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INNOVATION 2021

Brain on Nature

A new app called NatureQuant harnesses the latest nature-is-medicine research to track and rate your time outside. Next up: determining the right dose.

BY ALEX HUTCHINSON

THE CORPORATE ORIGIN STORY IS ALMOST PERFECT. ONCE UPON A TIME, A DATA GUY, A SOFTWARE GUY, AND AN ENVIRONMENTAL PHYSIOLOGIST MET ON A HUT-TO-HUT SKI TRAVERSE OF OREGON'S THREE SISTERS WILDERNESS. SNOWY CHUTES UNDER BLUEBIRD SKIES BY DAY, THEN STARRY

nights in rustic huts stocked with Bend's finest microbrews. Mountain air and hearty camaraderie. No cell service. Though they didn't know it at the time, the three men were ticking off the four domains that would subsequently be at the heart of their AI-powered algorithm for quantifying the health benefits of nature: environmental quality, stress reduction, physical activity, and social contact.

Of course, every medicine has its side effects. Christopher Bailey, the software guy—ex–Adobe Systems, at the time the chief technology officer for an app called HotelTonight, which was bought by Airbnb in 2019—had some pretty bad heel blisters, rubbed right down to the fatty tissue. And on the last night, Chris Minson, a University of Oregon physiologist, crashed out of a friendly "pick stuff up from the floor with your teeth while standing on one leg" balance competition—while sipping his first drink of the evening, he is at pains to clarify—and broke his fifth metatarsal, an injury that required a snowmobile extraction, a bone graft from his shin, and the surgical insertion of a metal plate. Nonetheless, something clicked. A seed was planted.

NATURE AS MEDICINE is a cliché with a robust pedigree that you can trace back to our sun-worshipping, tree-venerating protoancestors millennia ago. The idea started going scientific in the early 1980s: that's when Harvard entomologist E.O. Wilson published his book *Biophilia,* on humanity's innate affinity for nature; when the Japanese Ministry of Agriculture, Forestry, and Fisheries coined the term *shinrin-yoku,* or forest bathing; and when a researcher named Roger Ulrich noticed that patients recovering from gallbladder surgery at a Pennsylvania hospital were discharged nearly a day earlier, on average, if they had a view of trees outside their window. These days, the link between cumulative time spent in natural settings and health outcomes—including the big one, longevity—is solid. There's data on cancer and heart disease, anxiety and depression, immune function and stress hormones, and more. "It's not just one study," points out Harvard epidemiologist Peter James, whose 2016 analysis of the 108,000-person Nurses' Health Study found a 12 percent lower rate of nonaccidental mortality among those with the most greenery in a 250-meter radius around their home address. "It's 500 studies."

Of course, there's a perennial gap between knowing and doing. Psychologist Laurie Santos and philosopher Tamar Szabó Gendler have dubbed it the G.I. Joe Fallacy, from the tagline of the PSAs that followed the 1980s cartoon: "Now you know. And knowing is half the battle." Most of us know, or at least intuit, that a walk in the park is restorative. But knowledge alone has not sent us flocking to the woods. In the 1990s, data collected by the Environmental Protection Agency suggested that Americans were spending less than 8 percent of their lives outdoors. There is little evidence that the situation has changed for the better in the past 30 years, despite that mounting pile of nature-is-medicine research. (It remains to be seen whether the pandemic-inspired park frenzy of both 2020 and 2021 heralds a lasting shift.)

That's the conundrum that Jared Hanley, the data scientist and veteran adventure racer who organized the Three Sisters trip back in 2016, kept contemplating. "And I came to the conclusion that for things to matter, you have to measure them," he recalls. "You just gotta slap a number on it. And once you start tracking it and ascribing value to it—however arbitrary it is, like Bitcoin for example—society starts focusing on it." A 2019 study from Britain's University of Exeter offered a handy benchmark: 120 minutes of nature per week, it found, was enough to measurably boost health and well-being. An *Outside* cover story around the same time, on "science's newest miracle drug" (that would be nature), provided Hanley with the impetus to recruit his erstwhile tripmates Bailey and Minson, with their complementary skill sets, to the cause. Nature, Hanley decided, needed an app.

> The way a leafy promenade or a burbling brook tugs gently at our senses seems to restore our perennially depleted capacity to focus; it also lowers stress, boosts mood, and even enhances performance on cognitive tests.

The three men incorporated NatureQuant in late 2019, with Hanley, a former investment banker, as CEO; startup veteran Bailey as chief technology officer; and Minson as chief science officer and their bridge to the world of academic research. Their tagline is "delivering technology to assess and promote nature exposure," and their initial vision was an app that would keep track of how much time you spend in natural environments. The target audience was not necessarily people like themselves: not-quite-grizzled adventure-sports veterans in their forties and early fifties brought together by the vibrant outdoors scene around Bend and Eugene, where they live. "We're all super into the outdoors and nature, and we really believe in the benefits," says Bailey, a dedicated mountain biker, trail runner, and skier.

"But I don't think the average person realizes that benefit as much as they could." An app that charts your progress toward a goal of 120 minutes a week, they figured, could serve as the equivalent of an activity tracker spurring you on to 10,000 steps, nudging you whenever you're racking up too many indoor hours.

But they immediately ran into a practical problem. "To create that app," Hanley says, "we very quickly realized that the only way it would work is if we know where all the nature is, and what part of nature is important for health." To fill this gap, they began assembling a master database combining inputs from a huge range of sources: park databases, visual and infrared satellite imagery that picks up both greenery and water, aerial and street-view photography fed through image-recognition software, tree canopy, road density, noise pollution, light pollution, air pollution, water quality, and more. All this data is combined using a machine-learning algorithm, which then spits out the company's signature NatureScore—a zero to 100 rating of a given natural setting's beneficence, accurate to within ten meters.

At NatureQuant's website, you can currently plug in any address in the United States and get a NatureScore, including a simplified rating of one to five leaves that splits the 100-point scale into quintiles. (The company is in the process of expanding coverage to Canada, with Europe to follow.) The vibe consciously evokes Walk Score, the walkability rating service acquired by real estate brokerage Redfin in 2014, which now delivers 20 million search results per day. And it fits into a larger constellation of "location intelligence" services that provide data to inform real estate decisions. "It's a way of quantifying something that is normally very subjective, and of gathering together all these things you notice in person, like are there trees on this street?" says Sara Maffey of Local Logic, a Montreal-based company that scores addresses on 17 different traits and is in talks with NatureQuant about adding its data to the mix. It's not just home buyers who are interested, Maffey points out: neighborhood greenness correlates with home value, so developers and investors want the data, too.

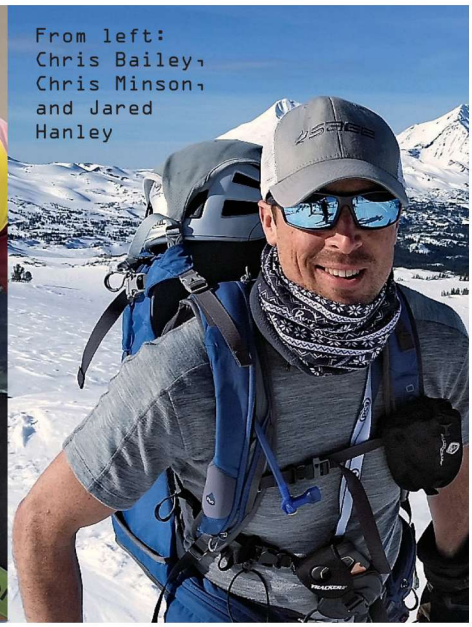
The ancillary uses of the NatureScore geographical database, even without a consumer-facing app that tracks individual movements or nature exposure, caught Hanley and his colleagues off guard. They soon realized that their algorithm could predict all sorts of things, like urban heat islands and county-level crime rates and even COVID cases—the latter a consequence, presumably, of better air quality associated with more trees, but also potentially linked to subtler effects such as people spending more time outdoors and getting more exercise in nature-rich neighborhoods. They began forging links with organizations like the Arbor Day Foundation, which promotes tree planting. When the foundation pitches cities on the need for more trees, it's easy to quantify the positive effects on pollution and noise and stormwater, says Dan Lambe, the group's president. But the broader health benefits have always been harder to measure. "What NatureQuant is doing is truly unique," he says. "It could be a game changer for investment."

They've also entered discussions with Davey, the country's biggest arborist company, and with Citibank's City Builder platform, which helps investors find high-impact community investment opportunities. These sorts of partnerships may eventually give NatureQuant a revenue stream from its data—the company is determined not to charge consumers for the app. At this point, it's keeping its options open. "If we can partner with someone like Apple, and overnight get this on 50 million Apple Watches," Hanley says, "that's really going to have the biggest public impact."

ON THE SCREEN, a series of blue dots appear one by one, superimposed onto a map of Boston: first in Cambridge, then drifting south across the Charles River, past Fenway Park, toward Harvard T.H. Chan School of Public Health. It's April 2021, and Peter James, the Harvard epidemiologist, is giving a talk at a National Institutes of Health summit on Alzheimer's research, and he's sharing tracking data from his phone. "Most environmental-epi studies focus on the area around the residential address to define exposure," he explains, "but we know from time-activity surveys that individuals spend more than 50 percent of their time away from home."

The theme of the session is the so-called exposome, a term coined in 2005 to describe the cumulative impact of environmental influences on health. James's 2016 study of nurses linked the greenness of their home addresses to health outcomes; he is now

FROM LEFT: COURTESY OF DIANA NAGAI; COURTESY OF NATUREQUANT (2)



From left: Chris Bailey, Chris Minson, and Jared Hanley

following up with a cohort of nurses using Fitbit and GPS data to get a more accurate picture of where subjects spend their time. As a result, he's grappling with the same question that NatureQuant faces: What are the active ingredients in nature?

To epidemiologists, good greenspace is notable for what it lacks—health hazards like pollution and traffic—and for the kinds of behavior it promotes. People tend to be more physically active in parks and to socialize with friends and neighbors, both of which are associated with better health. But for the audience of Alzheimer's researchers, the outcome of interest is cognitive function, and James's research suggests that a more subtle mechanism is at work. The way a leafy promenade or a burbling brook tugs gently at our senses seems to restore our perennially depleted capacity to focus; it also lowers stress, boosts mood, and even enhances performance on cognitive tests.

Of course, there are other elements of the exposome that have similar effects. "Neighborhood-level racial and socioeconomic factors are big potential confounders," James says, "because we know poorer neighborhoods have fewer amenities." As a result, he adds, those are the neighborhoods that get the biggest boost from greenspace.

IN JANUARY, President Biden issued an executive order promising new emphasis on environmental justice, the idea that benefits and risks associated with the environment should be distributed equitably among communities. In principle, federal agencies have had to consider the environmental impact of their decisions on minority and low-income communities ever since the Clinton administration. To support that goal, the EPA has a nifty screening tool called EJScreen that maps demographic indicators alongside data about air pollution, traffic, water quality, and so on. But there's a fundamental problem with this approach, Hanley says: "They only really look at the negative side of the calculation, without thinking about how we mitigate some of these problems, or even create healthier communities, by providing more nature."

Consider Fiat-Chrysler's 2019 announcement of a $2.5 billion expansion of its Detroit facilities. To offset increased pollution in a predominantly Black neighborhood with already poor air quality and high asthma rates, the company offered to reduce emissions from another plant in a nearby, predominantly white neighborhood. Parsing the components of NatureScore suggests some obvious alternatives to this myopic approach to environmental justice. "Turns out the best way to clean the air in a neighborhood is just planting a bunch of trees," Hanley says. "Let's mitigate all the hazards, but let's also invest in benefits." Across the country, three-quarters of the population in census tracts with low NatureScores are people of color, compared with less than half of the population in places with high NatureScores. The disparities are even more pronounced when it comes to income and education level.

Crunch enough of these numbers and you start to see the limits of personal agency. "Yes, people can make better decisions," James says, "but that doesn't scale like urban planning does." Still, for a certain kind of tech-forward nature nerd, the idea of an app that tracks your individual nature exposure remains intriguing. Since I live in Toronto, I can't yet check my own NatureScore, but I asked my editor to look up her address in Brooklyn. She lives about a mile from Prospect Park, but the algorithm only gives credit for what's in a 0.6-mile radius (though that radius, along with the weighting of different elements of nature, can be tweaked by the company for clients with specific interests). Her score was a dismal 5.5 out of 100, suggesting an imminent decline into infirmity and perhaps madness.

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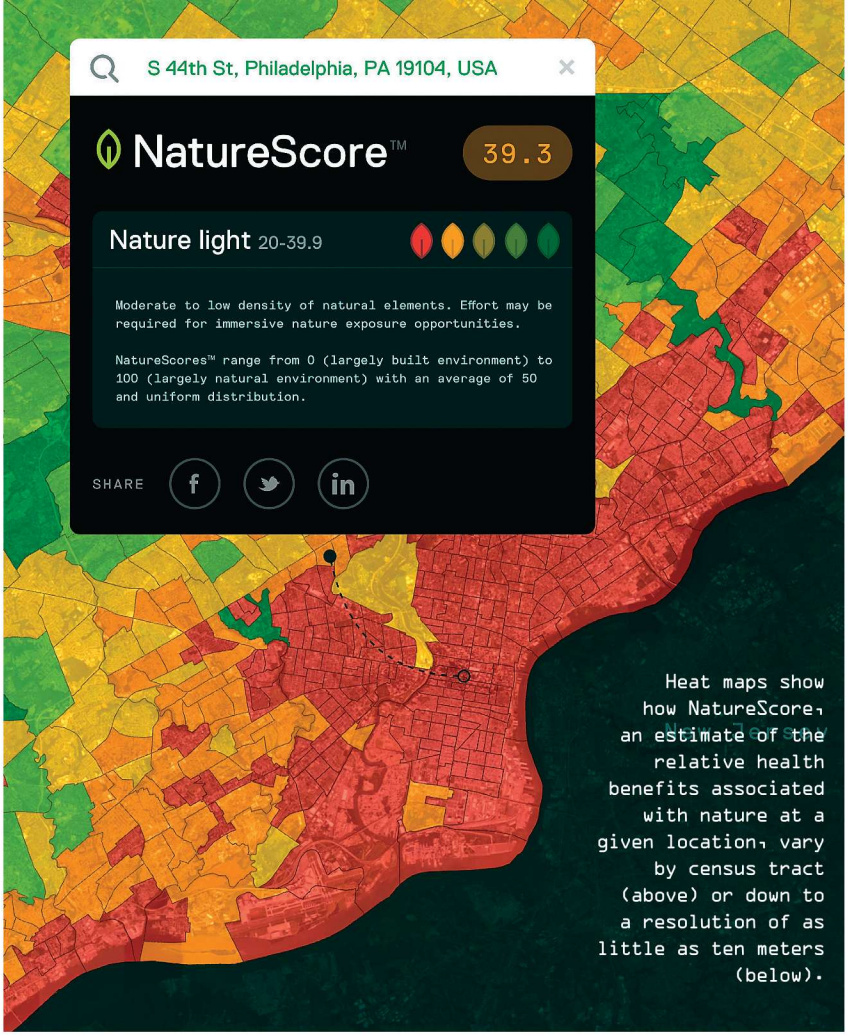
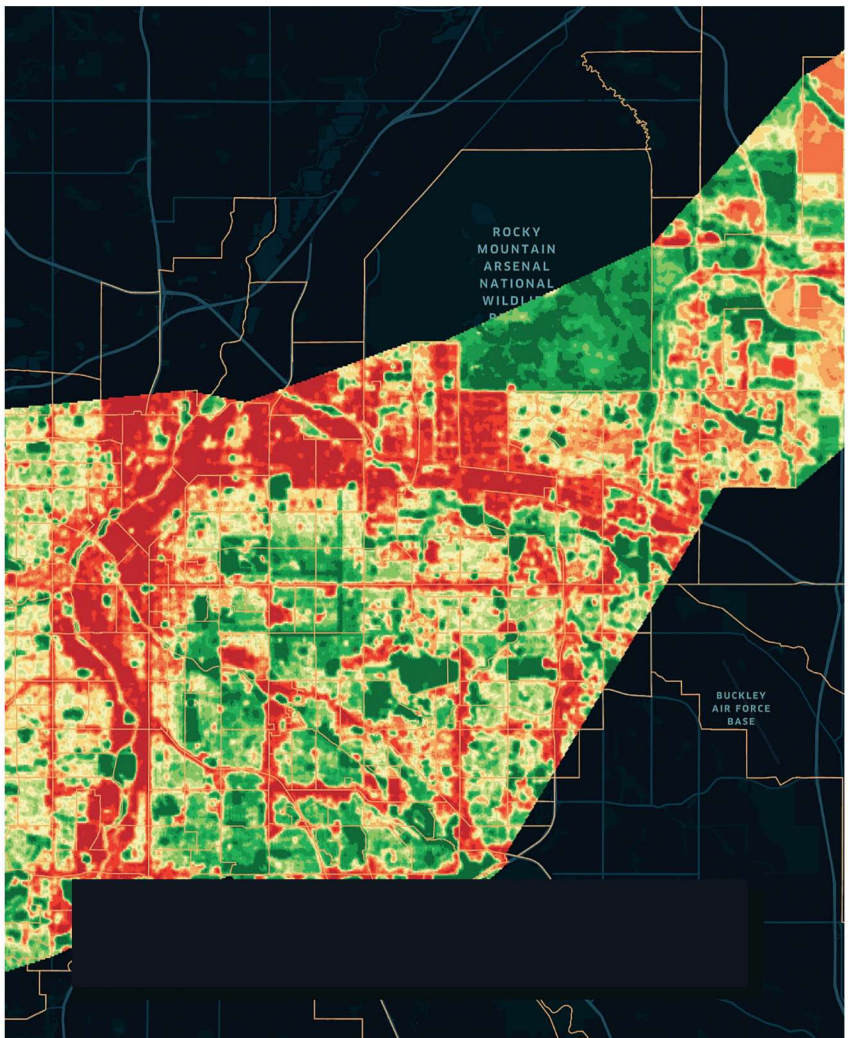
Fortunately, she's a runner. In April, NatureQuant quietly launched a Strava feature that offers a taste of what the full-fledged app, which is expected to debut by the end of this year, will eventually provide. It calculates an average NatureScore on a scale of one to five leaves for any given route you upload, this time using a sight line of 50 meters to either side of your path as the outer boundary of what features it considers (compared with 1,000 meters for the address lookup); it also assigns a prorated NatureDose, in minutes, toward your 120-minute weekly goal. Every minute run or pedaled along a remote mountain trail gives you a full minute of nature; less verdant settings like, say, a semi-urban bike path earn you a fraction of a minute. For my editor, that essentially translates to full credit for her loops of Prospect Park and not much for the concrete jungle she passes through to get there. A 55-minute run to and around the park in early May, for example, earned a NatureScore of four leaves and a NatureDose of 37 minutes. There's a reason she almost always runs there.

I FIRST HEARD about NatureQuant in late 2020, in an e-mail from Minson, whose physiology research I'd written about previously. "We are acutely aware," he admitted in that first exchange, "of the irony of using technology to improve our exposure to nature." I've been mulling over that apparent conflict ever since. Is the answer to our ever accelerating estrangement from the rhythms of the natural world really to be found by spending even more time interacting with our devices—by peering down at our screens rather than engaging with our surroundings? By tracking our movements through the wilderness with a device that will also ping if our boss sends an e-mail? "Off the top of my head, it strikes me as a little absurd," admits *Outside* contributing editor Florence Williams, whose 2017 bestseller *The Nature Fix* helped introduce the links between personal health and the natural world to a mainstream audience. "But maybe it can work like a gateway drug."

Our experience of nature has always been intertwined with technology, points out John Shultis, an adjunct professor at the University of Northern British Columbia who studies outdoor recreation. Our current system of federal, state, and municipal parks owes a lot to the mass adoption of the automobile in the early 20th century, which spurred demand for the conservation of wild places to drive to for a visit. Technology spun off from the military and the space program led to better outdoor gear that fueled the backcountry boom of the 1950s and 1960s. Even *Pokémon Go,* Shultis notes, got a surprising number of kids outside. The question, he says, is whether we end up more focused on our technology than our destination when we get there.

In many ways, the debates about nature prescription mirror the ones in the exercise world. How much physical activity do we need? What kind of workout is best? Do self-tracking apps boost our activity levels or just turn us into gibbering neurotics? The difference is that exercise research has a half-century head start. The foundational study in the exercise epidemiology world, which found that stair-hopping conductors on London's double-decker buses were more than half as likely to have heart attacks as the sedentary drivers, was published in 1953.





COURTESY OF NATUREQUANT

Heat maps show how NatureScore, an estimate of the relative health benefits associated with nature at a given location, vary by census tract (above) or down to a resolution of as little as ten meters (below).

The first exercise guidelines didn't follow until the 1970s, and the modern advice to accumulate 150 minutes of moderate exercise a week dates to the 1990s.

"We've got a long way to go before we get to where physical-activity recommendations are now," admits Benedict Wheeler, a researcher at the University of Exeter's European Centre for Environment and Human Health, and one of the coauthors of the 2019 study recommending 120 minutes of nature per week. "But at least we've made a start." Maybe it'll end up being just one hour, he says; or maybe three is better. Either way, most people in urban settings—and these days that's more than 80 percent of Americans—need more.

Wheeler and his colleagues' analysis was based on fairly crude survey data: asking people how often they had gone outdoors in the previous week, how long each one of those outings lasted, and how they would rate their general health. The most tantalizing dream for NatureQuant is to do some hardcore prospective research, tracking exactly how much time people spend in nature for weeks or months or even years, and comparing it with their long-term health outcomes. Then the company will use all that fancy machine learning to tease out which specific elements of nature, in precisely what dose, make the most potent elixir. It would be like NASA's Clear Air Study from the 1980s, which ranked houseplants on their ability to filter toxins out of the air, for use in future space stations—but for the whole wild world.

And if they managed to scrape together the funding for this notional über-study, what then? "Quite admittedly," says Bailey, NatureQuant's software guru, "a large portion of the population would rather take a pill of some sort to solve their problem." But maybe that's just because they don't know or have forgotten what it's like—the transcendent peace of a backcountry ski hut in the shadow of volcanoes, or even the relative calm of a tree-lined path through an urban park. Or they get busy and the day slips away yet again in a flurry of Slack chats and Zoom calls. They just need a gateway drug, a reminder, a prod from their phone, where the rest of their life already plays out.

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