ers big rewards. "It's not a continuous function," Ivashina explains. "It's not like I get a little bit more money as my performance increases. It's all or nothing." This perpetuates the cycle: there's a chase to pick top-quartile funds, so there's a chase to be a top-quartile fund, regardless of the long-term growth and stability of the fund.

If pension-fund managers are rewarded for favoring the proverbial hare over the tortoise, they will do so. To solve this problem, and help inculcate the discipline necessary to drive the long-term investment needed to address critical societal problems, Lerner and Ivashina suggest compensation schemes that de-emphasize short-term rewards. Giving a pension-fund manager some type of carried interest—a share of an investment's profits—or the option to invest alongside the fund are strategies that might encourage more scrutiny of short-sighted tricks. Another might be to use an alternative performance measurement known as the public market equivalent (PME), which computes the ratio of an investment's private return to what a like sum would have yielded in public markets. No statistic is perfect, the authors acknowledge, but some align more with a long-term outlook.

Extrinsic incentives can go only so far, however. Some of the most successful funds pick employees with a deep connection to their mission. The Canada Pension Plan Investment Board (CPPIB) and Yale Investments Office (YIO), two exemplars of long-term investment, both embrace this strategy, Lerner and Ivashina note. CPPIB often recruits prominent Canadian investors who have had successful careers elsewhere, paying them well to ensure that millions of Canadians retire comfortably. Most of YIO's investment professionals are graduates of the university, and often accept below-market salaries to bolster their alma mater's endowment. In both cases, *intrinsic* incentives encourage employees to focus beyond the short-term.

But sticking to a long-term vision is also made more difficult by media scrutiny. News organizations barely covered a major hit to Harvard's endowment in 1973, Ivashina and Lerner write, largely because networks like CNBC and Bloomberg didn't exist. But 35 years later, Harvard felt compelled to publish a statement detailing its losses within weeks after the collapse of Lehman Brothers. This scrutiny makes it easier to stick with investments that appear safe from the outside, even if the likelihood that they will pay off is low. Private-equity investment often rewards innovative strategies—breaking into new or underdeveloped markets—but media coverage can make it harder to justify risky decisions if they *don't* pay off. In addition, the industry's pay scales attract attention. Though most institutional investors make less than those dealing in private markets, their high salaries relative to non-investment personnel often spark public shock and outrage when institutions publicly file their financial statements. Some top institutional managers move to the private sector, where they will be paid more and scrutinized less. "It's a bit of a difficult spot" for institutional managers, Ivashina said. "They subscribe to the mission, they take a pay cut, and yet they still face the critique that it's unfair."

Pressure to follow short-term strategies and stray from a mission can come from internal sources, too. "Good governance," Ivashina and Lerner write in their book, "is the first line of defense to ensure that good judgment is exercised and patience prevails." Some boards include a significant number of government appointees, ex-officio officers, and employees—each group representing different priorities. A policy of monthly meetings might push the group toward frequent short-term changes, especially if there is high turnover among board members. Lerner and Ivashina suggest instead a board composed of mostly financial experts who have relatively long tenures and meet infrequently. That way, members will have a chance to form a team dynamic over time and patiently pursue a long-term mission. To prosper for decades and deliver solutions to the most critical problems, they emphasize, patience is more than a virtue—it pays.

—JACOB SWEET

VICTORIA IVASHINA EMAIL:
vivashina@hbs.edu
VICTORIA IVASHINA WEBSITE:
hbs.harvard.edu/faculty/Pages/profile.aspx?facId=378483
JOSH LERNER EMAIL:
jlerner@hbs.edu
JOSH LERNER WEBSITE:
hbs.harvard.edu/faculty/

HM Explore More

For additional, online-only, articles on research, see:

"Effective Treatment Everywhere"
A Harvard-University of Michigan summit on opioids stigma, drug marketing, and race.
harvardmag.com/opioids-summit-19

Lessons from Lehman Brothers
A Business School exhibition traces the rise and Great Recession fall of the iconic investment bank.
harvardmag.com/lehmanbros-19

FROM LEFT: KEITH TOLMAN; COURTESY OF THE LEHMAN BROTHERS RECORDS, BAKER LIBRARY, HARVARD BUSINESS SCHOOL

SURVEILLING CERVIDS

From One Animal to an Ecosystem

EUROPEAN ROE DEER are much smaller than any deer Americans are used to seeing. At 45 pounds and just over two feet tall, an adult is closer in size to a greyhound than to its larger cervid cousins. And unlike highly social species like red deer or elk, roe deer like to be solitary. They spend most of their lives alone, within a range of one square kilometer—and the reason why is a mystery. These animals are built for movement: they can sprint at 30 miles per hour. "What makes them stay in such a small space for their entire lifetime?" asks Nathan Ranc, a fifth-year graduate student in organismic and evolutionary biology (OEB). And how do they choose their home territory?

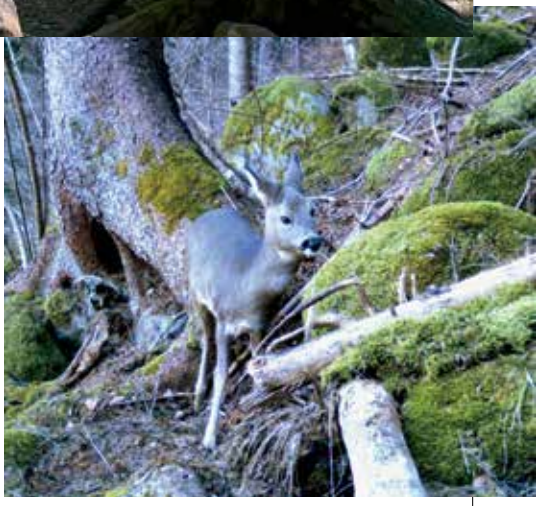
These questions underpin all of ecology,

Reprinted from Harvard Magazine. For more information, contact Harvard Magazine, Inc. at 617-495-5746

because the answers influence how animals mate, form social groups, and use resources in their environment. To study how roe deer form their home range, Ranc says, it's important to understand each animal as an individual, with a mind and a memory that differ from that of other deer. In the Alps of northern Italy, Ranc (co-supervised by OEB professor Paul Moorcroft and Francesca Cagnacci of the Fondazione Edmund Mach) and his colleagues are trying to build a model that can explain each of the factors that determine why particular deer choose to live where they do.

Home ranges in this species are particularly hard to understand because roe deer aren't especially territorial: they don't try to keep other does or bucks off their territories (except during the summer mating season, when males will fight off other males). This generally accommodating behavior contrasts with that of a territorial species like the Yellowstone coyotes Moorcroft has studied. In 2006, he and colleagues proposed a model of home-range formation among those predators that provided a powerful incentive to stay put: moving outside their own range might get them killed by other coyotes. But for roe deer, if there is no risk of confrontation in foraging afield, why not move?

Two different theories might explain their behavior: one is that by getting to know a place, a deer can better remember what forage is available where, and at what time of year. This matters because roe deer are picky eaters: unlike grazers that devour vast amounts of grass, they are browsers, choosing the highly nutritious tips of shrubs and herbs. A second theory hinges on their vulnerability to predators. The roe deer's main predator is the Eurasian lynx, which ambushes its prey. To escape an attack, Ranc says, these tiny deer have only a split second to decide in which direction to run, "and it better be a good one." Intimate knowledge of escape routes may give them a better chance of survival.



Above and right: Roe deer caught by the researchers' cameras. The map below displays a deer's movement (as captured by a GPS collar, which died at the red square). Darker shades of blue show older locations and lighter blue, the more recent ones.

To study the first hypothesis, Ranc and his colleagues have fitted 26 deer with GPS collars that register a location every hour and also include accelerometers, allowing the researchers to more precisely reconstruct the animals' movement. In addition, supplemental food—corn—is left throughout the landscape, and the researchers adjust its availability. The animals quickly learn which places are stocked with corn and, when the corn is removed, they learn that, too, and stop frequenting those locations. The individuals that most prefer corn are more likely to seek out the new locations, but all else being equal, the deer prefer to stick to places they know. "We study how roe deer learn about the changes that we make and how those changes make them redefine their home range," Ranc explains. He says the team hopes to publish its results in the next year: "We have evidence that roe deer rely on past experience to make their foraging decisions."

In a second project, in Aspromonte National Park in southern Italy, the team is studying a roe deer population in a region where they had been hunted to extinction and only recently reintroduced. "Their spatial memory is nil" in these new areas, Ranc says, creating ideal conditions to study how their home ranges emerge.

He sees the work as part of a turn in ecology toward understanding the importance of *individual* animals' behavior. Until recent decades, "a lot of our understanding of the human impact on wildlife has excluded the idea that animals have created a unique knowledge about a unique place," he explains. "And that knowledge is not necessarily transferable." Animals that have been pushed out of a territory and then reintroduced will have lost the deep knowledge of the local environment that is otherwise

All images courtesy of Nathan Ranc

Reprinted from Harvard Magazine. For more information, contact Harvard Magazine, Inc. at 617-495-5746

passed down through generations.

A broader goal of studying how animals use space is to understand how humans can conserve and coexist with them. This is, for Ranc, what the work is really about. He caught a passion for the wild as a boy growing up in France, watching animals in the woods through binoculars. Many of Europe's large animal populations had rebounded by the 1990s, after hitting rock bottom in the twentieth century. "Now, in Europe, he reports, "wolves, bears, lynx, and bison are all increasing in population size and range," even though in many other parts of the world, the situation for wildlife is "dire. There's no sugar-coating. It's catastrophic."

He finds it more motivating to think about conservation success stories, and about how careful study of the living patterns of species like the roe deer can help the animals thrive alongside human beings. This is not only interesting as fundamental research, he says, but "it also helps us understand how animals react to change—and humans make a lot of changes."

—MARINA N. BOLOTNIKOVA

NATHAN RANC WEBSITE:
moorcroftlab.oeb.harvard.edu/people/nathan-ranc

TWIN TALES

ZIP Code vs. Genetic Code

When considering the risk of a given disease—cancer, cardiovascular problems, Alzheimer's—what matters more: the genes inherited from parents and grandparents, or the environment? Is disease influenced more by DNA, or by factors such as air pollution levels, socioeconomic status, or even regional weather conditions?

It's common to think of disease and health "as this tension of ZIP code versus genetic code," explains Chirag Patel, assistant professor of biomedical informatics at Harvard Medical School.

But a study by Patel and his research team challenges this "either-or" thinking, using Big Data to tease apart the complex interplay of environment, genes, and other factors in disease. They analyzed an insurance database of almost 45 million people in the United States, Patel explains, zeroing in on 700,000 pairs of non-twin siblings and 56,000 pairs of twins, in what is likely the largest study of twin pairs to date. Studying identical twins is a common way to consider nature-versus-nurture questions because such siblings have identical genes and often grow up in the same environment. In typical twin studies, researchers must recruit participants and examine just one or two diseases at a time. But this massive preexisting database enabled Patel and his team to consider 560 different diseases at the same time.

"You have this huge sample size, which we all love in science," he says, "but these types of data are not meant for this work." Preparing the database for study was therefore a challenge. Because the data did not specify which siblings were twins, for example, postdoctoral fellow Chirag Lakhani, who led the analyses, isolated the twins by searching for family members born on the same day. The team also had to determine which twins were identical (with identical DNA) and which fraternal. Male-female twin pairs cannot be identical, but same-sex twins have an equal chance of being identical or fraternal. Working with colleagues at the University of Queensland in Australia, the Harvard team developed a statistical technique for estimating which of the same-sex pairs were identical. When they compared their findings with previous small-scale studies on twins and disease, "we found by and large that there was a strong correlation with the things that we were seeing," Patel says.

Of the 560 diseases studied, 40 percent had some genetic component, while the shared environment (elements such as air quality and aver-

Illustration by Dan Page

Reprinted from Harvard Magazine. For more information, contact Harvard Magazine, Inc. at 617-495-5746