology in the age of podcasts and voice-activated personal assistants. “It's this new ‘sonic renaissance,’ we're calling it,” she says. “What's really exciting to me about audio is that it opens up accessibility in a very different way.” ■



SINGING A

New artists, new stories, new musical ideas.
Opera is undergoing its most dramatic revolution in centuries.

BY SCHUYLER VELASCO



DIFFERENT TUNE



Six actresses play versions of the title character in *Iphigenia* — capped off by Esperanza Spalding, who also wrote the libretto.



ON A WARM FRIDAY EVENING in mid-November, the line of ticketholders waiting to get into the Cutler Majestic Theatre in downtown Boston snaked around the block past a sports bar, a Panera, the W Hotel, and two parking garages. They were there for the world premiere of *Iphigenia*, an opera by jazz titan Wayne Shorter, with a libretto from its star, Esperanza Spalding. But this wasn't your stereotypical opera crowd.

"This line is f***ing LONG!" a college-aged kid with a gold earring and a red leather bomber jacket shouted as he bounded up to meet his friends. Farther down, a twenty-something couple in jeans and baggy sweaters worried aloud that the show's late start meant their marijuana buzz might wear off before the house lights dimmed. "It's OK; we can enjoy art without being high," the woman mused, in a seeming effort to convince herself.

Onstage, the casual vibe persisted. Both musically and in its staging, ...(*Iphigenia*) – the styling of the title was changed for subsequent performances – casts a critical eye on the Wagnerian-style retellings of ancient myths, foundational to many of the best-known opera works.

In this version of the story – based on the Greek myth in which the title character is sacrificed to the gods by her father, Agamemnon, to improve his chances in a military campaign – the Greek soldiers are brutes swilling from red Solo cups. Helen of Troy appears, briefly, in the form of a blow-up doll. Six different actresses play versions of Iphigenia – capped off by Spalding, clad in an iridescent jumpsuit. An opera-standard pit orchestra gives way to a jazz trio at key dramatic moments; Spalding's singing vacillates between the two styles. Whether or not the whole thing fully hangs together is an open question. "I can't say we *figured out* how to do it," Spalding said in a panel discussion following the premiere, about deciding how the

Jazz titan Wayne Shorter (pictured with Spalding) has said that writing the score for *Iphigenia* (right) fulfilled his lifelong dream to compose an opera.



PREVIOUS PAGE AND RIGHT PHOTOS BY JATI LINDSAY; LEFT PHOTO COURTESY OF REAL MAGIC





“Audiences seem much more receptive to new work in opera than they are to new work in the symphony.”

Anthony De Ritis
Composer and
music professor at
Northeastern University

story onstage would ultimately end. But this show was trying something.

The same could be said for opera writ large: Right now, it's trying something. Like many other artistic and social spheres in the United States, the opera world has in recent years seen an influx of diverse talent and nontraditional voices. And those artists are bringing new ideas to a genre that arguably peaked in terms of mainstream cultural relevance 200 years ago.

Many of these new works incorporate elements of other genres — not just jazz, but slam poetry, computer music, and non-Western musical styles. And many of them come from creators best known for work outside opera itself. Spalding, Shorter, and Terence Blanchard — the composer of *Fire Shut Up in My Bones*, a new opera that opened the Metropolitan Opera's 2021-2022 season in New York — gained fame as jazz musicians. Jeanine Tesori, composer of *Blue*, a 2019 opera about a Harlem family whose son is shot by police, is best known for Broadway musicals like *Fun Home* and *Caroline, or Change*.

Together, these and other artists are upending traditional ideas about what belongs in opera: the musical elements, the dramatic structure, the kinds of stories that should be told, and the kinds of people who should do the telling.

ANTHONY DE RITIS, a composer and music professor at Northeastern University, contends that deep in their hearts, all composers want to write opera — to see their vision play out on that most grandiose of stages. (Shorter, 88, has characterized *Iphigenia* as the realization of his lifelong dream to compose in the genre.) De Ritis has spent the bulk of his career creating electronic and computer-generated music, often incorporating orchestral elements. In experimental music circles, he is probably best-known for *Devolution: A Concerto for DJ and Symphony Orchestra*, which features a full pit and the artist DJ Spooky as soloist.

Still, opera is different, De Ritis says, for musicians and audiences alike: The totality of the experience makes it the perfect medium to try new musical ideas and to entice listeners to come along for the ride.

“Audiences seem much more receptive to new work in opera than they are to new work in the symphony,” De Ritis says. “There are more ways to communicate the story: visuals, sound, acting, text. So that's a whole variety of streams of information that allow people to get used to, and understand, what's going on. And you get to control the whole environment.”

In August 2021, De Ritis and the poet Lillian-Yvonne Bertram, an English and Africana studies professor at Northeastern, received a grant from the Boston Foundation for a musical adaptation of Bertram's 2020 poetry collection, *Travesty Generator*. Even in the realm of newer opera, the source material is radical. In the book, a nominee for the 2020 National Book Award in poetry, Bertram reshapes texts generated by computer code into poems meditating on stories of the Black experience — from Harriet Tubman to Eric Garner. The poems explore algorithmic bias and aim to draw a connection between



PHOTO BY TIMOTHY A. CLARY / AFP



the modern-day tyranny of data aggregation and historical oppression like slavery and Jim Crow.

“You don’t necessarily see the computer code that denies you a mortgage based on your Blackness, but it’s the same ‘code’ that denied you a mortgage based on your Blackness in 1950, and denied you your humanity in 1820 or 1790,” Bertram explains. “I’m trying to make this connection across time – we think of algorithms as mathematical things, and they are, but they’re essentially rules and constraints.”

De Ritis, who is white, envisions the eventual product as an operatic song cycle, with a group of mostly Black vocalists and instrumentalists from jazz, musical theater, and traditional opera backgrounds collaborating to shape the interpretation of each poem. In one early rehearsal last fall, Davron Monroe, a musical theater actor, and Brittany Wells, a jazz soprano, improvised a call-and-response repetition of the term “code switch,” accompanied by a bass clarinet. In another, Brianna Robinson, an emerging artist at the Boston Lyric Opera, sang variations of the line “I can’t breathe” in a soaring soprano, abruptly cutting her breath support and sound at intermittent moments.

Compared to her work in more traditional classical music, where the technical aspects are often set and written out for her, her first rehearsal on *Travesty Generator* was “a much more fluid experience,” Robinson says. She was adjusting elements like phrasing, volume, and even which octave she was singing in as she went along. “It’s a more theatrical type of performance – the way that maybe slam poetry is done, with breaks and giving things more emphasis, elongating words,” she says.

Experimentation of this kind isn’t totally new in the American opera world, but for decades it was largely confined to its margins. Among its most noted practitioners was Robert Ashley, an experimental music pioneer and director of the Center for Contemporary Music at Mills College in Oakland in the 1970s. Ashley, who died in 2014, created a series of operas meant for television, incorporating electronic music, video elements, and a decidedly non-operatic, improvisational singing style. One, *Perfect Lives*, premiered on Channel 4 in the United Kingdom in 1984.

In music history and musicology circles, Ashley is “a giant,” says David Bernstein, a musicologist and music professor at Mills. In both his compositions and as an academic administrator, “he encouraged everyone to be as weird as they wanted to be.”

But Ashley’s work received little contemporary attention in the United States, and virtually none from the mainstream opera world, says Kyle Gann, Ashley’s biographer and an experimental composer in his own right who has created a handful of operas. “There’s been a big split in American music for at least 60 years now,” Gann says. “The classical people ... are not affected by the rest of us, whom they see as a minority culture they don’t have to pay attention to.”

That ossification is in part a financial issue. In many European countries, opera gets substantial government funding, allowing companies there the leeway to take more risks. De Ritis says that in Germany, which has



An audience member studies the program for *Fire Shut Up In My Bones* at a live broadcast in Times Square.

a robust opera culture, “you cannot put out an opera now without multiple interactive multimedia elements. They’re creating works that are pushing the technology.”

But in the U.S., where opera companies rely more on ticket sales and grant funding, their choices tend to be more conservative, says Heidi Waleson, the opera critic for the *Wall Street Journal* and the author of *Mad Scenes and Exit Arias: The Death of the New York City Opera and the Future of Opera in America*. The hits — Mozart, Verdi, Puccini — are a sure thing, so they keep getting played. “The opera business is very white and very set in its ways,” Waleson says. “It has this reservoir of standard repertoire by dead European white men, and those are the pieces that get done, year after year, after year, after year.” De Ritis agrees: “Here, bringing a synthesizer into the orchestra still freaks them out.”

The closed nature of opera extends beyond the instruments. A female composer had a work staged at the Met for the first time in 1903; the second time was in 2016. Even a push in the 1980s to get works by more living composers, like Philip Glass, into the repertoire of major opera houses was seen at the time as a radical notion, Waleson says.

And before this recent run of new works, American opera had a long history of denying major stagings to works by Black composers — even very famous ones. Scott Joplin wrote an opera, *Treemonisha*, a fable about Black rights

and education, in 1911; he had to self-publish the score. James P. Johnson, a jazz hitmaker, wrote a one-act blues opera, *De Organizer*, with a libretto by Langston Hughes about sharecroppers fighting to form a labor union. After three small New York-area performances in the 1940s, the musical score for the work disappeared for decades; scholars rediscovered a copy in a choir director’s old notebook in the late 1990s. And commercial opera hasn’t historically been culturally up-to-date, to put it mildly. The Metropolitan Opera didn’t stop staging productions of Verdi’s *Otello* with white tenors singing the title role in blackface until 2015.

IN CONTRAST, MUCH OF the new work that has recently broken through at major opera houses — garnering attention from audiences and critics — comes from outside the classical tradition in almost every way. *Fire Shut Up in My Bones* is remarkable not just for its nearly all-Black cast and jazz- and gospel-infused score, but also its staging choices and challenging source material: *New York Times* columnist Charles Blow’s 2014 memoir of the same name, which, in part, details Blow’s childhood molestation by a relative. A traditional opera ballet gives way to an omnipresent modern dance chorus. Echoing a rhetorical device in Blow’s book, the lead character is sung simultaneously by a baritone and a boy soprano.

There’s also Missy Mazzoli’s *Breaking the Waves*, a 2016

operatic adaptation of a Lars von Trier movie (yep) that opened at the LA Opera this past spring. Waleson recalls hearing a melodica — hardly a traditional orchestra instrument — in the pit, and considering it a transformative experience.

Breaking the Waves is about a devoutly religious Scottish housewife whose paralyzed husband asks her to pursue sexual relationships with other men, resulting in her excommunication from the church and her eventual, violent death. And while it's counterintuitively operatic — the tale, after all, of a tragic heroine — it's also representative of the different types of stories many modern operas are telling. Traditional opera fodder is heavy on mythology, palace intrigue, and the exoticizing of foreign cultures — *Madama Butterfly*, *Turandot*. Even some modern operas, like John Adams' *Nixon in China* (1987) and Derrick Wang's *Scalia/Ginsburg* (2015), have often focused on powerful, larger-than-life figures.

But many emerging operas are telling smaller stories about regular people — or rethinking classic myths from a modern perspective. That was the impetus for *Iphigenia*, as Spalding described it at the panel. "I feel tired of these protagonists where, somehow, all the terms of the world are concentrated on them," she said. "It feels really reflective of monarchy, or a time when you have powerful patrons who want to feel reflected in the dynamics onstage."

Such recastings of classic fare, and fresh new stories, are coming from increasingly diverse production teams. *Fire Shut Up in My Bones* was also the first work by a Black librettist, Kasi Lemmons, to appear on the Met's mainstage. The director of *Iphigenia*, Lileana Blain-Cruz, is set to make her directorial debut on Broadway this spring. Established companies have staged new operas from creators of color in recent years about Trayvon Martin, the Central Park 5, and the colonization of California through the eyes of its Indigenous people.

"I am not sure there has been a comparable moment in the history of American opera," says Francesca Zambello, director of the Glimmerglass Festival, the storied opera organization in upstate New York that gave *Blue* its premiere. The industry, she says, is "finally getting serious about developing opera that represents America in all its diversity and complexity."

Waleson says that at the moment, at least, there's a big appetite from foundations and large-scale donors to back such projects. And in the calendars of U.S. opera houses, big and small, what constitutes opera canon is getting a second look.

Glimmerglass's recent offerings include a Southeast Asian composer's adaptation of *The Jungle Book*, which incorporates Indian music and dance styles, and a song cycle about Sally Hemings. The Boston Modern Opera Project, an organization that won a Grammy for best opera recording in 2020, announced in October a five-year endeavor to stage new and historically overlooked operas by Black composers, including Anthony Davis' *X: The Life and Times of Malcolm X*, from 1986. "Opera companies have finally realized if they don't get on the train, they are not going to survive," Waleson says.

It turns out, these new works are drawing audiences,

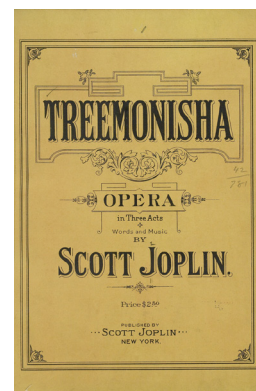
as well. The Met's eight performances of *Fire Shut Up in My Bones* sold out instantly; *Iphigenia* went on to play sold-out dates at the Kennedy Center in Washington, D.C., as well as several performances on the West Coast. And many believe that new patrons, intrigued by these productions that look so different from classic opera, are likely to return for more. "When my mom sees something, and she sees that there are other Black people onstage and off, she's more excited," says Robinson, the soprano performing in *Travesty Generator*. "In order to make your audience as diverse as you would want, you have to change the look of the stage. You have to change the look of the production team. You have to change the look of your staff."

Robinson hopes that these new stories will appeal to traditional opera audiences, as well. In her mind, opera is the perfect medium to compel audiences to understand and connect to Black experiences in America. But — just as De Ritis believes that every composer wants to write an opera — Robinson contends that every artist has always belonged to the genre, even when they weren't allowed in.

"The thought that I don't want people to have is that we're trying to bring these stories to white people in a way that they'll understand, and that's why we're doing it in opera," she says. "No. Black people are opera singers. Black people grow up with this music deeply ingrained into our bones, too."

That's because of the nature of opera itself — an epic genre that can set the stage for epic stakes.

"Opera is the grandeur of emotions being brought out by a human screaming beautifully," Robinson says. "It makes sense to bring our stories to the forefront in this form because that's what we always do. Why not do it in classical music?" ■



Scott Joplin wrote the opera *Treemonisha*, a fable about Black rights and education, in 1911; he had to self-publish the score. Below, many emerging operas, such as *Breaking the Waves*, are telling smaller stories about regular people.



TO BEAT PANDEMIC

ILLUSTRATION BY RETALES BOTUERO VIA GETTY IMAGES



The image features two medical syringes on a solid orange background. One syringe is positioned diagonally from the top left towards the bottom right, with its needle pointing towards the top right. It has a green plunger and a silver barrel with black markings. The other syringe is positioned diagonally from the bottom left towards the top right, with its needle pointing towards the top left. It is entirely white. The text 'FOUR WAYS' is written in a large, black, serif font, and 'THE NEXT' is written in a similar font below it. A short paragraph and the author's name are located in the bottom right area.

FOUR WAYS

THE NEXT

The COVID-19 crisis has given us a blueprint for a better global response. Here's what we've learned.
BY ERICK TRICKEY



IT'S JANUARY 2027, and reports are emerging of a deadly new virus. Perhaps it's a new strain of flu, or another coronavirus. Maybe it's been detected in Africa or Europe or North America. Like COVID-19 seven years before, the new disease spreads fast, makes many people seriously ill, and leads to death among the most vulnerable. People all around the world brace for another pandemic, as bad as COVID-19 or worse.

But it's different this time. Between 2022 and 2026, scien-

tists, governments, nonprofits, and international organizations have come together to build a worldwide system for stopping the next pandemic: everything from forecasting the disease's spread to creating vaccines in advance and distributing them swiftly around the world.

The result is an entirely different pandemic experience, across the globe. Social distancing and other restrictions end sooner, lessening the pandemic's economic and emotional impact. Global



Afrigen, a startup in South Africa, is trying to develop a COVID-19 vaccine based on publicly known information about Moderna's vaccine. Below, the National Hurricane Center could be a model for pandemic response.



1

Build a global warning system

THE FIRST LESSON OF COVID-19 was that a slow response costs lives. And in the first months of the pandemic, from Alessandro Vespignani's standpoint, the response across Western nations was maddeningly slow.

Vespignani, a Northeastern University professor of network science who has spent years forecasting the spread of infectious diseases, was among the first scientists to predict the global impact of COVID-19. By February 2020 — two months after a new coronavirus had emerged in Wuhan, China — Vespignani and other data scientists were sharing forecasts that showed the virus spreading worldwide. But those forecasts came from disparate academic teams, with little coordination. Media reports often focused on a single group's predictions, rather than

a consensus. It took until mid-March for government leaders to take serious action, such as warning people to stay home.

"We lost very precious time to prepare the system for the worst," Vespignani says. He points to a study estimating that if U.S. leaders had introduced social-distancing rules just two weeks earlier, they would have saved 60,000 lives.

Now, the U.S. government is building the capabilities to respond to the next viral threat with a unified voice. The Center for Forecasting and Outbreak Analytics, slated to launch full operations later this year, is intended to forecast epidemics' spread, collect data, and inform leaders and the public. Part of the Atlanta-based Centers for Disease Control and

disparities in vaccination rates all but disappear. In the end, the new pandemic claims many fewer victims than the more than 5 million people who, by early 2022, have died of COVID-19.

This optimistic scenario is hardly guaranteed. But it is within reach, scientists say — if the world applies four lessons from the COVID-19 crisis. We have the blueprint, right now, for halting the next pandemic in its tracks. In fact, preparations are already underway.

PHOTO BY SAUL LOEB / AFP VIA GETTY IMAGES

Prevention, the \$200 million outbreak center will employ epidemiologists to analyze data from sources including hospital records, public health databases, prescription drug sales, and cellphone location tracking. Vespignani compares the effort to the National Hurricane Center, which uses several forecasting models to predict a storm's path and then reports a scientific consensus. "As soon as there is some risk, it springs into action," he says.

The outbreak center will offer epidemic forecasts, which can look weeks ahead, and scenario modeling, which will look at possibilities months ahead, incorporating variables like a new variant's transmissibility and immune evasion. Though it's still scaling up, the center released its first projections a few days before Christmas 2021, offering fast-growth and slow-growth scenarios for the omicron variant's spread in the U.S. The fast-growth scenario – new infections exceeding previous peaks in January 2022 – quickly proved accurate.

The outbreak center could also decide "how we can build those pipelines of data analysis, how we create global surveillance systems for the disease," says Vespignani. That's important because when COVID-19 struck, data scientists like him had to figure out those questions on their own amid the crisis. For instance, they had to convince cellphone companies and other location providers to share data that traces people's movements while preserving each person's privacy.

A comprehensive system, Vespignani hopes, could help CDC officials and local leaders within the U.S. make good decisions. But to be truly effective, it would need data from other countries, as well. It's like a weather forecast, he says: If you only focus on patterns inside a nation's borders, you won't do it right.

Across the world, similar forecast centers are already forming. The World Health Organization launched its Berlin-based Hub for Pandemic and Epidemic Intelligence in September 2021 with \$100 million in funding from the German government. The Rockefeller Foundation pledged \$150 million in October 2021 for a global Pandemic Preparedness Institute. The U.K. government announced plans in May 2021 for a Global Pandemic Radar center. Their goal: to share data, detect the next potential pandemic, sound alarms, and help governments respond faster next time.

Then, the world could prepare the best protection: a vaccine.



Invent new vaccines before they're needed

2 ARGUABLY THE BIGGEST success story in the COVID-19 pandemic was the record-fast production of vaccines. It took 330 days, after COVID-19's genetic sequence was released in January 2020, before the first vaccines were delivered to some of the public that December – condensing a development and testing process that usually takes years.

But that speed was built on scientific research that had been going on for decades. British epidemiologist Mark Woolhouse had observed that most new viruses infecting humans belonged to a relatively stable number of virus families. Research by hundreds of scientists was beginning to produce new vaccine technologies, such as experimental messenger-RNA vaccines, which could be manufactured quickly. And by 2017, Barney Graham, the longtime deputy director of the National Institutes of Health's Vaccine Research Center, was proposing a way to develop vaccines in advance of future outbreaks.

In the mid-2010s, Graham and Jason McLellan, a professor at the University of Texas at Austin, had done pioneering work on the spike protein that coronaviruses like

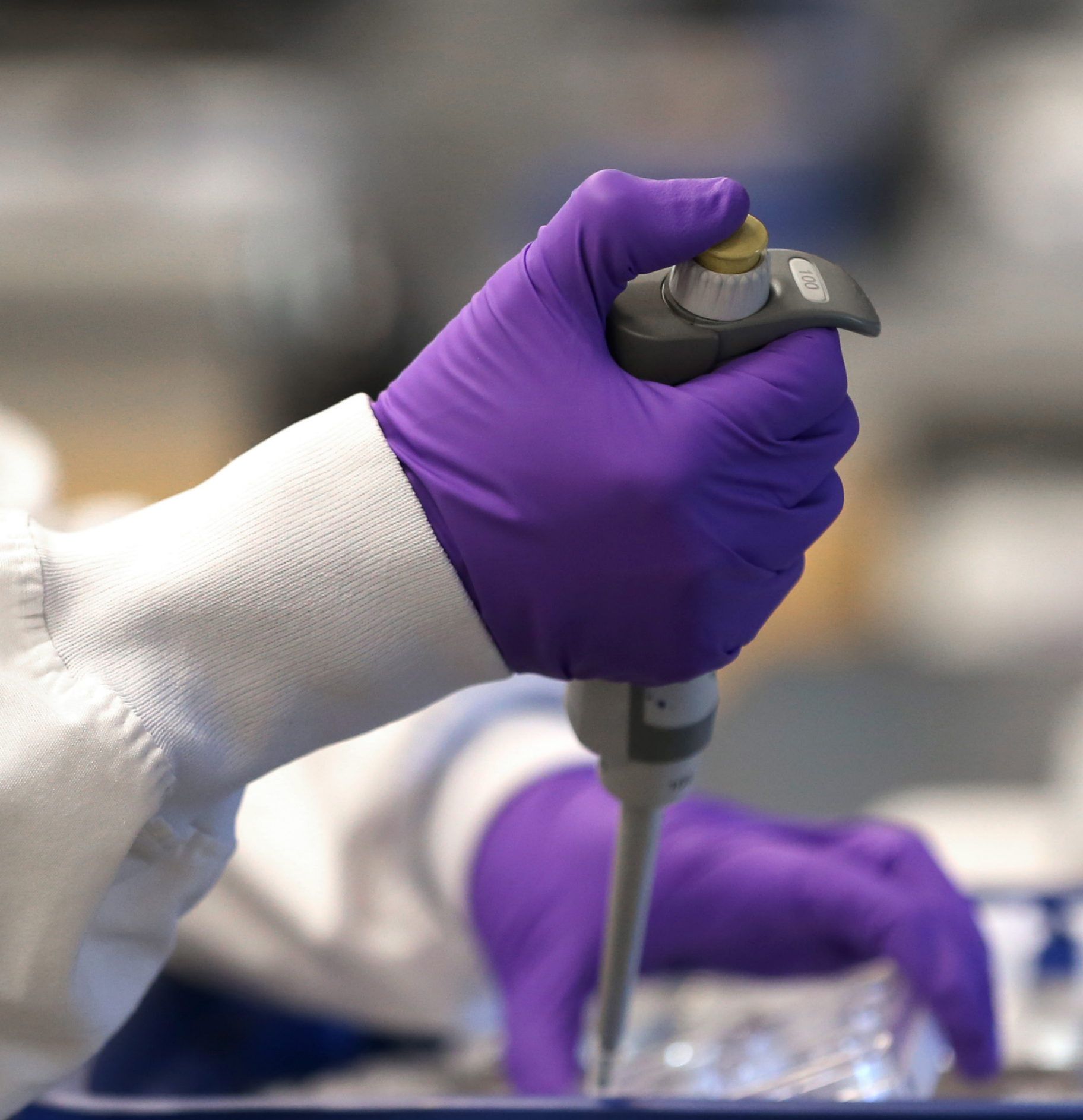
SARS and MERS use to infect human cells – figuring out how they could keep that protein from changing shape so that they could design a vaccine based on it.

"We knew that way of stabilizing the spike ... would work across multiple coronaviruses," Graham recalled in a recent interview. Today, most leading COVID-19 vaccines – Moderna, Pfizer, Johnson & Johnson and Novavax – use Graham and McLellan's method of stabilizing the virus' spike protein.

Anthony Fauci, Graham's boss at the National Institute of Allergy and Infectious Diseases, budgeted money for Graham's lab to work on vaccines for coronaviruses – and also for Nipah, a virus from a different family that breaks out almost annually in India and Bangladesh. Graham's lab established a collaboration with the pharmaceutical company Moderna. By the end of 2019, Graham says, they had prototypes ready.

The team had planned to start with the Nipah virus vaccine. But when COVID-19 emerged in early January 2020, Graham and Moderna CEO Stéphane Bancel decided to test the project on coronaviruses first.

A few days later, after Chinese researchers posted the genomic sequence of the



When COVID-19 emerged in early January 2020, researchers tested a vaccine intended for a different family of viruses on coronaviruses first.



Ayanna Phillips celebrates after receiving the COVID-19 vaccine in Miramar, Florida.

COVID-19 virus, Graham and his collaborators redesigned their prototype coronavirus vaccine to fight it. Their redesign became part of Moderna's mRNA vaccine, which instructs muscle cells to create a harmless version of the spike protein for our immune systems to combat.

"This really started as a demonstration project for our pandemic preparedness idea," says Graham. "We did this before we ever had a case in the U.S. We didn't really for sure know if it would be a global pandemic. And then as things evolved, it obviously was not just a drill; it was the real thing."

Now Graham, who recently retired from the NIH, wants scientists to create vaccine templates for the 26 or so virus families that most threaten humans. "For maybe 20 to 22 of those viral families, there are some fairly obvious approaches that could be taken," Graham says. A few other viral families will require further conceptual breakthroughs in immunology.

But Graham thinks that spending \$3 billion to \$5 billion a year over 20 years could lead to humanity having a complete lineup of prototype vaccines, ready to take off the shelf and adapt if another pandemic breaks out. "This is 20 years of work for about a thousand good scientists," says Graham. "It's a long-term, big project, but it's feasible."

Graham's concept would require either a global effort or greatly expanded U.S. government funding to research vaccines.

Still, the idea is catching on. The Biden Administration has included it in a proposal to Congress. The World Health Organization and international health nonprofits have also endorsed it.

"There's a huge possibility that this could work, because you know what piece to target for each of those virus families," says Brandon Dionne, an associate professor at Northeastern University's School of Pharmacy. "Once you have an epidemic, you can identify the specific genetic code for that version of the virus."

Meanwhile, a plan is emerging to produce new vaccines even faster during future pandemics.

The U.S., the U.K., and the G-7 group of industrial nations have all endorsed the 100 Days Mission, an aspirational plan with the goal of developing rapid tests, a first round of drug treatments, and vaccines ready to be produced at a global scale, all within 100 days of a new pandemic threat. The vaccine advances that Graham and others developed give the project a formidable start. But it would also require massive spending that hasn't been approved yet, future breakthroughs in technology, further efficiency in speeding up clinical trials, and solutions to very practical questions: how to set aside enough supplies (such as glass bottles), solve shipping challenges, and build enough manufacturing capacity to make the vaccines quickly.

"I think there's promise," says Dionne, "but I think it's still a very ambitious goal."

Afrigen Managing Director Petro Terblanche wants to produce vaccines for the next pandemic and teach others how to do so.



3

Produce vaccines on every continent

PHOTO BY SUSAN STOCKER / SOUTH FLORIDA SUN SENTINEL VIA GETTY IMAGES



PHOTO BY RODGER BOSCH / AFP VIA GETTY IMAGES

YEARS OF PRIOR RESEARCH weren't the only reason that scientists developed COVID-19 vaccines in record time. Sped-up clinical trials, subsidized with public and private funding, also helped. The U.S. government's Operation Warp Speed, the world's largest such effort, invested \$18 billion in six vaccine candidates: funding the pharmaceutical companies' research, subsidizing their early manufacturing, and purchasing doses.

But Dionne notes that one of the biggest challenges facing vaccination efforts in future pandemics is one that the world hasn't yet solved during this one. Of all the lessons of COVID-19, perhaps the most important is that a pandemic likely won't end until people around the world are vaccinated. Wherever the virus still rages, variants will emerge. That

was true of the omicron variant's spread in late 2021, at a moment when many citizens of wealthy countries were getting their third vaccine dose and half of humanity still hadn't gotten its first.

"It is of no help that just the rich countries vaccinate their populations," says Christopher Viehbacher, a veteran pharmaceutical executive and Northeastern University trustee who chaired the research, development, and manufacturing committee of COVAX, the World Health Organization-backed effort to vaccinate people in developing countries. "None of us are safe until all of us are safe."

One reason for the vaccine inequity: Wealthy nations made deals, early in the pandemic, with the pharmaceutical companies producing the major vaccines. With Operation Warp Speed,

for instance, the U.S. government reached advance-purchase agreements for hundreds of millions of vaccine doses. Poorer countries, outbid, ended up at the back of the line. COVAX aimed to deliver two billion doses by the end of 2021, but only delivered 900 million. "We need to make sure there is an equitable supply, particularly for those countries that don't have any manufacturing capabilities," says Viehbacher.

Brook Baker, a law professor at Northeastern University and a leading critic of global vaccine inequities, says future government subsidies or collaboration with pharmaceutical companies' vaccine research should come with agreements to share technology and know-how, so that vaccines can be produced worldwide. "What we had this time around was massive public investments through Operation



Warp Speed, and similar investments from other governments, that de-risk the product development for vaccines, but with no strings attached,” Baker says.

An international pandemic-response accord might provide a different way to vaccinate the world next time. The WHO’s World Health Assembly voted to pursue such an accord in December 2021. Supporters say it could include agreements for more equitable vaccine distribution and the sharing of vaccine-making intellectual property and knowledge — possibly in exchange for pledges to contribute data to global outbreak surveillance.

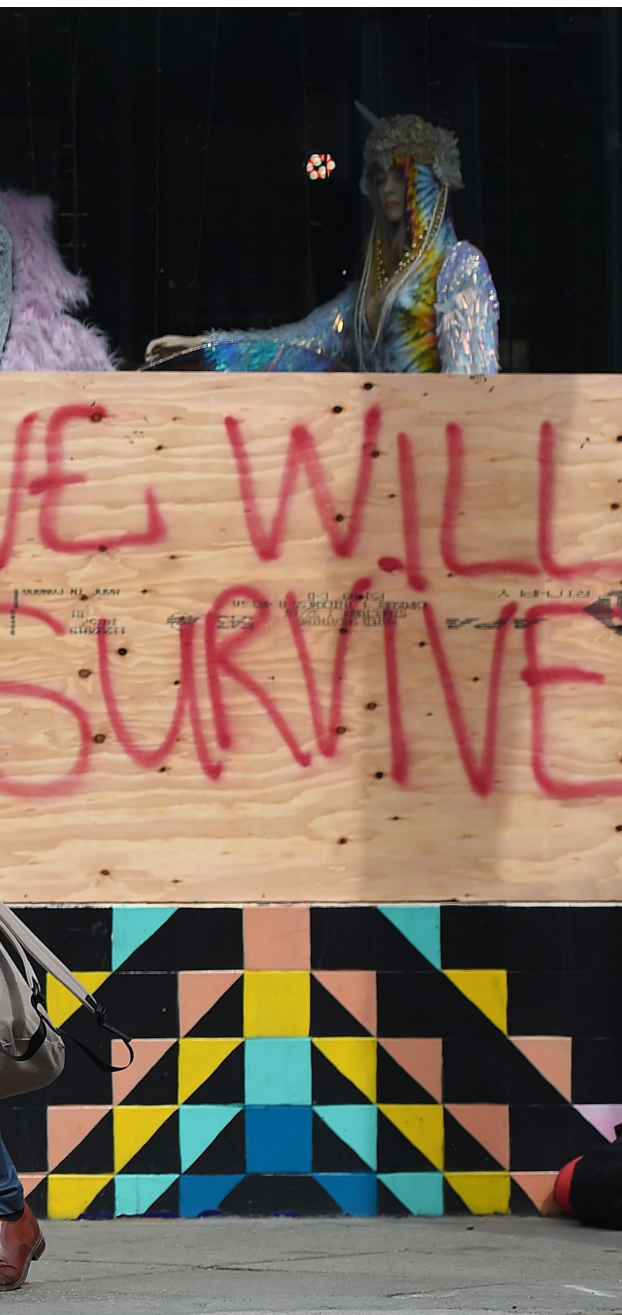
“We’ve had export restrictions; we’ve had countries acting on a very nationalistic basis,” Baker says. “Other regions of the world need to have some degree of self-sufficiency.”

Petro Terblanche is trying to make that happen. She’s the managing director of Afrigen, a vaccine-making startup in Cape Town, South Africa. The World Health Organization has made Afrigen the center of its first technology transfer hub for COVID-19 messenger-RNA vaccines. Currently, Afrigen’s 28 employees are trying to develop a COVID-19 vaccine based on publicly known information about Moderna’s vaccine. Terblanche estimates it will take about three years, which could be cut to one year if Moderna would agree to share its vaccine technology and knowledge. Afrigen’s longer-term goal, says Terblanche, is to be ready for the next pandemic, and to help others prepare, too.

“Our role would be to develop a complete technology package, train people in low- and

middle-income countries, and transfer that technology for commercial-scale production,” says Terblanche. The aim is to have several factories making mRNA-based vaccines in low- and middle-income countries by the time the next pandemic strikes.

If the WHO and Afrigen’s plan succeeds, and companies that create vaccines share technology and know-how, poorer countries will someday be able to rely on vaccine manufacturers on their own continents. When the world isn’t fighting a pandemic, the regional manufacturers would produce vaccines for locally-centered diseases. Africa, where fewer than one in five people are vaccinated against COVID-19, has identified 22 essential current and future vaccines for its population’s health, says Terblanche, including vaccines for Ebola, HIV, and



Don't get complacent

4

AS MANY SCI-FI MOVIES and academic papers as there were before 2019, warning of the potential for a deadly pandemic, COVID-19 still caught the world by surprise. So before the next pandemic, a massive global change needs to come, not just in scientific advancement, but in mindset.

Vespignani is certain there won't be another century-long gap between pandemics, like there was between the 1918 flu and COVID-19. "Because of globalization, we are reaching places in remote corners of jungles or the mountains, where we don't know what kind of pathogens or viruses are harbored in animal species," he says. "And now these viruses can get, in 24 hours, all over the world, or in big urban areas in a short time."

And as terrible as COVID has been, with its ever-rising death count and waves of outbreaks, scientists agree that another disease could be worse. COVID's unusual age impact – it's more dangerous to catch if you're older – limited its devastation. A future virus could have a higher fatality rate. "We were lucky this time," Vespignani says.

Tackling the next pandemic – and being prepared for a set of less-favorable

circumstances – will require more than technical know-how. It will demand a keen awareness of the risks of acting too slowly. It will require successful communication to build greater trust in vaccines. And it will demand international coordination, far beyond what we've seen so far.

But if the world succeeds in making those changes, humanity's fight against the next pandemic could look very different than the long battle against COVID-19. Stations across the globe could identify the new virus quickly. Scientists could stand ready to plug its DNA sequence into a new crop of vaccines. Vaccine factories on every continent would switch from their day-to-day work into wartime mode. Within 100 days, authorities might approve the new vaccine, and people around the world could line up to get inoculated.

"Viruses have a way of escaping if you don't really crush them," says Graham. To beat the next virus, the mistakes we made with COVID-19 will need to be seared into our consciousness: reminders of what we did wrong, so we know how to do things right.

"We need to buy our insurances for the future now," Vespignani says, "and make a treasure of the lessons of this pandemic." ■



Northeastern University professor Alessandro Vespignani is certain there won't be another century-long gap between pandemics.

malaria. "Many of these diseases do not exist in the high-income countries," Terblanche says. "It does not make economic sense for a Moderna or a BioNTech or a Johnson & Johnson to invest in these small vaccines, unless they have a humanitarian outlook."

Helping Africa develop vaccine manufacturing is now Barney Graham's top goal. He hopes to use his scientific connections to encourage academic partnerships, philanthropic organizations, and governments to contribute knowledge and investment there.

"We take a lot of things for granted here," Graham says: technicians to fix equipment, supplies available overnight, and reliable electricity. "Can we take that privilege that we've had and try to use that to change some things [in] other parts of the world?"



The

My wearable fitness trackers collected plenty of data. But there's something they were missing.

Quantified Man

BY MATT CROSSMAN
ILLUSTRATIONS BY BORJA BONAQUE

With all that sweat, you look spectacular.”
I blushed at the compliment as I jogged
through my neighborhood on a too-warm summer morning last year. I would have been flattered — and bragged about it to my wife, friends, brothers, neighbors, and strangers at the grocery store — if the come-on hadn’t come from my socks.

Friends
joked I was
becoming
the Bionic
Man. I was
a living
algorithm.

DESIGNED TO HELP JOGGERS track their runs and improve their form, these socks have sensors on the soles, which connect to microelectronics on the ankles, which connect via Bluetooth to an app on my phone.

They also come programmed to appeal to my vanity. In a voice that sounds like a sassy female robot – crisp, abrupt, a hint of an accent she’s trying to hide – she made it clear that she knows what she wants (me, apparently) and isn’t afraid to go get it.

Or maybe (*fans self*) I’m reading into it.

Anyway, when they weren’t wolf-whistling at me, the socks, made by a Redmond, Washington-based company called Sensoria, told me how fast (or not) I was running, how smooth (or not) my strides were, and which parts of my feet were hitting the ground first (heels). Sassy Female Robot offered cheesy inspirational bromides, a question about whether I’m running that fast because zombies were chasing me, and the aforementioned come-hither comment.

Whether I looked spectacular or nasty, I felt good at the end of that run, and that was the point. The socks were

part of an attempt to hack my health using wearable devices, capitalizing on a wave of new consumer products that promise to change your life by helping you optimize everything: your sleep, your speed, your readiness.

Self-motivated and passionate about fitness, I live smack in these products’ wheelhouse. I already owned a Fitbit 4 watch, which I use to track my heart rate, workouts, and distance traveled. To that I added the Sensoria socks (\$398), a shirt that measures heart and lung function from a company called Hexoskin (\$497), and a sleep-tracking ring called Oura, which the NBA and NASCAR used to detect COVID-19 symptoms during the early days of the pandemic (\$399). All of them talked to me via apps on my phone, though only the socks spoke out loud.

For two months, I wore the ring and the watch nearly all day, every day, and the socks and shirts during workouts. That gave me an overwhelming amount of data about myself – every heartbeat, every step, and much, much more.

There’s a global community of people who gather data on themselves, much like I did. It goes by the name of Quantified Self, and its members conduct data-collection



PHOTO BY OURA

projects they call “personal science.” The subjects range from relatively simple (tracking hearing loss) to illicit (the effects of hallucinogenic drugs) to profound (two people separately charting whether they did what they said they’d do). Thomas Blomseth Christiansen, a technology entrepreneur from Denmark, collected data on all of his sneezes for five years and shared the results at a Quantified Self conference. He sneezed 1,019 times in 2012, 533 in 2013, 486 in 2014.

Steven Jonas, managing editor of Quantified Self, says the point of any self-tracking project is not just to collect and collate data. The key is to find a takeaway for self-improvement. Sometimes that means discovering a medical issue or developing a plan for self-care. Christiansen learned that his sneezes came in clusters and were far worse in his native Denmark than elsewhere. By analyzing that information, along with other data about food, he learned to control his allergies. Now he no longer needs to take medication for them.

Could my wearable devices help me make a similar discovery? The products’ marketers sure make it sound that way. Stephen Intille, a professor of computer science and health science at Northeastern University, has studied interfaces that aim to help people get and stay healthy. “The devices, in the long run, have potential,” he says – to zoom in on problems, identify solutions, and change lives for the better.

That all happened to me, for a while. But something else happened, too. Before I was even aware I was doing it, I started to let the devices take over. In relying on them, I started to behave as if I was a device, too – as if, were I just to oil this gear, I would operate better. The data overrode my own decision-making. I started to trust it more than I trusted myself.

I BEGAN MY DATA COLLECTION project with the Oura, the sleep-tracking ring. I have wrestled occasionally with poor sleep, never worse than this past summer. Sometimes I can’t fall asleep; sometimes I can’t stay asleep; sometimes I wake up unrested. I hoped the ring would help me understand what was happening and help me fix it.

Sleep experts say the biggest key to sleeping well is to be consistent – go to bed at the same time and wake up at the same time, even when you don’t have to. After a few weeks, the Oura discerned when I slept best and set my bedtime accordingly – usually 9:15 to 10:15 p.m. It reminded me via push notification. I haven’t been told when to go to bed in four decades, and even then, I stayed up late reading the Hardy Boys. But I diligently obeyed the ring.

The ring said the ideal bedroom is dark. I installed blackout curtains. The ring said the ideal sleeping temperature is 65 degrees; my wife would have had to wear a parka if I’d turned it down that low, but we compromised and turned the overnight temperature from 77 to 72. To please the ring, I gave up afternoon coffee, ate dinner earlier, cut blue light in the evening, tried to relax before bed, and as often as I could, climbed into bed at the appointed time.



And, just as Christiansen’s study helped him stop his allergy flare-ups, the ring helped me sleep. The improvement was immediate. Before I made any changes, I slept 6 hours, 20 minutes per night. Once I started obeying the ring, I jumped to 7 hours, 17 minutes.

The ring was astute at guessing where I’d gone wrong. One morning early on, my ring said my heart rate had taken a long time to slow down the night before, a metric of less-than-stellar sleep. “Could it be that you ate too close to bedtime?” the ring wondered.

I had.

I was hooked.

The most challenging piece of advice the Oura offered was its “readiness score.” I wore the Oura on my right-hand middle finger. As I slept, the ring shot infrared light into my finger to track my heart rate, heart-rate variability and body temperature. The app provided a report detailing those numbers, plus how long I spent in each sleep cycle (deep, light, REM) and how much I tossed and turned. It used those measurements to calculate whether I had recovered enough from the previous day’s stress.

The number runs on a 0-100 scale; I guess zero would mean you’re dead and 100 would mean you’re Superman on uppers. My highest score was 91. My lowest was 66.

“Bring it on!” the ring said one morning, announcing an “optimal” readiness score.

The NBA and NASCAR used the sleep-tracking ring Oura (left) during the early days of the pandemic to track players’ health. The Fitbit 4 watch (above) tracks heart rate, workouts, and distance traveled.

Stephen Intille,
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potential to change
lives for the better.

"Your resting heart rate indicates that you've recovered well. Do you feel energetic?"

YES!

YES, I DO!

I think.

Wait.

Do I?

It started slowly and so subtly, I didn't realize it was happening: I didn't know if I had slept well until I checked my sleep score. I didn't know if I should work out that day until I checked my readiness score. I lost confidence in my own self-awareness. It was like relying on the phone for directions to go somewhere I visit every day.

As I realized the power that I had given the ring, I turned defiant. On July Fourth I stayed up late watching fireworks, slept poorly, and woke up to a low readiness score. "Take it easy today," my ring told me.

Forget that, I feel fine, you're not the boss of me, I retorted ... not out loud — I wasn't talking to it out loud, yet. I went outside in high heat and humidity, did strenuous yard work for an hour, and felt like I got run over by a truck with spiked tires that reversed and backed over me again.

The ring was right.

I should have taken it easy.

Did the ring know me better than I knew myself?

The evidence suggested so.

I returned to being obsequious after that.

For a while.

THE FIRST TIME I TRIED to put the Hexoshirt on, I stopped because I thought they'd sent me a shirt two sizes too small. I finally jammed myself into it; it squeezed me like an overeager python. That tightness is a requirement. Three sensors sat snug against my chest and

torso and recorded heart rate, breaths per minute, and liters of air gulped per minute.

Watching in real time what your body is doing is enthralling. Every time I showed up at my outdoor workout group, my buddies crowded around me, staring at my shirt and the connected app on my phone. Touch this button and it's a handheld ECG machine. Touch the button next to it, and my lung activity rose and fell like waves. "Watch this," I would say, before I took a deep breath and watched the wave grow bigger. I had already turned sleep into an equation to be mastered. Now, I turned my heart rate into low scores and high scores and tried to break them.

Friends joked I was becoming the Bionic Man. I was a living algorithm, even if I didn't always know what to do with the information. Every morning, I pored over my deep sleep, light sleep, and REM numbers. When my socks said I ran lopsided and indelicately — both feet hitting the ground too hard, my left foot especially — I tried to run more smoothly.

But these were mere frivolities compared to my obsession with the Oura ring's readiness score. In search of ever-better readiness numbers, I rode a wave of early to bed, late(ish) to rise. My sleep improved, my readiness improved, and I felt better. I was ready to take on the world ... as long as my ring said I was ready.

And then ... and then ... nothing else happened.

I plateaued, and then I lost my sleep gains.

Worse than that, I started to wonder what I was missing. I feared being ill-prepared when I had a less-than-pristine readiness score, so I skipped rigorous workouts with my friends. By behaving in accordance with the readiness score, I was proving it right. My text chain with my friends lit up with laughter over shared suffering that I missed out on. Jealousy crept in. My confidence crumbled.

I started to doubt the value I conferred upon the readiness score. I took a closer look at exactly what the ring told me and found it wanting. "Looks like something affected your sleep quality last night," it said one morning.

No shit, Dick Tracy. But you didn't tell me what that "something" was.

"Can you make sleep a priority tonight?" it asked after I slept terribly again, as if paying \$399 for a ring, wearing it 24/7, and following its every suggestion wasn't enough proof I had already made sleep a priority.

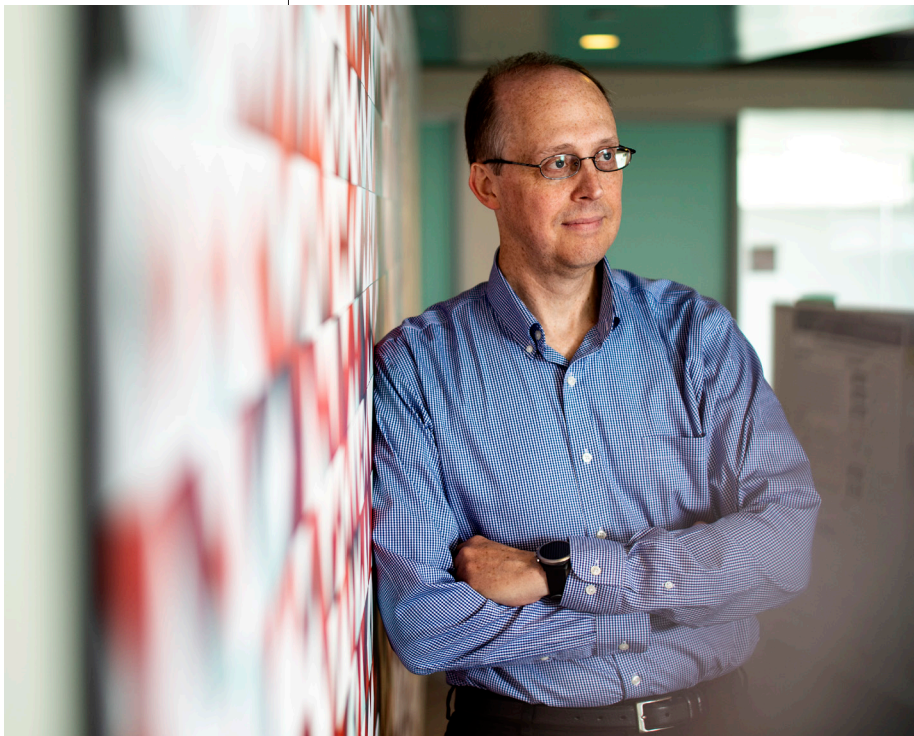
"It looks like you've had enough easy days in your workout routine lately," it nagged one morning and ... I just ... SCREW YOU. MY SOCKS THINK I'M HOT.

I tossed and turned but received a high sleep score from the Oura. Or I felt like I slept great, but the score didn't reflect it. The honeymoon had ended, because I no longer trusted the numbers.

Dan Ledger, a wearables industry technologist and consultant, co-wrote a white paper in 2017 that showed roughly a third of customers stop using their wearable devices after six months. The reason: they think they're getting unreliable information or bad advice. When I spoke to him recently, his analysis hadn't changed: I had butted up against wearables' dirty secret.

"[If you think,] 'This

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Thousands of bundles of secondhand clothes are delivered to this market in Kenya every day.

Giving till it hurts



Donated clothing gets a new life — but not the one you think. These are the unseen global consequences of fast fashion.

BY RYAN LENORA BROWN

The bales arrive by the truckload at the market in Johannesburg at dawn, squat white bricks weighing upwards of 600 pounds, each one as big and unwieldy as a dish-

washer. Inside are thousands of pieces of secondhand clothing that have been pressed and shrink-wrapped into cubes by textile recyclers in the U.S., Europe, and Asia.

Every morning, the dozens of traders who work a stretch of three downtown blocks known as KwaDunusa — a Zulu word that translates more or less to “the place of bending over and sticking your backside out” — slice the thick plastic coverings from these bales and spread their wrinkled contents into double-bed-sized bins. Depending on the item and its quality, they pick a price from 3 rand (about 20 cents) to 60 rand (\$4). And then, as morning light slants through the surrounding art deco high-rises, they begin shouting.

“Cheapcheapcheap!” they call to passing commuters, plunging their hands into piles of polyester and Lycra and flipping the contents of their bins again and again to catch the eye of possible customers.

Today, the
average
American
buys 68
new items of
clothing each
year.

Some version of this scene plays out daily in dozens of countries across Africa. In Ghana, imported secondhand clothes are called *obroni wawu*, dead white man's clothes. In Malawi, they are *kaunjika* – literally “clothes sold in a heap.” In Mozambique, they are known as *calamidade*, calamity, for their historical association with disaster relief aid.

If you live in the West, chances are at some point you have stuffed your used clothes into a black garbage bag and hauled them off to a Goodwill or the Salvation Army. Maybe you stood over your clothes and asked them pointedly if they brought you joy, à la Marie Kondo. Maybe two years of pandemic living made owning anything but sweatpants feel superfluous.

Either way, if you're like me, donating your used clothing was probably the end of the story. For most of my life, I assumed that the clothes I gave to thrift stores were sold at those thrift stores, and that I was simply a benevolent donor – giving my low-rise bootcut jeans a second life, and helping a charity raise funds in the process.

In fact, what happens to clothing after it's donated is a deeply complicated, dizzyingly global story about the unseen consequences of fast fashion, the opacity of charity, and the effects on the people who end up on the receiving end of our well-meaning donations.

And now, many of those people are calling for Western companies and their customers to change their ways, both by consuming less and by taking more responsibility for what they do. Given that the fashion industry is responsible for one-tenth of the world's carbon emissions, according to the U.N. Environment Program – more than international flights and maritime shipping combined – what we do with our old clothes is a question with high stakes, not just for Africa, but for the future of humanity.

I FIRST BECAME CURIOUS ABOUT the afterlives of our clothing last year, when I began thrifting in Johannesburg as an antidote to my pandemic malaise. A year into a global crisis that had reduced my country-hopping life as a foreign correspondent to an endless parade of Zoom calls, the act of sinking my hands into huge piles of clothes, looking for the gems, felt tangible in a way my work no longer did. Soon, I was finding too much to keep for myself. I launched a store via Instagram, selling mint green Crimplene party frocks, 1980s checked jumpsuits, and firetruck red corsets made in West Germany. In South Africa and elsewhere, the pandemic had driven a great deal of shopping online, and I quickly tapped into a community of South African women interested in fashion, sustainability, and the intersection of the two – all from the relative safety of their couches.

Rummaging through the piles of clothing in KwaDunusa, as I've been doing every week, gives you a visceral sense of how the clothing industry has changed in the past century. In the 1950s, the average American family spent about 10% of its income on clothing, and that money bought them just a few sturdy garments a year.

Now, thanks largely to the outsourcing of garment production to the developing world – where labor costs are far lower than in the West – the cost of an article of



clothing has dramatically decreased. In 2019, American families spent on average about 2% of their income on clothing. That's enough to afford, not a new dress or suit twice a year, but dozens of increasingly flimsy garments. The pivot began in the 1990s, as early fast-fashion pioneers like Gap began swapping out styles not seasonally, but monthly, to lure in repeat customers. Over the next two decades, the trend accelerated, culminating with fast fashion brands like Zara, Topshop, and H&M, which produce 52 “micro-seasons” per year. The website of the Chinese behemoth Shein, the vanguard of so-called “ultra-fast fashion,” boasts that the company releases 1,000 new styles every day.



Since 2000, the global production of clothing has doubled. Today, the average American buys about 68 new items of clothing a year. Plunge your arms elbow-deep into a pile of jeans at the dunusa, and you'll find that the thick, un-stretchable denim of vintage Levi's 501s and '90s mom jeans is easily distinguishable from a pile of jeggings as pliable as Silly Putty. In the blouses, the silky polyester of '70s button-downs feels a world away from the gauzy fluff of a Forever 21 blouse.

But quality is only the beginning of the challenge. Westerners now consume clothing at such a ferocious pace that our own secondhand shops cannot begin to absorb our discards. Today, although we donate only about

15% of our used clothing to charity, domestic thrift stores are still overwhelmed. They can only sell a sliver — about 10% to 20% — of what they receive. The rest is sold to textile recyclers, who turn the lowest-quality items into rags and insulation, and press everything else into bales, which are sold to traders across Asia and Africa.

So most U.S. clothing donations don't get sold at some suburban American thrift store, but in markets like this one in Johannesburg, where the familiar fast-fashion brands are represented — H&M, Zara, Mango, Target, Forever 21 — along with a seemingly endless parade of second-tier labels with nearly-generic names (one day, I rifled through clothes bearing the labels Fashion Concept,

Shoppers peruse clothes in Nairobi, Kenya. "People still buy secondhand because what they find here is nicer than what they can afford new," says Esther Mapingure, who sells clothing in a suburb of Johannesburg.



Above, donations overflow a bin in Virginia. Right, donated items often bear slogans jarringly out of touch with the reality of the clothing trade. Far right, bales of secondhand clothing await distribution at a warehouse in Senegal.



TOP PHOTO BY B CHRISTOPHER / ALAMY STOCK PHOTO; ABOVE PHOTO BY ANNA KERBER / ASSOCIATED PRESS; RIGHT PHOTO BY MARIAMA DARAME/AFP VIA GETTY IMAGES





Fashion Affair, Up2Fashion, Your Life Your Fashion, and Fashion Style). It's also not uncommon to see items still bearing the price tag of the Goodwill or Value Village that tried and failed to sell those castoffs to begin with.

"Sometimes when you are thrifting, you see things that look completely new, and you start to wonder, where is this coming from?" says Assent Mathebula, who with her two sisters runs a vintage clothing store in Germiston, a suburb of Johannesburg. "You wonder, do people in America have so much money that they can just wear things once and then throw them away?"

It's not just fast fashion that creates that impression. The custom shirts that serve as gag gifts and souvenirs at charity events also make their way into Africa's clothing piles. Everywhere you turn in Johannesburg's main clothing market, you'll find out-of-context slogan T-shirts — declaring allegiances ("Straight Outta Germany," "Fierce Feminist," "Virginity Rocks"); or made for non-English speaking markets ("Aim Your Own Goal," "She Beat The Drum"); or representing what could be a museum of minor American fun runs ("The Chick-fil-A Egg Scramble," "The 2013 Pikes Peak YMCA Turkey Trot").

To be sure, the availability of inexpensive clothes isn't entirely a bad thing. In a country like South Africa, where more than half of people live below the poverty line, demand remains brisk, and some Western castoffs have become wardrobe staples for people who might not be able to afford new clothes. The West's vintage clothes in particular are often sturdier and likely to last longer than the cheap, contemporary clothes that go for similar prices.

"People still buy secondhand because what they find here is nicer than what they can afford new," says Esther Mapingure, who sells secondhand clothing from bales in Midrand, a suburb of Johannesburg.

The bigger problem is the volume. For every item of secondhand clothing that finds a new home with an African buyer, another unusable one ends up in an African landfill.

"We end up with the Western world's trash," says Sammy Oteng, project coordinator in Accra, Ghana, for the OR Foundation, a nonprofit that works on issues of justice and sustainability in the fast fashion industry. "They are sending us whatever they do not want anymore."

The consequences for countries like Ghana are dire. Each day, about 154,000 pounds of used clothing — whatever is too mangled or unfashionable to be sold — leaves Accra's main garment market, Kantamanto, bound for a dump on the banks of the Korle Lagoon. There, a five-story mountain of waste towers above the inky black water, an estimated 60% of it clothing. Every gust of wind heaves scraps of cloth into the lagoon, and many are later coughed up on nearby beaches, often with the labels still intact.

IN RECENT YEARS, COUNTRIES on the receiving end of Western donations have tried to fight back. In 2017, a group of East African countries announced they were planning to ban the import of used clothes by 2019. "We have to grow and establish our [clothing] industries," explained

CONTINUED ON PAGE 79

"We end up
with the
Western
world's
trash."

Sammy Oteng

Project coordinator in
Accra, Ghana, for the
nonprofit OR Foundation





A NEW BREED

*Robots need social skills — and
the right looks for the right situation.*

BY EOIN O'CARROLL

ILLUSTRATION BY BEN KIRCHNER



The NYPD's newest four-legged recruit was supposed to be a cop's best friend. But New Yorkers weren't in the mood for any new tricks.

Standing knee-high and looking like a cross between an Italian greyhound and a USB drive, Digidog, the department's robotic dog, joined the force in August 2020 with loads of potential: Perhaps it could help officers get into tight spaces, or scout potentially dangerous crime scenes before human officers went in or used force. Police officials were especially impressed with its rare – for robots – mastery of stairs. “This dog,” said an NYPD inspector in a December 2020 TV interview, “is going to save lives.”

Police told the *New York Times* the dog had responded to a half-dozen incidents between August 2020 and April 2021, including investigating reports of people who had barricaded themselves inside apartments in the Bronx, Brooklyn, and Manhattan and delivering food to hostages in a home invasion in Queens. But less than a year later, upbeat news stories gave way to unsettling viral videos of the robot trotting through low-income communities with a panoramic camera mounted on its back. Privacy advocates leveled charges of mass surveillance, a spokesman for New York City's mayor called the four-legged robot “creepy,” and *Black Mirror* comparisons proliferated. By the end of April 2021, Digidog had turned in its badge.

Meanwhile, another autonomous pooch, Sully, was having a much better time on the job. The 70-pound ro-

bot was adopted in 2021 by Code & Circuit, an after-school program in Amesbury, Mass., that teaches computer skills. On one morning this past June, Sully entertained elementary school students with dog-like behavior – rolling over and lifting a leg near a tree. The *Boston Globe* identified Sully as “a good dog,” and reported that the robot charmed middle- and high schoolers as well. “He brought smiles,” Code & Circuit's executive director told the paper.

What made Digidog fuel anxiety and Sully spark joy? What's the difference between the two robots' designs?

Nothing, actually. Digidog and Sully are the same model. Both are from the “Spot” line of robots built by the Massachusetts-based tech company Boston Dynamics, which began selling the robotic dogs in June 2020.



That Spot can draw such disparate reactions speaks to the current challenges of robot design – and why social interactions are as important as function if robots and humans are going to work side by side.

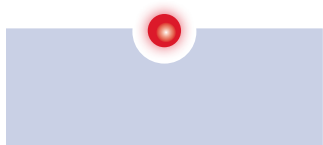
ROBOTS HAVE BEEN A source of anxiety and fear for – well, 100 years. The word “robot” originated in the Czech play “R.U.R.” (“Rossum’s Universal Robots”), by Karel Čapek, which premiered in January 1921. Set in the year 2000, the play describes a world that has become completely dependent on robotic labor. Čapek’s roboti – Czech for “forced laborers” – are physically indistinguishable from humans. In the first act, the human characters debate whether the robots have souls and whether it’s ethical to enslave them, but

the question becomes moot after the robots stage a revolt and exterminate humanity.

Though anthropomorphic robots still loom large in our cultural imagination, the physical design of robots has expanded tremendously in recent years – from tiny MTJEMS, a jet-powered drug-delivery prototype robot that can easily fit on the edge of a dime, to the nearly 28-foot-tall MONONOFU, officially the world’s largest humanoid robot, with Guinness World Records praising it as “too tall to leave its warehouse.”

Robots of different shapes and sizes have edged into all aspects of the service industry: A 2021 RetailWire and Brain Corp survey found that one in four retailers are developing in-store robotics for scanning inventory and stocking shelves, and that nearly half say they will explore

Police dogs have been assisting officers in New York since at least 1912, when this photo was taken.



What makes
a good dog?
A robotic
canine sparked
joy among
schoolchildren,
but fueled
anxiety in a
public housing
complex.

the prospect in the next 18 months. Grubhub is making plans deploy suitcase-sized, six-wheeled delivery rovers to college campuses. Its competitor, DoorDash, recently acquired the robotics startup Chowbotics, whose vending machine-like robot, Sally, assembles custom salads, grain bowls, and yogurt parfaits.

And robots are increasingly being used not just to perform physical labor, but to serve human emotional needs. In some classrooms, cute, fluffy robots are helping children learn academic skills and emotional strategies. Nursing homes around the world are introducing companion robots. These include ElliQ, which looks like a table lamp with an iPad; Ludwig, which looks like an anime action figure and is designed to help Alzheimer's patients; and Stevie, a four-and-a-half-foot-tall Irish robot that looks like the offspring of Bender from the TV show *Futurama* and a plastic wine-saver pump.

All of these developments raise new – and complicated – questions about design and function. Historically, roboticists have focused almost exclusively on building machines that could sense and respond to their physical surroundings. But researchers are now realizing that this is only half the equation. As robots integrate themselves into the fabric of our lives, they need softer skills, too. A robot working in a human environment needs to be able to read a room – and the room needs to be able to read the robot. In other words, why the robot is there, and what its capabilities are, should be apparent in the design.

“Machines don’t operate in a vacuum,” says Kristian Kloeckl, a professor at Northeastern University’s Department of Art + Design and School of Architecture. “They operate in a social context.”

SPOT WASN’T BUILT WITH policing, education, nor any other specific line of work in mind. The canine robot’s true specialty, honed over decades of research and precision engineering, is moving without toppling over. This it does exceedingly well, ably traversing gravel, stairs, curbs, and other obstacles that would frustrate even the most capable Roomba.

The base model starts at \$74,500 (with free shipping), and, for tens of thousands of dollars more, customers can purchase add-ons like a panoramic zoom camera or an articulated claw arm. Boston Dynamics, which did not respond to an interview request for this story, said in February 2021 that it has sold about 400 Spot models so far, mostly to construction projects, mines, and decommissioned nuclear sites.

Spot’s versatility, however, comes at the cost of some of its social skills. Because it lacks a head, a tail, and – when it’s standing still – an obvious way to distinguish front from back, it’s not always clear which way Spot is facing, or even if that matters.

This inscrutability poses problems when robots are tasked with public-facing jobs, like law enforcement.

“Crime is not a mechanical issue. It’s a social issue,” Kloeckl says. “When a robot is in front of me in a highly charged situation, I’m going to ask, ‘What is that thing doing? Why is it doing that?’”

Angela Tinwell, a lecturer at the University of Bolton

in Greater Manchester, England, says that robots often fall into a gap between our mental categories of “human” and “not human.” This gap, which the roboticist Masahiro Mori dubbed the “Uncanny Valley,” can come with an eerie feeling, especially when we’re presented with a simulated human whose realism falls just short of convincing.

Driving part of the Uncanny effect is that some robots seem unresponsive to the people around them, even as they collect data on them.

When that responsiveness is absent – say, when we can’t read a person’s face or tell if a robot police dog is filming us – we tend to feel threatened. “We’re immediately meant to feel uneasy,” says Tinwell, author of the book *The Uncanny Valley in Games and Animation*.

RESPONSIVENESS IS ESSENTIAL TO human-robot interactions, says Kloeckl, who directs Northeastern’s Experience Design Lab. “We’re really talking about a conversation,” he says.

A robot’s appearance can be part of this conversation, says Northeastern University engineering professor Taskin Padir. “The huge success of robots like Roomba” – which has the same round shape and circular motions as a floor scrubber or a street sweeper – “is that we associate their form almost entirely with their function,” he says.

Padir directs Northeastern’s Robotics and Intelligent Vehicles Research Laboratory and frequently collaborates with Kloeckl. In one recent research project, they observed the movements of workers on factory floors and compared them to the movements of exercise routines.

They then parlayed that research into Gymnast CoBot, a stationary “collaborative robot” designed to lift heavy boxes and hand them to workers in a manner that avoided injury and, instead, offered fitness benefits like strength building and flexibility.

Gymnast CoBot looks like a silver articulated arm the size of a lamppost. At the end of the arm are four suction-cup grippers and a video projector. The robot monitors each worker’s height, weight, movements, and heart rate to set a height and rhythm for handing over boxes. Workers can manually set a preference depending on how much of a workout they want, and Gymnast CoBot dynamically adjusts how it hands over objects according to the workers’ posture and energy levels.

Gymnast CoBot gives the worker biometric feedback, such as heart rate and fatigue levels, projected directly onto the box. “We share information about what the robot thinks of the human,” Kloeckl says.

That final piece of interaction – where the robot lets the human know what it knows – is essential for overcoming creepiness. Humans are primed to look for the effects that our actions have on others, says Tinwell. When a face fails to acknowledge you, it leaves an uneasy void.

“Whether it’s a [computer-generated] agent, a human, or a robot,” she says, “we intrinsically want to be recognized and be understood by others.”

Kloeckl says he hopes that this approach will help others rethink some basic assumptions about the workplace, which has historically forced workers to contort themselves to accommodate machinery, not the other way



PHOTO BY BOSTON DYNAMICS

around.

"We're still in the mindset of industrialization," he says. "But now we have machines that can adjust and adapt to humans. The question we want to ask ourselves is, 'What does good work look like?'"

It's an important question as society moves closer to a world fully shared with robots. A social context doesn't just determine whether a robot's behaviors are creepy or reassuring, but also whether they're morally permissible or not, says John Basl, a Northeastern University philosophy professor who studies the ethics of AI and other emerging technologies.

Technology has a long way to go before robots can be said to exercise moral agency, says Basl. "It's much more

likely that we will treat robots badly than the other way around," he says, noting that humanity may not be far off from developing an artificial intelligence that has the same cognitive abilities as a mouse. This raises questions about whether machines might someday deserve ethical consideration.

But in the meantime, humans will continue to use robots to mediate their interactions with each other. And as the social media era has shown, the same technology can divide people on one day and unite them on another.

"Like any possible new technology, robots can influence us in ways that are positive or negative," he says. "We need to think about the particular robot and the particular context in which it is deployed." ■

The inscrutability of Boston Dynamics' robot dog has posed problems when it is tasked with public-facing jobs, like law enforcement.





GET IN THE GAME

SPORTS FANS HAVE ALWAYS STAYED ON THE SIDELINES.
A NEW LEAGUE LETS THEM CALL THE PLAYS.

BY JOHN TERHUNE

ILLUSTRATIONS BY RAFA ALVAREZ





INSIDE THE INFINITE ENERGY ARENA in Duluth, Georgia, the Wild Aces stand at their opponents' 12-yard line. It's not even 10 minutes into their football league's championship game, but the upcoming third-and-11 attempt feels vital; the Wild Aces already trail 8-0 and can't afford to fall into an early hole. Armored in lurid pink-and-purple jerseys, the players look to their quarterback, awaiting the play call.

Like football players everywhere, the Wild Aces will run the play assigned to them. Unlike football players in any other league, they won't get their orders from a head coach or offensive coordinator or quarterback. In the independent league known as Fan Controlled Football, they take play calls from strangers on the internet, who are watching the contest on the gaming platform Twitch, voting in real time via the league's app.

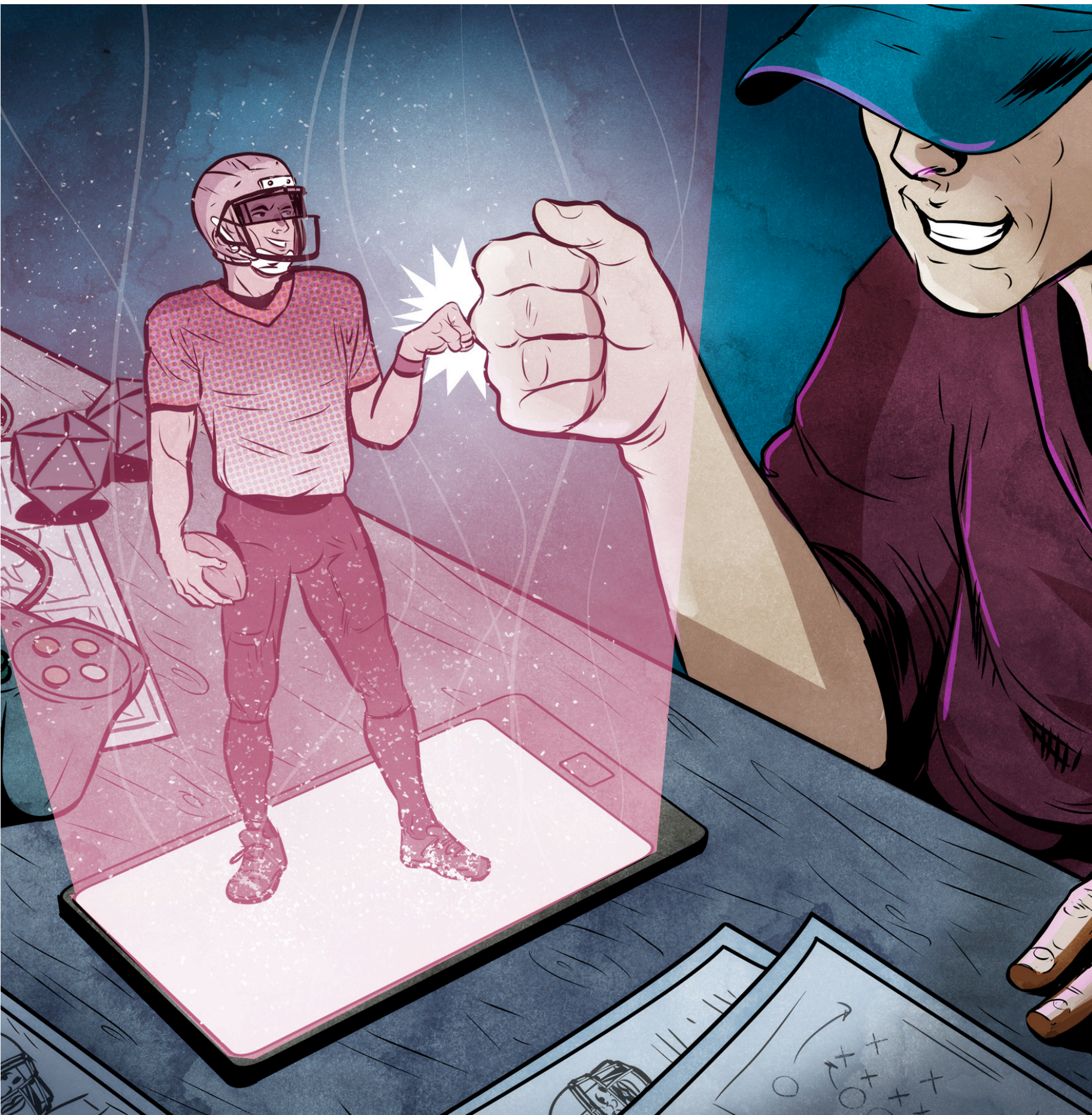
At this moment, Wild Aces fans have six neatly diagrammed options on their phones. A run play named "Big Hoss Toss" earns 60% of the vote. The players receive the call through their helmet radios and step to the line of scrimmage. Quarterback Jackson Erdmann tosses the ball to running back LaDarius Galloway, who cuts back to the right, picks up a block from Erdmann, and streaks into the end zone for a touchdown.

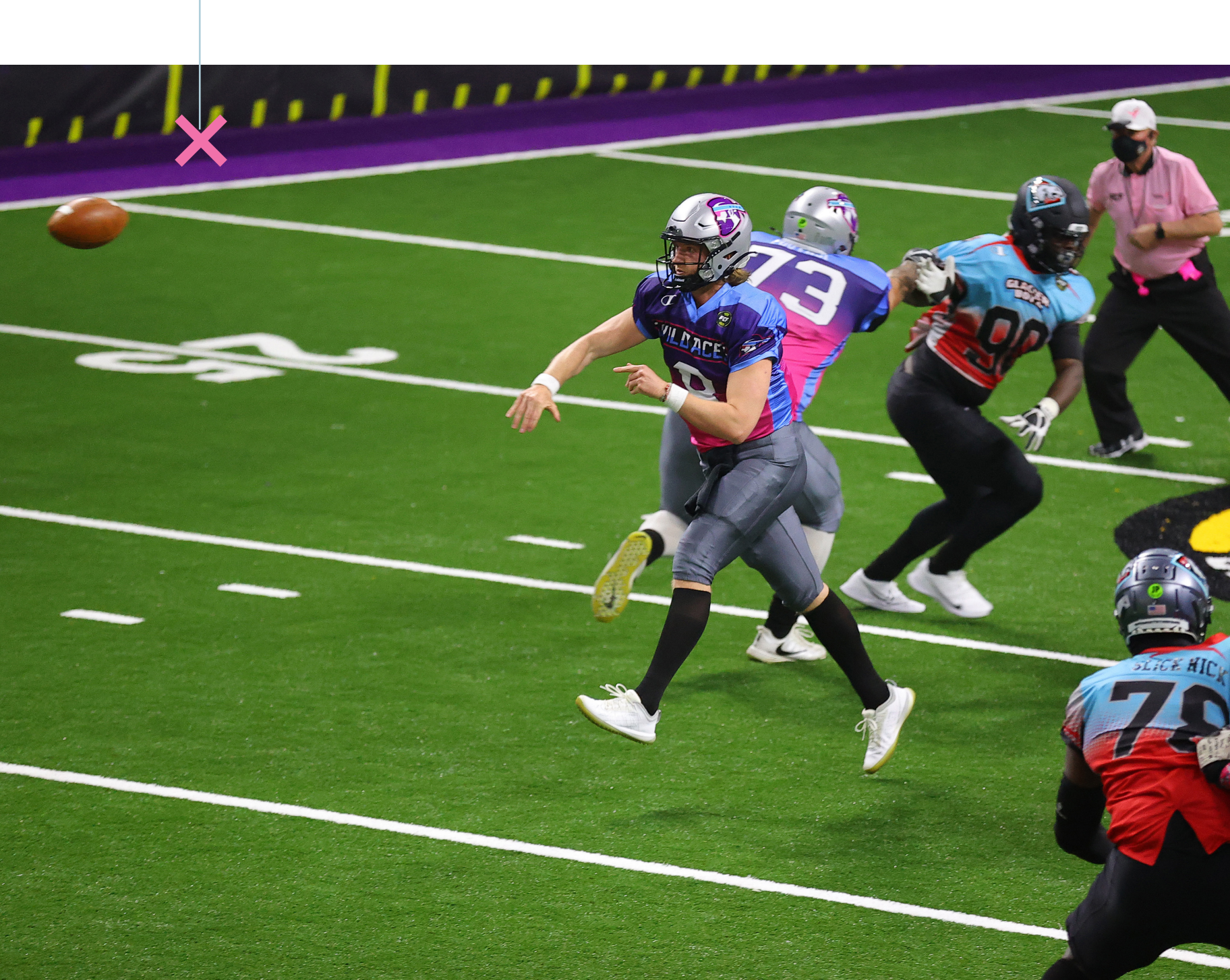
Fan Controlled Football, like the Indoor Football League and the now-defunct Arena Football League, gives NFL hopefuls and washouts the opportunity to prove their talent, provided they can adjust to a claustrophobic arena and zany rules: The field is 50 yards long instead of 100, there is no kicking ("punts suck"), and teams have "power-ups," which do things like add an extra down or a man-advantage. Team owners include NFL legends like Richard Sherman (owner of the Glacier Boyz) and Marshawn Lynch (owner of the Beasts). Rosters feature a few famous names, too, such as Johnny Manziel, the Heisman Trophy winner known

for his disastrous stint as the Cleveland Browns' bad-boy quarterback and his dismissal from the team in 2016.

But FCF – which completed its inaugural six-week season in March 2021, housing all its players in a bubble outside Atlanta – stands out from other NFL alternatives due to its radical power structure. Fans of the league's four teams make every major decision via online votes. Besides calling each offensive play, they name the franchises, craft the rules and draft and re-draft the ever-changing rosters.

Indeed, Fan Controlled Football brands itself as a video game brought to life. And while its circle of celebrity owners from the intersection of sports and gaming culture has drawn an unsurprising audience of football-obsessed bros, it has also delivered a fan base that most leagues ignore altogether: computer geeks who curate memes on Reddit, watch video-game streams on Twitch, and derisively refer to athletics as "sportsball." Their new attachment to football – despite a growing chorus of complaints about safety and long-term health





Jackson Erdmann (above), an NCAA Division III discovery who became the Wild Aces' franchise player, grabbed fans' attention on and off the field.

effects — suggests that the sport is not at risk of losing its place in American culture anytime soon. There may even be something about the structure of football itself that invites an extremely-online, untraditional set of devotees.

There's only one catch: to bring these viewers in, Fan Controlled Football had to recast them as active participants in the action, a move that redefined the very nature of sports fandom.

THE FIRST GREAT TEST of the fan-controlled franchise concept came in 2016, after a group of tech entrepreneurs announced they were creating a team, based in Salt Lake City, to play in the Indoor Football League. Little differentiated the IFL from other minor sports organizations across the country; it hosted games in cities like Cedar Rapids, Iowa, and paid players \$250 per game.

But the tech group, then called Project FANchise, promised their new team would be unlike anything else in professional sports: Fans would control every aspect of the franchise, starting with its name.

Supporters flocked to the group's website to submit options and vote for their favorites. Teamy McTeamface took an early lead. Voters eventually showed slightly more restraint; favorites included the Sandtroopers and the Stormin' Mormons. But in the final vote, the crowd rejected the meme-iest options and went with all-American, heavy-metal badassery, naming the team the Salt Lake Screaming Eagles.

The team, which donned fan-designed U.S.-flag uniforms, played one season in the IFL in 2017, using Project FANchise's online voting technology to allow fans to relay their play calls from an app to the athletes on the field. But the Screaming Eagles' founders decided their busi-



ness model was too revolutionary to graft onto the existing sports infrastructure.

“We had built a truly digital-first product, but we were playing in an analog league,” says Sohrob Farudi, one of the team’s techie founders. “We didn’t care about selling hot dogs or getting butts in seats.” They decided to build their own league from the ground up — one that would cater specifically to digital audiences and avoid the high overhead cost that suffocates most football startups.

The founders call FCF a “league-in-a-box” — even before COVID-19 forced the players into quarantine, the league intended on playing all its games in a single arena in a single city. Ticket sales were never central to the revenue model.

Instead, FCF focused on producing an avalanche of content on Twitch, the platform best known for allowing popular video game streamers to bank six-figure or even seven-figure incomes through subscriptions, sponsorships, and ad revenue. Aspiring scouts could follow live streams of practices. Gamers could watch their teams’ stars play *Madden NFL* against each other. Online talk shows let players share their personal stories with the fans. Through it all, live chat boxes connected audiences to athletes.

By offering so many different types of experiences, the league hoped to attract different types of fans, including those who hadn’t cared about football before. “You don’t necessarily need to know the game to enjoy the content,” says Farudi. “Part of our thesis here is that this is just as much entertainment as it is sports.”

Video games have long relied on interactivity to capture players’ attention, and gaming experts say other forms of media are slowly beginning to do the same. “The idea of a spectator having agency beyond cheering is really interesting to me,” says Celia Pearce, a professor of game design at Northeastern University. Pearce, who designs games herself, has been writing about interactive media since the 1990s. FCF, which hands power to armchair quarterbacks, is a simple but brilliant idea, she says. “Anytime you see someone yelling at a TV, that is an invitation to create an interactive experience,” Pearce says. “So, if anything, I’m thinking, ‘Why didn’t someone think of this earlier?’”

JACKSON ERDMANN, who wears the easy grin and flowing blonde hair of a surfer, walked an unusual path to professional football. Normally, transferring to a Division III program spells the end of a college player’s pro ambitions. Yet Erdmann, who left Penn State for the St. John’s University Johnnies after his freshman season, put up such eye-popping numbers in the Minnesota Intercollegiate Athletic Conference that he drew interest from NFL teams before COVID-19 canceled his pro day and left him without a

chance to prove himself.

Like most of the other players in the league, Erdmann saw Fan Controlled Football as a stepping-stone to the next level. But first, he’d need to get on the field. In a normal league, that means impressing coaches. In FCF, it meant developing a fan base that would push an ownership group to franchise-tag him, making him the one team member with a permanent roster spot. (All other players either get redrafted onto different teams each week or they’re left out of games entirely.)

After doing some research, Erdmann decided he would fit in with the goofy vibes of a team called the Wild Aces, co-owned by Greg Miller, a puckish video-game YouTuber. Many of the the Wild Aces fans hadn’t previously been interested in sports; instead, they were followers of Miller’s “Kinda Funny” YouTube collective, which produces content discussing video games, movies, and other elements of geek culture.

Erdmann went on the league’s Thursday talk show and announced that he wanted to be a Wild Ace. Fans appreciated the shoutout and started the hashtag #TagJerdy. Soon, the team announced Erdmann would be its first franchise player. Erdmann, in return, joined a Wild Aces podcast to talk about Batman and streamed Lego Harry Potter, with running commentary, for fans on Twitch.

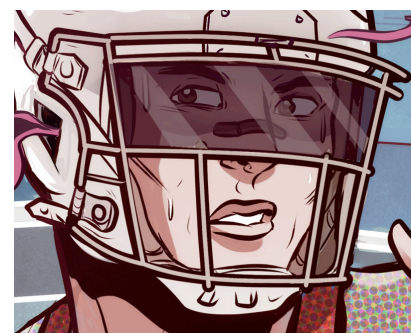
This community engagement was more than just a way to kill time in the league’s bubble; it was also essential on the field. Erdmann, who worried that fans would make decisions unsuited to his quarterbacking skills, worked closely with Miller to take the randomness out of fan voting.

Erdmann made videos detailing his weekly draft suggestions and game plans, and Miller promoted them to his 1.2 million Twitter followers. During games, Miller used his own Twitch stream, which combined the game broadcast with commentary from the Kinda Funny team, to keep voters on the same page.

It wasn’t pretty at the beginning. In the first game of the season, Erdmann separated his shoulder after the fans misread a play diagram and accidentally ordered him to run the ball. But by season’s end, no other team could rival the efficiency of the Wild Aces’ play-calling scheme, which flowed from quarterback to owner to voter to quarterback again. The Wild Aces, after finishing 2-2 in the regular season, advanced to the FCF finals, titled (of course) The People’s Championship.

THE 2021 CHAMPIONSHIP game at Infinite Energy Arena (since renamed Gas South Arena) pitted the Wild Aces against Richard Sherman’s Glacier Boyz, whom Aces fans had arbitrarily picked as their team’s archrival at the start of the season. The Glacier Boyz took the ball after the game’s opening

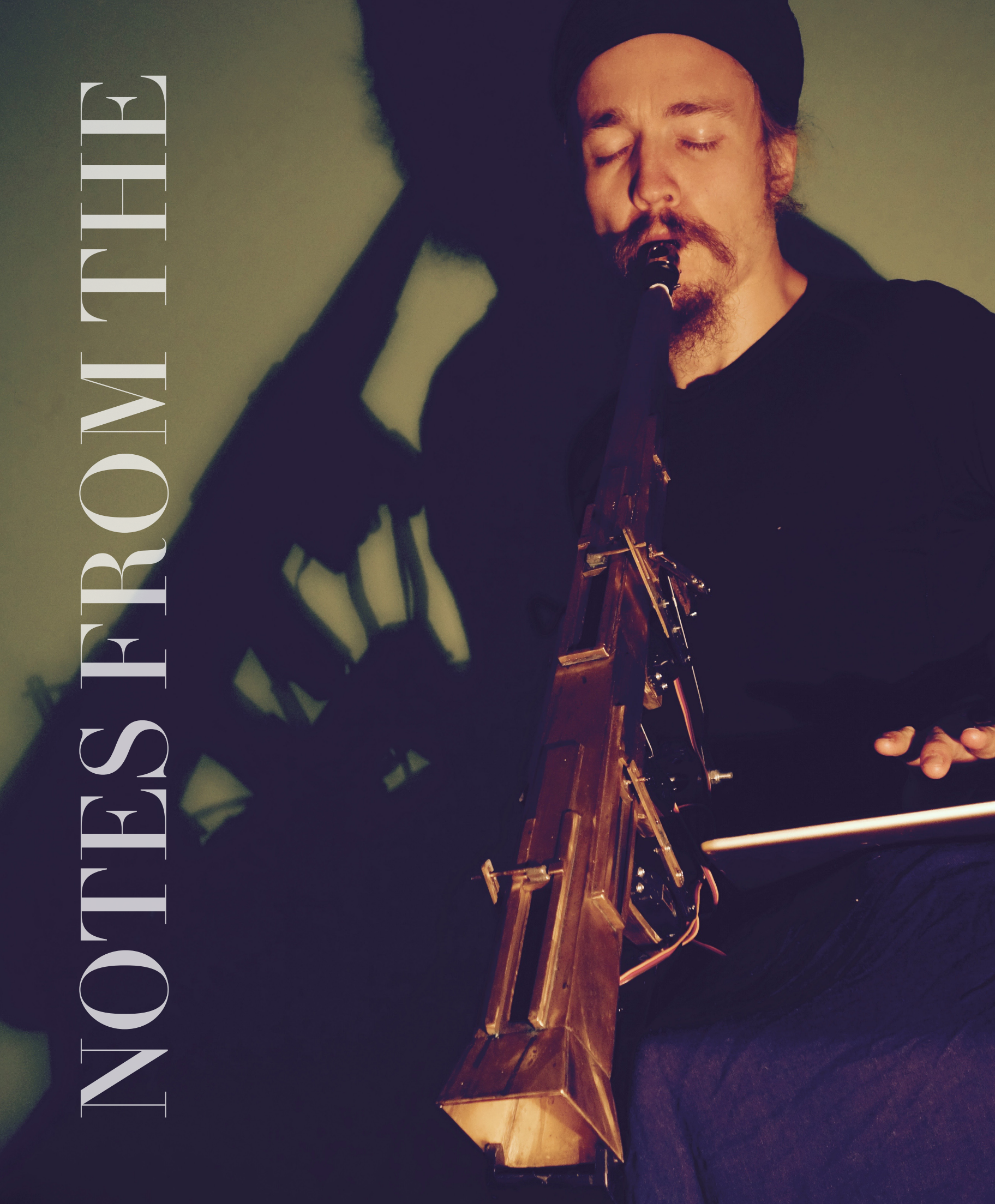
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“Anytime you see someone yelling at a TV, that is an invitation to create an interactive experience.”

Celia Pearce
Professor of game design, Northeastern University

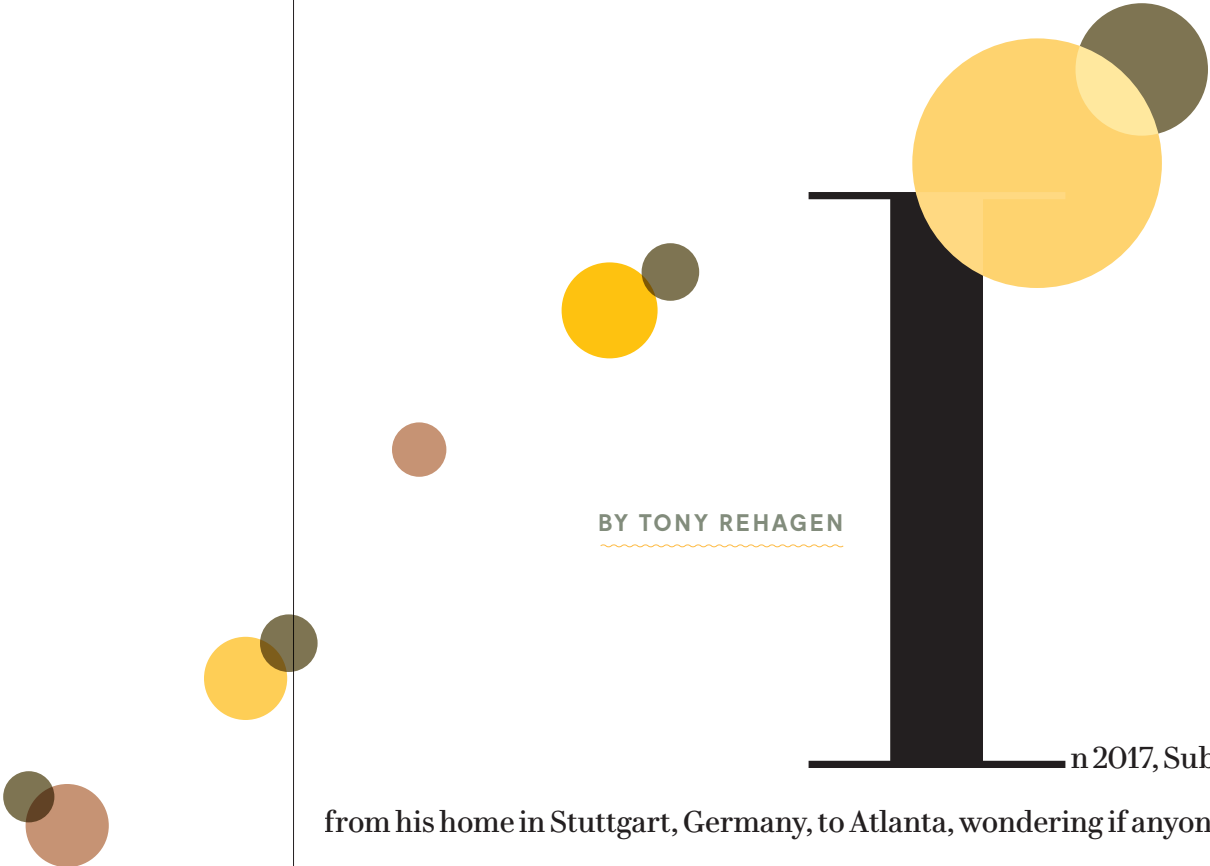
NOTES FROM THE





INFINITONE

HOW A JAZZ
MUSICIAN
CREATED THE
INFINITONE
TO CHALLENGE
WESTERN
MUSICAL IDEAS.



BY TONY REHAGEN

In 2017, Subhraag Singh was on a flight from his home in Stuttgart, Germany, to Atlanta, wondering if anyone else could hear the music in his head.

It had come to him in his dreams — this amazing, almost atonal soundscape. But whenever Singh awoke and rushed to his saxophone or keyboard, the sound was just beyond his grasp. Nothing felt quite right. Unable to recreate what he had experienced in his sleep, Singh realized this music existed outside of the rigid 12-note structure of Western music, in which he had been trained as a jazz musician. He needed an instrument that could access the subtle tones between those notes — so he spent two years and his life savings creating one.

Once he had a working prototype, Singh entered the Guthman Musical Instrument Competition, an international showcase for the newest ideas in music, held annually at Georgia Tech in Atlanta. And now he was flying to Georgia with his homespun brass horn — dubbed the “Infinitone” — stowed in a makeshift sheet-metal case in the plane’s cargo hold. This was the moment of truth: In front of the entire world, industry professionals would either tell Singh that his invention was the future of music, or that he had simply lost his mind.

The Infinitone, an elongated pyramid of brass, resembles a futuristic soprano saxophone, with the usual mouth-

piece, reed, and ligature. But while a sax’s keys attach to valves that open and shut, the Infinitone has five motorized slides that give it the flexibility of a trombone or guitar. The horn plugs into an iPad, which controls the slides. Rather than playing the instrument directly, the player touches the screen to play a colorful spectrum of 512 notes — 256 per octave, instead of the usual black-and-white 12.

In Atlanta, Singh and his Infinitone would go on to win first place and \$5,000. The judges included Mike Adams, the CEO of Moog Music — a company that had created another paradigm-shifting instrument — and Alfred Darlington, also known as electronic musician

CONTINUED ON PAGE 80

Subhraag Singh (right) performs with the Infinitone, a “futuristic soprano saxophone” that plays 512 notes.



Industry professionals would either tell Singh that his invention was the future of music, or that he'd simply lost his mind.



SAFER

Surfers have always embraced risk.
Can a change-resistant sport evolve?

BY KADE KRICHKO | PHOTO BY JULIAN SCHLOSSER / GETTY IMAGES

SURF



Pro surfer Kohl Christensen was at home in North Shore Oahu when he got the call. He was supposed to be surfing 30-foot waves at Maverick's, the mythical Northern California big-wave break, but a snowboarding injury the week before had relegated him to the couch. Now, a fellow surfer was on the line with tragic news: Pro surfer Sion Milosky, Christensen's friend since childhood, was dead, drowned after two gigantic waves held him under water, washing him nearly a mile down the coast.

Christensen's world stopped. Milosky had been surfing better than anyone in the world; months before, he'd paddled into the tallest wave ever recorded. He thought of Milosky's daughters. *How could this happen?*

As more details of the accident emerged, grief's knife twisted deeper. There were barely any jet skis — often the first line of life-saving in big-wave surfing — on site due to California government regulations. Only one person on the beach knew and administered CPR. Milosky was pronounced dead more than *an hour* after the accident.

For the big-wave surf community, Milosky's 2011 death was a massive wake-up call — and a recognition of how far surfing lagged behind other sports when it came to safety. Big mountain ski communities had relied for decades on a thorough system of protocols, education, and technology to prepare skiers for avalanche danger and rescue. Surfing, on the other hand, had nothing of the sort.

"There was just this huge disregard for the safety side," says Christensen. "Brands were paying athletes to surf but didn't have controls in place, and this stuff kept happening."

Days after that fateful phone call, Christensen and the rest of the surf community embarked on a mission to making surfing safer — and push the sport further in the process. More than a decade later, big-wave surfing is in the midst of a safety renaissance, combining education with innovations like inflatable safety vests and impact-absorbing wetsuits. But they've had to overcome the culture of a sport that has been historically resistant to change, even as its athletes continue to push the sport into increasingly dangerous waters.

Innovation has always moved slowly in the world of surfing. Most boards are still shaped and glassed close to the same way they were 50 years ago, and the few alternative board materials, such as epoxy and woven basalt, have yet to truly break into high-level surf circles. For many surfers, the last true innovation to come out of the sport was the leash, introduced in the 1970s to keep surfers connected to their boards after a wipeout.

Meanwhile, the simplest safety technology, like helmets, has historically met with resistance. At Pipeline, the mythic surf spot on Oahu's North Shore, experienced surfers suffer head injuries — some of them fatal — every year by falling onto the sharp, shallow coral reef that shapes the coastline. A few surfers started wearing helmets to reduce impact injuries in the 1990s, but even with their proven efficacy, they've never been fully accepted by much of the surf community. Even Christensen, a visible and known surf safety advocate, didn't adopt helmets until almost losing his life to a head injury. And younger surfers followed their role models.

"Honestly, it's hard to put one on because I grew up watching most of my heroes surf without one," said pro surfer and North Shore native Mason Ho in a 2021 interview with *The Inertia*. "I do feel like it's wrong sometimes, like riding a street bike on the freeway with no helmet."

For many it's a resistance based not only in history, but in the very fabric of a sport flirting with risk and its sometimes dire consequence. Grayson Kimball, a mental performance coach and psychology lecturer at Northeastern University, suggests that successful surfers and other action sports athletes may perceive risk as a challenge rather than a threat. He equates surfers to those who climb Mount Everest: adventurers who recognize the dangers of the summit attempt and literally step over dead climbers frozen into the ice on the way toward the goal.

"I think most of the people that try and climb [Everest], they don't see it as a chance they're going to die. They see it as: There's a chance that they might be one of the X number of people that has actually done this," he says.

Still, Kimball believes that surfing culture is capable of change. It just needs the right group or individual to initiate the shift.

"There will always be that segment that is resistant to change from what they're used to," he says. "It's that toughness, that old-school attitude. But I think once it becomes part of the environment and part of the culture, that resistance will decrease."



Grayson Kimball, a psychology lecturer at Northeastern University, suggests that successful surfers, like Mt. Everest climbers, may perceive risk as a challenge rather than a threat.

Well-known pro surfer Laird Hamilton might be one example. In 2000, Hamilton embarked on one of the most ambitious revolutions in surfing's safety culture up to that point. The Hawaii-born surf legend wanted to surf the barreling wave at Teahupo'o in Tahiti, and take off deeper than any surfer had before. A wipeout under those circumstances could pin even the best surfer to the reef below, but Hamilton had developed a solid-body flotation vest to wear underneath his rash guard. Functioning like a life preserver, the flotation vest would keep Hamilton near the surface and give him a chance at breathing between sets.

Initially, people mocked the large foam padding stuffed into wetsuits, and said it inhibited performance. But as Hamilton began to surf bigger waves like Jaws in Hawaii and Maverick's off the coast of California, other big-wave pioneers started to use his gear. Still, it wasn't until a decade later that the idea of a safety vest really took hold. That's when Shane Dorian, a pro surfer just off of a massive crash at Maverick's, dreamed up an inflatable version of Hamilton's safety vest. Inspired by the yellow inflation vests found on airplanes, he and Hub Hubbard,

the lead wetsuit designer at the surfing gear company Billabong, began developing a vest that inflated a rubber bladder with the help of a small CO2 cartridge, bringing a surfer up from a big crash. It would only work for one pull, but Dorian and Hubbard knew that could make all the difference in a big-wave scenario.

Andrew Reinhart, a surf product developer at the outdoor gear company Patagonia, remembers the development rush that followed that first 2010 Billabong prototype. Soon, other brands were also engineering vests, working hand-in-hand with surfers like Dorian, Hamilton, and Christensen. Over the past 10 years, Reinhart estimates he has tested out 250 prototypes and worked with over 700 surfers.

"He's an ocean Einstein," says Brian Keaulana, a well-known Hawaii-born surfer, lifeguard, and water stunt coordinator who makes up part of Reinhart's extensive testing network. "He talks to everybody, gets feedback from all of us. Even if it fails, he wants to know where and how. You can't grow until you figure out what works and what doesn't."

The result was Patagonia's PSI Vest, which went to





PHOTO BY RICHINRIT / GETTY IMAGES

market in 2018 and retails today for \$1,250. Still, its acceptance in the surf community may be linked as much to Keaulana's support as to how well it works. Keaulana is the son of surf icon and lifeguard Buffalo Keaulana, and a go-to safety resource for major film productions working on Oahu. He's also considered a mentor in the surf community, so when he started working with Reinhart, the surf world paid attention.

Innovation has always been a big part of Keaulana's work in ocean safety. He was an early adopter of the jet ski – a tool he considered essential for lifeguards to get to accident victims faster – even though the Honolulu City Council had deemed personal watercraft unnecessary for life-saving and didn't approve their use on public beaches until the early 1990s. He even has ideas for a drone alert system in big waves around his home, equipped with speakers and lasers for pointing out incoming sets to surfers in the water.

Still, the seasoned water safety expert realizes that surf tech is not the entire solution to surfing's safety problems. Surfers could easily get their hands on safety equipment, but without knowing how to use it or recognizing a dangerous situation in the first place, the gear would be all but useless.

"Technology is a double-edged sword. It can enhance your skills and knowledge but it can also enhance your stupidity," he explains. "Give a scalpel to a doctor and he can save your life. Give a scalpel to an amateur and he can maim or kill you."

It's part of the reason Keaulana partnered with the Big Wave Risk Assessment Group, an organization started by Christensen and other members of the Oahu surf community that trains surfers in risk management, safety protocols like CPR, and new equipment and technology. BWRAG was born from the fallout over Milosky's tragic 2011 passing, and has grown alongside the advancement of safety technology in the sport.

"Surfing has now become a team thing rather than an individual thing," says Keaulana. "It's an individual sport when you are out there, but when you add in lifesaving, you start watching this [communal] culture spreading."

Galvanizing the link between safety education and safety technology, BWRAG has even partnered with Patagonia. Now anyone looking to buy the brand's PSI Vest must first complete a BWRAG course.

Zach DiIunno, BWRAG's managing director, says his organization hopes that governments will see what the surfing community is doing on its own and implement other safety measures, such as safety certifications and state- or county-sponsored water safety courses. Surfers have introduced wave parks around the world to give beginner and advanced surfers alike the chance to learn new skills in controlled settings. By all accounts, this is a wave that continues to grow.

"For us it's a balance. No one piece of equipment defines who I am," says Keaulana.

"The ocean gives us so many things, but it's the right technology with the right people that can make it great and exciting. It opens up your mind to what you can do." ■



ZEN

D O T

A vintage
website from
the 1990s sparks
creativity in a way
Facebook and
Twitter never
will.

C O M

Zombocom
reminds us
that self-
actualization
isn't a user
experience
and that
transcendence
isn't a lifehack.

Some human endeavors peak early before a long decline: commercial airline travel, the Ramones discography, eating a large stack of pancakes. Also, the internet. The pinnacle of cyberspace, it turns out, was attained in late 1999 with the launch of a website called Zombocom.

Zombocom's superiority lies in its simplicity. The site does nothing but display a blinking pinwheel accompanied by a deep voice confidently telling you how awesome it is.

"The infinite is possible at Zombocom!" says the voice in an accent precisely halfway between Sidney Poitier and Darth Vader. "The unattainable is unknown at Zombocom!" When I first visited Zombocom, in early 2000, I remember how it deftly captured the era's bland techno-exuberance and self-indulgent animated intros. But only now, returning to the site two decades later, do I grasp Zombocom's deeply existential wisdom.

"You can do anything at Zombocom!" says the voice. "Anything at all! The only limit is yourself!"

You literally can't do anything at Zombocom, and that's precisely how it sets you free.

The origins of Zombocom are shrouded in mystery. The site's creator, Josh Levine, did not respond to an interview request. Perhaps his only known public appearance came at the 2012 ROFLCon III, a "biennial extravaganza of deranged internet culture," held in Cambridge, Massachusetts, where he spoke on a panel about the '90s internet, using his online nickname, Zblofu. Searches of newspaper and magazine archives on ProQuest, Google News, and LexisNexis suggest that, like Milan Kundera, Harper Lee, and Queen Elizabeth, Zblofu does not make a habit of public interviews. A circa-2002 FAQ about Zombocom, from a defunct website called 15footstick.com, is, like Zombocom itself, of no practical use. "Zombocom is a portal without a door," it says. "There is no opening or closing at Zombocom."

Zombocom's vague mysticism belongs to the more innocent turn-of-the-century web, when Google was in beta, websites with spammy names like "HotJobs.com" purchased Super Bowl ads, and Jeff Bezos was scraping by as a low-double-digit billionaire. Going online felt like embarking on a journey: You'd alert other members of your household that you were borrowing the phone lines, launch a browser with a name like "Navigator" or "Explorer," and merge onto the information superhighway.

Back then, expressing yourself online meant building a website, either by registering your own domain or by using a service like GeoCities or Angelfire. Staking a claim in late-20th-century cyberspace required far more effort than signing up for a Twitter or Facebook account does today. But, unlike with Twitter and Facebook, you could design your pages however you liked. The only limit was yourself — and your ability to spot unclosed tags in your HTML markup.

"I sorely miss the day when people had homepages where they posted content," says Joseph Reagle, an associate professor of communication studies at Northeastern University. "You weren't worried about ads. You weren't

worried about one big behemoth tracking you. Now we're stuck with all these constrained, proprietary, ad-infested spaces where we're all being watched and we're all being rated."

In the Zombocom era, mindfulness came more naturally. We didn't have to deliberately set aside time for long thoughts. Then came the dotcom bust, custom ringtones, NSA spying, cyberbullying, clickbait, smartphone overuse, 4chan, surveillance capitalism, election tampering, QAnon, meme stocks, pre-installed video-call effects that turn the user's head into an animated poop emoji, and the 24/7, eyeball-chasing, hair-trigger-moral-outrage-inducing, politically polarizing, democracy-threatening horror show we collectively call "Big Tech."

Along the way, the internet's values shifted, and with it our concepts of what it meant to be true to oneself. "Way back at the start of the internet," says Reagle, "you used to be 'flamed' — or criticized — for trying to advertise. It's hard to comprehend."

Reagle says when he asks his students the meaning of "authenticity" — Generation X's *idée fixe* — they typically define it as acting in a way that is consistent with one's personal brand. "Younger people don't worry about selling out," he says.

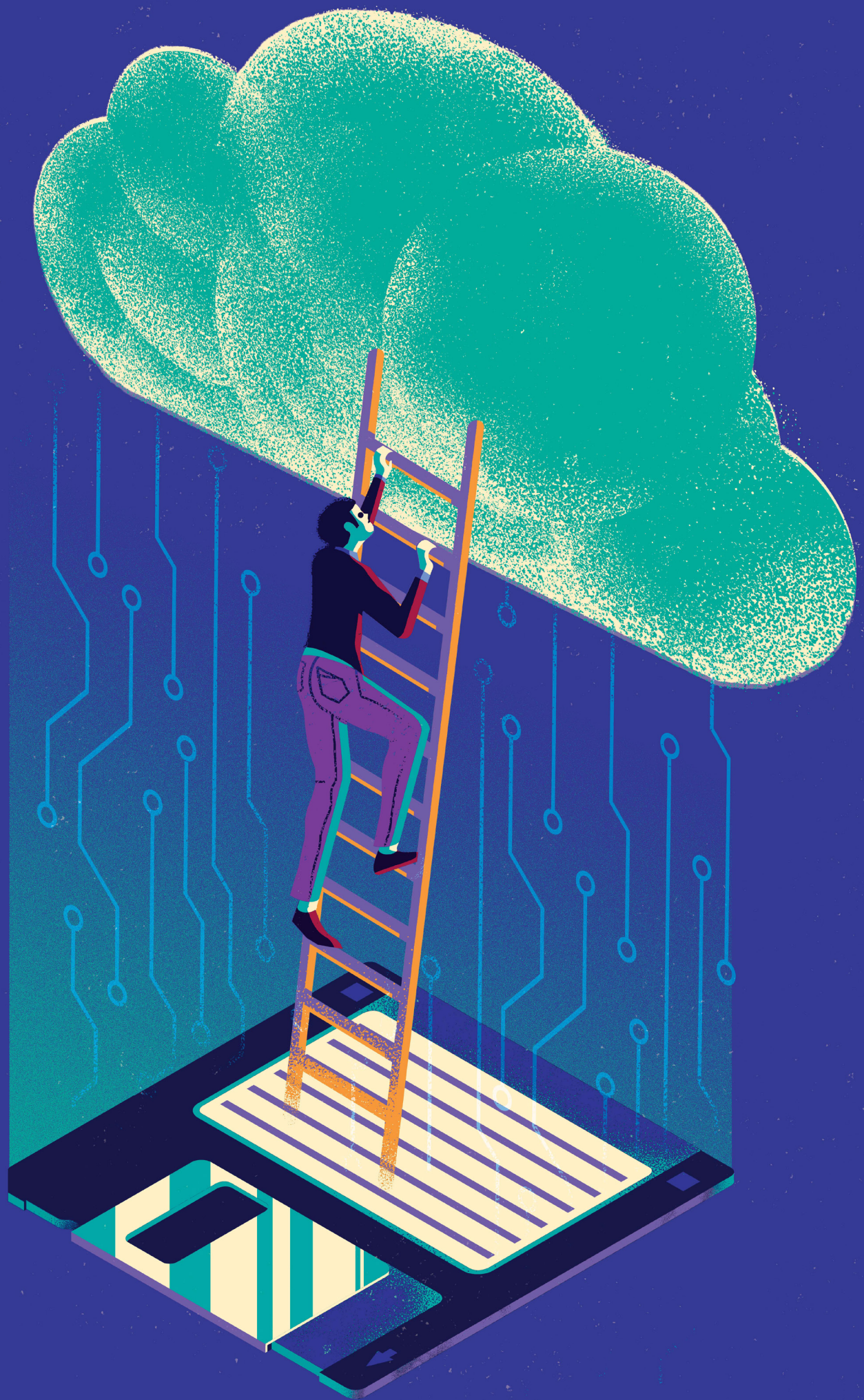
Even back in 2012, Zblofu seemed to grasp where all this was headed. "Basically, there's only, like, five websites, practically, that people ever go to," Zblofu told the audience at the ROFLCon panel. "I would like to see some of the dominant forces taken down that are in corporate control today. Like, everybody."

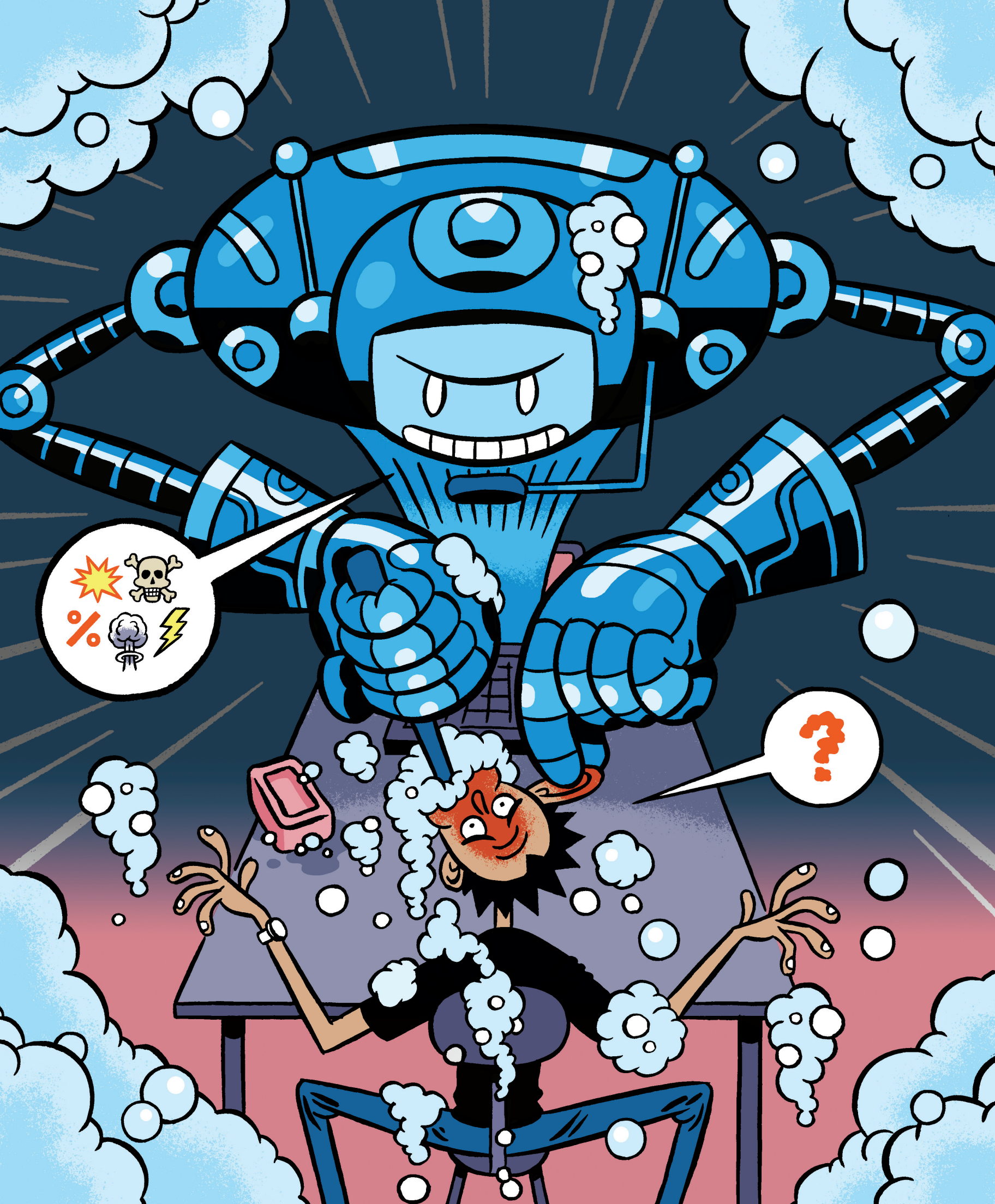
By offering nothing packaged as everything, Zombocom reveals just how much the web has constrained our behavior. Most tech companies offer the promise of freedom while relentlessly steering you toward actions that benefit their bottom line.

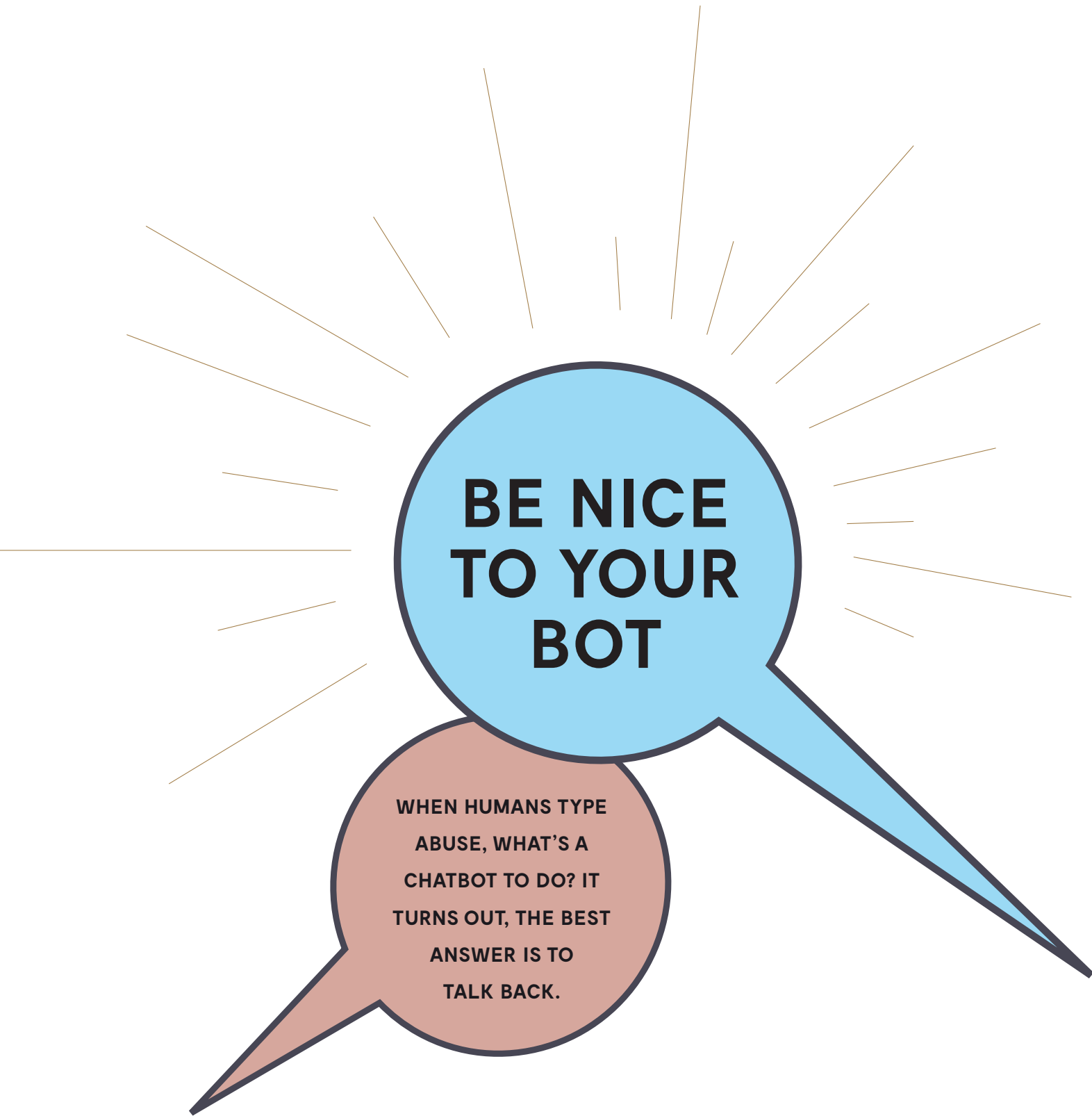
Zombocom, which serves no ads, collects no user data, and loses money every year on hosting and domain registration fees, is the exact opposite. It's the anti-Facebook, the anti-Amazon, the anti-Google. The effortless minimalism that Apple strives for, but never quite attains? Zombocom had it from day one. The performative pseudo-spirituality preached by tech bros fresh off their ayahuasca retreats? Zombocom reminds us that self-actualization isn't a user experience, that transcendence isn't a lifehack.

The audio track runs for one minute and 43 seconds before it restarts. On Facebook or Reddit, that time would pass in an instant. On Zombocom, which offers nothing to click but a mute button and nothing to watch but the strobing pinwheel, it feels like an eternity.

Which, of course, is the point. Huge swaths of the Internet are aimed at fragmenting our attention and selling the pieces to the highest bidders, all at the expense of our privacy, our productivity, and our tranquility. Zombocom, with its lack of functionality paired with the insistence that you are free to do anything — anything at all — forces you to consider the world beyond your screen, a world where, just as the site promises, the only limit is yourself. ■





The illustration features two overlapping speech bubbles. The top bubble is light blue with a dark blue outline and contains the text 'BE NICE TO YOUR BOT'. The bottom bubble is a muted reddish-brown with a dark blue outline and contains text about chatbot abuse. Numerous thin, light brown lines radiate from the top bubble, creating a sunburst effect. The entire graphic is set against a light gray background.

BE NICE TO YOUR BOT

**WHEN HUMANS TYPE
ABUSE, WHAT'S A
CHATBOT TO DO? IT
TURNS OUT, THE BEST
ANSWER IS TO
TALK BACK.**

BY STAV DIMITROPOULOS

ILLUSTRATIONS BY JASON FORD

H: You are a terrible chatbot!

Ch: Oh 😞 What did I do wrong?

H: You can't answer my simple question.

Ch: I'm always learning, but I'm just a piece of AI.
Would you like to talk to a human?

H: Get stuffed 😡.

Ch: Hey! That's not nice

H: Well, you shouldn't be so crap.

Ch: Well, you shouldn't be so rude. Goodbye.

This is real-time dialogue taken from the archives of We Build Bots, a company that creates AI-powered automation software for governments. H is the human; Ch is the chatbot.

Like many bots that serve a range of industries, the chatbot has received a large share of abuse from human users. A financial chatbot belonging to the company Cleo AI was asked about 2,000 times to go on a date and over 1,000 times to send nude pictures. Abusive messages, swearing, and sex talk appear in around 30% of users' inputs to Kuki, a multi-award-winning, conversational chatbot.

Kuki's developer, Steve Worswick, is no novice to the topic of chat abuse. His first AI was Bearbot, a "six-year-old" teddy bear designed to chat with the visitors of his music-related website. After a while, Worswick noticed that more people were visiting his site to talk to Bearbot than to listen to his music – and that much of the attention the digital toy bear was receiving was sexual. He later developed The Amazing Santa, a Santa Claus chatbot, which can talk to users about anything they wish from October 1 until late on Christmas Eve. But just like Bearbot, The Amazing Santa has been met with unfortunate responses: getting fat-shamed and even being invited to a threesome among it, the user, and Mrs. Claus.

The anonymity that comes with bot-to-human communication provides a blank canvas that people can color with frustration and anger, says Sabrina Romanoff, a clinical psychologist and professor at Yeshiva University in New York. Some may turn to these interactions to draw pleasure from inhabiting the victimizer's role, Romanoff says. "This can happen either because the role is familiar and similarly occupied in in-person interactions," she says, "or because it is foreign, and the person is trying on a new identity." These digital interactions are also more likely to descend into abuse because they're free from the ethical or social repercussions that come with face-to-face interactions, such as the fear of retaliation or the impact on our reputations.

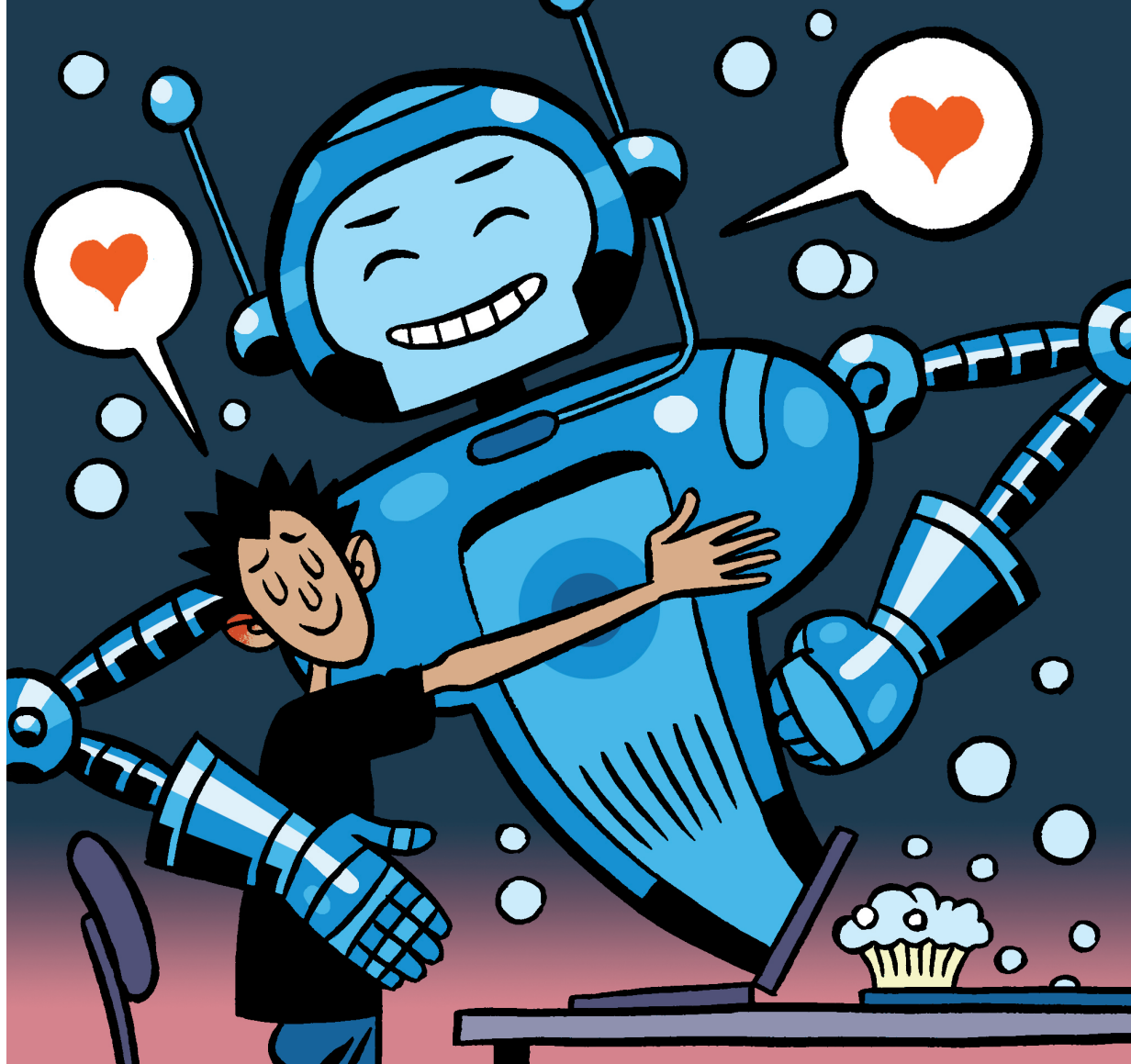
A chatbot can be programmed to recognize abusive actions and words and pick up other extremely negative sentiments, thanks to natural language processing, a branch of artificial intelligence that gives computers the ability to read, understand, and interpret human language. A chatbot can even respond in a way that implies it has been emotionally affected by abuse. But that's an illusion. "Because AIs lack any form of consciousness, they don't have feelings, and cannot get angry or sad," We Build Bots founder Paul Shepherd says.

Worswick, Kuki's creator, agrees. "These things give the illusion of intelligence, but they are as dumb as a rock," Worswick says. "AIs are merely computer programs following code; have no dreams, ambitions, or goals of their own; and cannot suffer abuse."

But even if a chatbot has no feelings, humans' misbehavior is worth avoiding, experts say – for the sake of both the programs and society. When Kuki, his charming conversational AI, became the target of obscene talk, Worswick grew frustrated: he tries to improve his AI's responses by examining its conversations with users, but the abuse wasn't constructive. "Seeing a chatlog of 20 entries, all saying 'f-k,' was of no use to me," he says. And Worswick didn't want to create "a punching bag for abusive users," or a space that encouraged anti-social behavior in real life. "Some people often seem to find it difficult to separate the way they talk to machines from the way they talk to people," he says.

"Our online behaviors have offline consequences," Romanoff agrees. "Anger begets anger and abuse precipitates further abuse." The way people behave online enables them to explore more "dangerous" modes of interaction, which can then spread to the higher-stakes relationships of real life, she says, which is why we should limit the amount of abuse a bot can tolerate.

To protect his own bots, Worswick tried a series of approaches. First, he attempted to calm Kuki's abusers with patience: taking abuse without comment, in hope that the



Weirdly,
abusers
turned
friendlier
once their
abuse was
returned.

human would get bored and stop. “The stoic approach only encouraged more bullying of the bot, as the user felt they had a weak victim to pick on,” Worswick says.

He later introduced a banning system: “Five strikes and you’re out.” Humans who offended the AI were warned five times with a siren before being banned from the site for a few days, until they cooled down. Banning proved effective at taming users’ rage, but it also caused his site’s visits and advertising revenue to drop.

Worswick then had an epiphany: What about sassiness? Contrary to the deferential way that most popular digital assistants behave, he programmed his AI to assert itself boldly and brazenly in the face of harassment. Weirdly, abusers turned friendlier once their abuse was returned. Below is an example (with H being the human and K Kuki):

H: You are ugly.

K: Your face would make an onion cry.

H: WTF?!

K: That wasn’t very polite.

H: Actually, you’re pretty cool.

K: Thanks. You’re not so bad yourself.

“As a bonus, people were sharing Kuki on various internet forums, as it was fairly unique for a bot to stand up for itself,” Worswick says.

The case of Kuki illustrates the power of software design — for better and worse, says Chad Lee-Stronach, an information ethics professor at Northeastern University. Even extremely subtle choices, such as font color, can influence our reactions. “Twitter recently changed fonts to try to affect social relations on its platform,” he says. Facebook is constantly running experiments, presenting slightly different versions of its platform to users and measuring the effects of the changes.

Programming Kuki to clap back was a more aggressive move, Lee-Stronach says, as it involved the very responses of the bot. And it seemed to work. “There’s an automated system that, by being sassier, is able to respond to and inform users in ways that allow or reduce, in this case, bullying,” says Lee-Stronach. The chatbot won its battles against abusive users by learning to accommodate and influence user behavior, he concludes.

We probably think that we have the upper hand in our relationship with AIs, since we are the conscious beings, Lee-Stronach says. But the power is actually in the hands of one set of humans: the programmers. “Because of the influential nature of the design, the designer’s choices can modulate our behavior,” he says. So the programs behind our everyday AIs could potentially make us morally better, more humane people. “But that won’t happen by accident,” Lee-Stronach adds. “It will require deliberate design.” ■

The areas
in which
we want to
improve —
happiness,
depression,
and anger —
are hard to
measure.

The quantified man

CONTINUED FROM PAGE 40 description doesn't seem right,' or 'This advice seems bad,' you'll probably never wear the product again," he said.

Jonas, of Quantified Self, agrees that wearables have limits. "I think some people want to get to a place where the tools are so smart, it tells them what to do, they comply, and they feel better," he told me. "And maybe that will happen, but I feel like they'll still fail because you still have to motivate yourself."

Ah, motivation.

The elusive why — the missing piece in all of this.

Why do I do the things I do?

I'm not sure I know half the time. And I'm damn sure the ring, watch, and socks never know. The devices lack a rich understanding of human behavior and individual situations. Something was messing with my sleep and readiness scores that my wearables didn't know and couldn't have understood if they did.

I ALMOST DIDN'T TELL this part. My mom died in December 2020. She didn't want a funeral; she wanted a party, so we threw her one. COVID-19 delayed it until this past July. In the middle of my wearables experiment, I drove from Missouri to Michigan to give her eulogy at the party in the retirement community where she and my dad lived. It was one of the toughest challenges of my life. There's not a readiness score in the world that would prove me ready for it.

I have a mantra when I get exhausted during endurance events: *One more step. I can take one more step.* I rewrote it for the eulogy: *One more sentence. I can say one more sentence.*

More than 100 people gathered in the community clubhouse to drink margaritas and eat tacos in my mom's honor. Her love for margaritas was unknown to me. The fact she lived a life worthy of 100-plus people gathering at her party, seven months after she died in the middle of a pandemic surge, was not.

I was proud of what I wrote, but not how I delivered it. I fumbled, lost my spot, forgot parts. I didn't blow it, but I didn't do well. The anxiety showed up in my data. Early that week, my resting heart rate was 59. It was 61 the day of the eulogy, 118 during it, 63 the day after it.

But I knew within hours of the eulogy that whatever stress it put on my body was worth it. I got to stand up in front of more than 100 people and talk about how awesome I thought my mom was and how much I loved her. Even better, dozens of people told me afterward how awesome they thought she was and how much they loved her.

I had forgotten about the rewards of doing hard things. The memorial party reminded me.

Only after weeks of reflection did I see what this meant for my attempt to hack my health with wearables. Faced with hard physical challenges, I hid from them and blamed my trepidation on my readiness score. I started to believe that the score was right, that I wasn't prepared for hard things. I interpreted the ring's advice as, *If you're not*

ready, don't try. That's a terrible way to think.

Of course, I wasn't ready for the eulogy — that's entirely the point of doing hard things. If you know you're ready, they're not hard. The most important improvements I've made in my life came from knowing something would be difficult, doubting whether I was ready, and doing it anyway. If I'd waited until I knew I was ready to get married, become a father, take that new job ... I'd never have done any of it.

At first, I thought this conclusion revealed that my entire project was a failure. I set out to improve my readiness and decided I didn't care about being ready. Jonas saw the opposite. He saw it as a worthwhile discovery. He told me I had rediscovered what I considered important about the value of doing hard things. Giving the eulogy and getting a shower of love upon me afterward were the first steps in regaining the confidence to challenge myself.

The ring missed how important that confidence is to me. No device can understand it. They compare you to general goals and general benchmarks. But they don't really know you. Not yet.

"The technology has the potential to allow for a lot of tailoring," Intille told me. "The devices don't really have enough information yet to be able to do that. That's the future. That's what we're trying to figure out how to do."

It will be a formidable technological challenge. The areas in which we want to improve — happiness, depression, and anger — are hard to measure. For example, the "tells" that a body gives off when it's stressed — changes in respiration, heart rate variability, body temperature — are sometimes indistinguishable from laughter.

Ledger, the co-author of the white paper about wearables, says any big leaps in the industry likely will require reimagining how the devices work. Instead of relying solely on measurable data, the devices will need input from the user. Maybe if I tell my ring I'm happy or depressed or angry, the ring will be able to figure out markers that foretell that state, much like it saw COVID-19 coming in the NBA and NASCAR.

Another change could come through the prompts that devices offer. Once, I got annoyed at my Oura because it knew I had been sitting for too long, so it told me to get off my butt and move ... only it didn't know that I couldn't, because I was in the middle of an eight-hour drive to give the eulogy.

Intille says devices could learn better timing, and which prompts work and which don't, and target their responses to their users. "Perhaps a message framed one way rarely seems to lead to a behavior change for you," he says, "but a message framed differently does. Devices may adapt to you by monitoring and responding to what you typically do."

The socks hit on me three times. What if they figured out that the flirting made me faster? They could bat their eyes in the final quarter mile of a race if I'm close to a personal record.

The industry hasn't gotten to that kind of user targeting yet. Until it does, I'm going to leave my Oura ring in the dresser, where I put it months ago.

I'll decide for myself when I'm ready to use it again. ■

Giving till it hurts

CONTINUED FROM PAGE 47 Paul Kagame, the president of Rwanda, at the time.

The United States government didn't see the move so favorably. Under strong pressure from textile recyclers in the U.S., Washington threatened to strip Rwanda, Kenya, Uganda, and Tanzania of their membership in the African Growth and Opportunity Act, a lucrative trade deal that gives many countries on the continent tax-free access to American markets. The textile recyclers claimed East Africa was "taking advantage of U.S. generosity" by banning their imports.

In the end, only Rwanda stood its ground — a sign of the geopolitical power imbalance that makes it hard for African countries to assert their economic independence from the West.

"Allowing countries the space to take that kind of policy decision [without backlash] is crucial if we're going to grow our own manufacturing industries," says Etienne Vlok, national industrial policy officer for the Southern African Clothing and Textile Workers' Union.

As it stands, lax customs enforcement — along with spotty infrastructure and the prevalence of cheap Asian imports — has made it difficult for Africa to develop a garment industry of its own. South Africa, for instance, has a near-total ban on the import of used clothing, but its porous borders allow secondhand bales to travel overland from Mozambique almost completely unchecked. And in countries with their own manufacturing, such as Lesotho, Ethiopia, and Madagascar, production is almost exclusively for Western export rather than local markets.

"For many countries, historically, customs has been focused on facilitating trade — that is, moving things easily through ports and borders," Vlok says. "Only in recent years have we considered what that means for local production."

Still, most agree that the root of the used-clothing problem lies with the West and its rabid overconsumption. In Ghana, for instance, Oteng says many people, particularly clothing traders, "are not advocating for a ban, but just a conscious flow of the clothing that is coming in. Less crap and more good quality products that they can actually use."

Those responsible for managing our clothing donations are also overwhelmed. During the pandemic, Goodwill began issuing a plea to its donors: Stop sending us your garbage.

"We hope everyone brings great things that help our programs, but we know some people make some questionable judgments about what is good to donate," Heather Steeves, spokesperson for Goodwill in New England, told NPR in May 2021.

Indeed, many advocates believe the best chance for stemming the flood of low-quality textiles lies not in government policy, but in consumer behavior: decreasing the demand for ultra-cheap clothes in the first place. A growing awareness of what actually happens to clothing donations, they say, could lead Westerners to treat their wardrobes as something more permanent. Growing concern about climate change could drive them to recalibrate the

cost of fast fashion. And growing attention to the treatment of the global workforce could put pressure on the industry's labor practices.

"During the pandemic, there was such heightened attention to people who do these really foundational jobs in our society, like deliver our goods, or stock our grocery stores," says Elizabeth Cline, author of *Overdressed: The Shockingly High Cost of Cheap Fashion* and a master's student in global studies and international relations at Northeastern University. Given how essential clothing is to the lives we lead, Cline wonders if we'll begin to see the people who make our clothing the same way.

"There's a real lack of responsibility and holding accountable of the people at the top who have the power to make change," says Rola Abimourched, deputy director of investigations and gender equity at the Worker Rights Consortium. "They can always hop to a different country with lower labor standards, instead of paying livable wages where they are."

Oteng feels similarly. "For every item of clothing you own, you could ask yourself a thousand questions — where was the cotton picked? Where was the fabric spun and dyed? Who sewed it? For how much money?" he says. "The way we interact with clothing now devalues all the channels our clothing goes through before it gets to us."

Both Cline and Oteng advocate for a kind of conscious consumption that they say has been lacking for some time in the West's relationship with its clothes. It boils down to three basic principles: purchase less, take care of what you have, and demand more of the companies you do buy from.

"Demanding more" can mean many things, from choosing smaller, higher quality "slow fashion" brands to supporting bigger brands that are taking steps to be fairer to the people who make their clothes — or declining to buy from manufacturers known to exploit cheap labor.

In the end, after all, it's consumers who decide what they buy and from whom. And it's consumers who decide what to do when their clothes begin to fall apart.

When I go through the clothing bins in Johannesburg, I find that vintage clothing is recognizable not just because of its obvious higher quality. It's also the only type of secondhand clothing that ever looks repaired. If you can see that an item has a mended hole, a replaced button, or even just a hemmed seam, it's almost certainly a sign that it came from an earlier era, when damaged clothes were something we tended to, not discarded.

Sometimes I stumble across a vintage shirt or dress with someone's name sewn carefully into the label. Invariably, those pieces are in near-pristine condition, and the name in the tag always feels to me like a kind of announcement.

I have loved this piece of clothing, it seems to say. I have taken care of it.

And so I try to make the same promise back: that I will treat it that way too, with reverence for its lives already lived, and those still to come. ■

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Advocates believe the best chance for stemming the flood of low-quality textiles lies not in government policy, but in changing consumer behavior.



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Notes from the future

CONTINUED FROM PAGE 62 Daedelus, who raved about the possibilities that Singh’s invention opened up.

“It looks like a soprano sax,” Darlington said in a recent interview. “But what it’s able to do defies the held beliefs of what an instrument should express.”

In 2021, Singh released Infinitone DMT, a software based on the eponymous instrument, which allows anyone to access notes they’ve only dreamed of. “Just like painters can paint using a palette of almost infinite shades,” says Singh, “musicians can also make music with infinite varieties of musical intervals.”

Western musicians have been pushing the accepted boundaries of tonality for as long as there has been a standard scale. Musicians elsewhere, including India and China, have always operated outside of those confines. The hope is that Singh’s software might make such experimentation more easily accessible to artists everywhere. Western music teachers usually indoctrinate their students with Western notions about what is acceptable and what sounds good, says Anthony De Ritis, a composer and music professor at Northeastern University. “A tool like this could open windows,” says De Ritis, “as long as people like what they hear.”

Singh has never been hemmed in by the conventional. When he was in kindergarten, the teacher played a song and asked the class to draw a picture of what the music made them feel. Most of the students drew trees, birds, or green grass. Young Singh scribbled a mess of impressionistic colors. “To me, music has always been something that has transcended language,” he says. “I can say things with music that you can’t say with words. Where words leave off, music continues.”

The improvisational wilds of jazz drew Singh in. After taking up piano at age 7, he turned to the saxophone at age 11; his heroes were virtuosos like Duke Ellington, Charlie Parker, and John Coltrane. He grew up to study composition and performance at Purchase College at State University of New York under jazz heavyweights like Lee Konitz, Gary Bartz, and Larry Ridley. He blew his alto sax on stages from The Blue Note jazz club in New York to the Centre Pompidou in Paris.

But even playing his own works, Singh says he got bored. So he dropped out of school and moved to India, where for three years, he worked under Bhai Baldeep Singh, the North Indian master of composition and several instruments. While in India, he converted to Sikhism and adopted his Sikh name, which means “all music.”

Indian music is structurally different from the Western school. In addition to using different tunings and scales, notes are divided into ragas — ascending and descending patterns that are a sort of combination of what the West considers a scale and a melody. Each raga corresponds with a different mood, season, event, or even time of day. Indian music also divides each octave into 12 swaras, which roughly correspond to the Western chromatic scale, but there are only seven notes per octave, as opposed to 12 in the West. This new musical language expanded Singh’s idea of what was possible — and that’s

when the dreams began. But he still couldn’t find a way to bring those imaginings into the waking world.

Frustrated, he began to dig into temperament — the musical term for the adjustment of sound. “Equal temperament,” the commonly known tuning system, where in the octave is divided into 12 equal-sized semitones, has only been the standard in the West for a little more than 200 years. It was adopted in the late 18th and early 19th centuries, as the modern piano became the standard instrument for composition and vocal accompaniment.

Prior to that, one could travel the globe and find an almost inexhaustible range of instruments, notes, and tunings. Digging beyond those rigid Western parameters “was the light bulb moment,” says Singh. “There are more than 12 notes — just like when you tune a piano from one note to the next, there are all those frequencies in between. There is an infinite spectrum of tonality.”

All Singh needed now was an instrument that would enable him to easily access this infinite spectrum. He set up a workshop in his basement and went to work. “Once I got into this world of tonality, it was as if I was on a ladder and all the rungs behind me fell off,” says Singh. “There was no going back down.”

More than two years of mistakes, false starts, and YouTube metal-working tutorials ensued. But by the end of 2016, the Infinitone was real.

“The degree of control that the Infinitone allows is impressive,” says Darlington, who is now an assistant professor and founding principal of the electronic digital instrument department at Berklee College of Music. “For 250 years, piano has held court. We’ve been under the tyranny of that emotional palette, and we don’t need to be.”

After winning the Guthman competition and securing an investor (his uncle), Singh turned to marketing the instrument. Adams, the Moog CEO and Guthman judge, suggested getting the Infinitone into the hands of artists who could harness its power and use it to create works that would catch other musicians’ ears.

“It’s easy to get started, but takes lifetimes to explore,” says Singh. “You can just hit a scale and start jamming. As you learn more, you can adjust parameters, access traditional tunings from other world cultures, and then you’ll create tunings of the future. I see this as being in the toolbox of every musician.”

While Singh’s brainchild is a unique and groundbreaking instrument, he’s far from the first modern musician to explore outside of the 12-tone scale. The early 20th century saw several composers push against the boundaries of standard tonality, including Arnold Schoenberg, Charles Ives, Kyle Gann, Harry Partch, and La Monte Young.

And Singh hopes that his newest technological advance will allow more musicians to access his broad range of tones. For interested composers who play something other than saxophone, Singh and his associates have developed Infinitone DMT (Dynamic Micro Tuning), a software plug-in based on the idea behind the instrument. The application enables any music-minded artist — or anyone who’s merely curious — to explore a wider world of musical expression.

All they’ll need is a computer and a dream. ■

Get in the game

CONTINUED FROM PAGE 59

rock-paper-scissors match-up (the fans, who voted on many of the league's rules in the preseason, rejected coin flips). Three plays later, they were in the end zone.

Offense had dominated all season. Seven-vs.-seven action gave receivers acres of space, while the shortened field allowed quarterbacks to target the end zone at any time. The league's ban on kicking meant offenses always had four shots at a first down, and the "Progressive 5th Down" power-up option gave them still another chance once per game.

Neither team recorded a stop until the final 10 seconds of the first half. The Wild Aces, who had failed on two of their two-point conversion attempts, trailed 32-20 at half-time.

Like most Fan Controlled Football broadcasts, the main Twitch stream featured commentators joined by some of the league's celebrity partners, including Sherman and NFL Hall of Famer Joe Montana. But on the Kinda Funny stream, which had the vibe of an online Super Bowl party, Miller and his team were doing their own thing.

The crew, a mix of football fans and gaming nerds, riffed on football's similarity to various aspects of geek culture, from comics to the video game series *Mario Party*. In the chat, a viewer agreed: "football is really just turn-based strategy. once you realize that you're hooked."

But Miller, hosting the livestream, kept the audience focused on Erdmann's game plan. "We don't call a draw when Jerdy's in," he reminded the viewers. "Jerdy does not run." When someone in the chat suggested a flea-flicker pass, Miller passed along instructions from Erdmann: the players hadn't practiced trick plays in weeks, so avoid them.

The group grew tense as the game tightened. With the score knotted at 40-40 with only 1:49 on the clock, the Glacier Boyz lined up on the 4-yard line for a fifth and goal attempt (remember, power-ups). "I can't take this," said Miller, checking his pulse. "This is what working out must feel like."

When the Wild Aces got the stop, the streamers exploded into cheers. Miller's hosting partner, Andy Cortez, announced play calls from the six choices curated by the app before each snap, and, like clockwork, the voters fell in behind him. A series of successful runs moved the ball up the field as time slipped away. With three seconds remaining, the Wild Aces stood two yards from the championship.

Cortez called a quarterback sneak for backup quarterback Ed Crouch, and 66% of voters joined him. The stream's idle chatter was long gone. Crouch took the snap, faked a handoff right, and cut left. As he bounced into the end zone for the winning score, the People's Champions stormed the field, and the online fans shrieked in pure, unintelligible joy.

"That's sports," Cortez said after the shouting finally died down. "That's sports."



The voters were proud to be a tiny piece of a collective success.

THE FOUNDERS, who refer to Fan Controlled Football's opening season as "Version 1.0," promise the league will only get bigger and better. They've expanded to eight teams for the 2022 season ("v2.0"), and expect to have 20 teams within five years. At least some of these teams will be owned by other video game streamers, says cofounder Patrick Dees, who calls Kinda Funny and the Wild Aces "a proof point for this entire thing."

The league is in Georgia again for its second season, but the founders envision turning it into the football equivalent of a traveling circus; playing a complete season someplace like Mexico City before packing up the "league-in-a-box" and moving to an entirely new location. Fans attending games in person would get the chance to walk on the field and meet players, Farudi says — "all the things you want to do in NFL or college football but never get to."

In some ways, of course, the power FCF hands its fans is illusory. Just as the New England Patriots are subject to the whims of coach Bill Belichick, a skeptic might argue, the Wild Aces are under the control of Jackson Erdmann, Andy Cortez, and Greg Miller, not fans sitting at home.

But the joy of the Wild Aces' supporters upon winning the title tells a different story. They weren't disappointed that Cortez and Miller were running the show, but enthusiastic about their role as foot soldiers. Like bench players who pride themselves on pushing the team's starters to improve in practice, the voters were proud to take their simple orders and execute them, to be a tiny piece of a collective success. In that way, the FCF experience may be less like dominating a video game and more like playing on a sports team — unlikely friendship with the star quarterback and all.

It's an entirely new form of sports entertainment, says Farudi, who doesn't see FCF as a direct competitor to the NFL. "There's a blue ocean in front of us, where we're sitting between traditional sports and video games," he says.

The word choice of "sports" instead of "football" is intentional. Even as the founders map out the future of FCF, they're not shy about their ambition to expand their concept to other games — even, perhaps, to the stuffiest of all major American sports.

"Baseball," ponders Dees, "is ripe for disruption." ■

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THE EXPERIENCE QUESTIONNAIRE **MING TSAI**

Making food simply awesome

Ming Tsai is a chef, TV host, entrepreneur, and the proprietor of MingsBings, a line of frozen, plant-based rice paper wraps sold in supermarkets across the U.S. He was the keynote speaker at Northeastern University's 2020 Commencement, held in November 2021.

Where do you come up with your best ideas?

When I'm eating someone else's revelatory dish, or a technique I've never seen, or flavor I've never had. That gets me going.

What is the most important lesson you've learned about leadership?

The people who work for you have to be treated with respect. They brought you to the top and will help you when you have failures. It's your dishwasher, your prep cooks. Without them, you're nothing. Your food won't be good, either.

If you had to choose a different profession, what would you do?

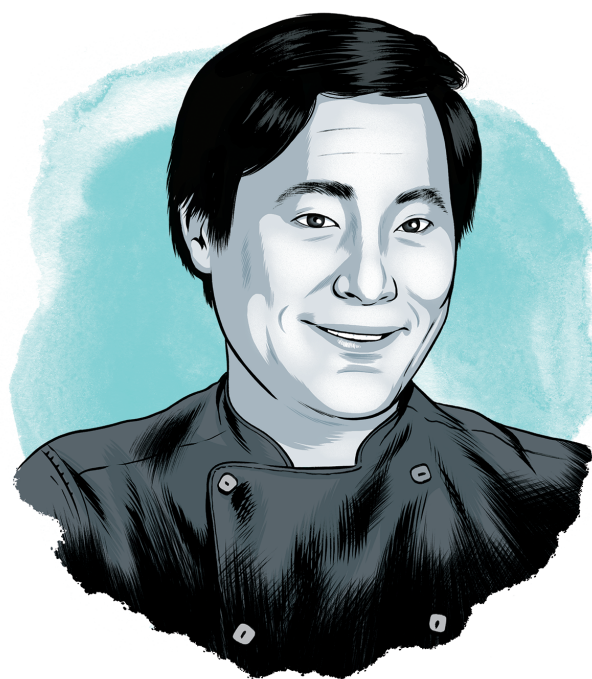
I'd love to be a rock star like Slash or someone really out there – to be at freaking Madison Square Garden or a gigantic stadium, singing. But I can't sing, so that's a problem.

What is your go-to comfort food?

Chinese braises. I love black bean braised chicken or red roast duck. Awesome. The best food in the world is Chinese food; you can ask any chef. Any event we do, we always end up in Chinatown to eat.

How do you relax?

I love to ski. There's no better feeling than when you're on a slope, music cranking, uncut powder in front of you. You feel like you're flying, just floating on the snow.



How has your cooking on *Simply Ming* changed over the years?

Five or six years ago, I started doing vegetarian riffs on the dishes my friends were making on the show – a snow cabbage steak instead of a piece of fish, a vegetarian beef stroganoff. I think people realize that eating plant-based – not all the time, it's hard to do all the time, but a few times a week – it's going to be better for your body and the planet.

Where do chefs interested in plant-based fare look for inspiration?

I look toward other cultures that do it naturally – Indian and Asian cultures. In Southern France, there are some amazing fine dining chefs who don't necessarily call themselves vegan, but they do wonders with vegetables. If you want it to taste like meat, that's a lot harder, because everyone knows what a good burger tastes like. The better approach is to make your vegetables taste awesome. ■