Better ways to forecast technological change

The tricky business of forecasting technological change is usually done in one of three ways: by treating new technology as a featureless, exogenous shock (referring to “black box” type models); by describing technology in terms of experience or learning curves that improve cost performance; or by relying on the often wildly varying opinions of experts.

But there are all ways of describing in highly aggregated fashion what econ- mimists are seeing as outputs rather than what causes those changes. To really understand technological change, you need to examine its underlying drivers and the motivations of the people and firms making it happen, says economist Deborah Sturmsky of UNC Charlotte.

Researchers invited to a working group at SFI this summer are studying technology, especially alternative energy technologies, as trophic networks akin to food webs that describe feeding interactions in ecosys- tems. The food web-like approach enables them to place a particular technology within its ecosystem and study how it evolves. Like food webs, these networks have hierarchical structures, but they are based on individual technologies’ distances from the natural resource-based inputs needed to create them.

The interesting dynamic in this approach, more on page 3

Code.org takes SFI’s Project GUTS to nation’s classrooms

SFI’s Project GUTS (Growing Up Thinking Scientifically), an afterschool program for New Mexico middle school students, is gaining national reach this summer.

Code.org, a Seattle-based nonprofit whose mission is to establish computer programming in the curriculum of every U.S. school, has incorporated Project GUTS into its national initiative to bring computer science to middle school science classrooms.

Irene Lee, Director of SFI’s Learning Lab and founder of Project GUTS, says her team of educators has customized existing Project GUTS afterschool modules for integration into science classes and started preparing teachers to use them.

“We’ll be offering workshops that prepare teachers from large school districts to imple- ment the modules we wrote,” she says. “That’s how the modules will get disseminated this summer and implemented next school year. Next summer Code.org wants to add more modules and prepare additional teachers in more large school districts.”

Having worked with Lee in the past, Pat Yongspradit, Director of Education at Code.org, says he knew adopting Project GUTS would be a good fit and that SFI’s program is a great model for teaching computer science to young people.

Project GUTS began in 2007 in a hand- ful of Santa Fe-area schools. The program has gradually expanded to include some 21 schools across the state. Project GUTS received national attention last year when the Afterschool Alliance and the Noyce Foundation recognized the program with one of two national Afterschool STEM Impact Awards.

Lee says she believes every child should have the opportunity to create models and run simulations to test ideas and learn about systems, skills she believes should be universal – like problem solving and critical thinking.

“I’m very much a product of public schools, and I’ve seen that there are bright individu- als everywhere,” she says. “Kids deserve a chance, and whereas previous programs fo- cused on finding the ‘best and the brightest,’ I think for many the early development of skills was a matter of exposure and privilege. There are kids all over the world who should have equal access and exposure to educational opportunities. That continually drives me.”

To support Project GUTS, contact Lee at lee@santafe.edu.

The new issue of SFI’s interactive science magazine, the SFI Bulletin, is on line. In our spring 2014 issue, “How Life Got Complex,” SFI External Pro- fessors Jessica Flack and David Krakau- er ask why, and how, many biological systems on Earth have evolved to be ever-more complex, even intelligent.

Existing explanations don’t get us there. As Krakauer writes so eloquently: “The theory of everything is a theory of everything except of those things that theorize.” The issue is available at www.santafe.edu/bulletin.
Creativity is a key ingredient of both science and art, but how much can scientific inquiry tell us about creativity? "Science can study creativity, but creativity is also central to the scientific process; it is useful to understand both directions of this interaction," says SFI Professor and Chair of the Coffee Faculty Jennifer Dunne, who is co-organizing a working group this summer with Bill O’Brien and Sunil Iyengar of the National Endowment for the Arts.

The two-day gathering July 9 and 10, "The Nature of Creativity in the Brain," is the first formal collaboration between SFI and NEA. The group is examining creativity through the lenses of cognitive science, psychology, education, defense, healthcare, the arts, and neuroscience.

There is mounting interest in these themes that spill out across different sectors and populations," says O’Brien. "If we are really trying to understand the brain, what can we learn from the nature of creativity? From an evolutionary standpoint, why is it here? From a psychological standpoint, how does it behave? From the point of view of artists, how does it feel?" The group hopes, through discussion, to ascertain future directions for more focused research into creativity, and to identify questions SFI scientists and other researchers might pursue using computational and other approaches.

"We are looking for different kinds of deep synergies that can come about from integrating art, science, and technology under the broad topic of creativity," says Dunne. "Though SFI is a science institute, we are very broad in terms of studying complex systems, so it is interesting to bring together this amazing, diverse group of scientists and artists.

When the working group concludes, it will post an executive summary of its findings on the SFI and NEA websites.

Statistical mechanics continued from page 1

In May, SFI External Professor Stefan Thurner co-organized an effort to help of two seminal figures in the field — SFI External Professor Constantino Tsallis and SFI Distinguished Fellow Murray Gell-Mann — to revisit their 1988 collaboration and address questions Tsallis says, is the set of assumptions physicists make in conventional statistical mechanics. When studying a gas, for example, the unusual thing to do is nearly ignore the possibility of collisions between particles. Often that assumption works out fine, but it fails, for example, when working with elementary particles in high-energy collisions — or when studying language, for that matter, where like the interactions of subatomic particles, grammar and semantics make some combinations of words more sensible than others.

Tsallis first addressed that problem in 1988 with the first example of what came to be known as generalized or nonextensive statistical mechanics, where nuclear forces, grammatical rules, or other interactions change how the information in a system scales with its size. Gell-Mann was an early proponent of the approach, and by 2002 the pair organized a workshop to see if “Nature likes that idea too,” Tsallis says.

Recent progress on generalized statistical mechanics and related ideas in information theory and machine learning made this the right time for one more workshop, Thurner says. Since the 2002 workshop, concepts that Tsallis and others developed have been applied in information theory, statistical mechanics, and ecology, not to mention physics.

Still, many questions remain. “One recurrent topic of the workshop was the question “to what extent is generalized statistical mechanics the theory behind specific models” in complex systems, Thurner says. In some cases, it may only be a good approximation, while in others, such as path-dependent but still random processes, the theory may turn out to be exact, he says.
ing entanglement of particles. This year, two research teams have added strength to the then-dismissed idea, according to an April 16 article in Quanta magazine.

In the Computer Science Teacher’s Association blog on April 29, SFI Learning Lab Director Irena Lee describes a new SFI-inspired GLUTS’s Girl’s curriculum and encourages readers to form partnerships with social science teachers.

An article in The Epoch Times on April 26 describes how noninvasive satellite monitoring might help improve the chances of survival of “uncontacted” indigenous human groups, citing an April 21 paper in The American Journal of Human Biology co-authored by SFI’s Marcus Hamilton.

RESEARCH NEWS

Dinosaur: Cold-blooded or warm-blooded?

It’s a longstanding puzzle: Were dinosaurs lumbering cold-blooded animals or swift-warmed-blooded creatures? Neither, according to a June 13 paper in Science co-authored by SFI External Professor Brian Enquist. Rather, dinosaurs took a middle path between warm-blooded mammals, or endotherms, and cold-blooded reptiles, or ectotherms. The researchers estimated dinosaur growth rates from fossils, then derived metabolic rates from the growth rates.

Eighteenth-century baby boom, crash offer population lessons

A June 30 paper in PNAS co-authored by SFI Science Board member and External Professor Tim Kohler sketches an 800-year baby boom among Native Americans in the southwestern U.S. starting around 500 A.D., followed by a crash, that Kohler says offers a warning sign to the modern world about population growth. Analysis of human remains from hundreds of archaeological sites enabled the researchers to assemble a detailed chronology of the region’s Neolithic Demographic Transition—a drift from a hunter-gatherer way of life to an agrarian civilization. They find that birth rates in some areas during this period were so high they likely exceeded the highest in the world today. The subsequent depopulation starting in the mid-1100s might have been a result of drought and of the human population reaching the region’s carrying capacity, Kohler suggests.

Aggressive greed’s altruistic side

In many group-living species, high-ranking individuals who bully to get what they want can also display altruistic behavior. For example, a paper in PNAS by SFI researcher Deborah Simonton and colleagues found that “gussyfying”—a term they coined to refer to individuals who dress up to attract mates—serves to establish social connections and provide a fitness advantage to other group members.

Can genotypic networks further human population studies?

SFI External Professor Andreas Wagner is among co-authors of a recent paper in PLOS ONE that explores application of the concept of genotypic networks in studies of human population genetics. Combined with the availability of larger datasets of sequencing data, genotypic networks represent a new approach to the study of human genetic diversity that looks to the whole genome and goes beyond the classical division between selection and neutrality methods, the authors write.

People think about health more on Mondays

A recent analysis of health-related Google searches finds that searches for health topics are far more frequent near the beginning of the week than later in the week—a pattern that might help devise strategies for improved public health. SFI Omidyar Fellow Ben Althouse is a co-author of the study, published April 21 in the American Journal of Preventive Medicine.

Rival science camps find common ground

While the movement toward an evolutionary perspective on human culture has been gaining traction over the past decade, the field of cultural evolution is a divided house.

The disagreements—mainly between two factions—hinge on a working definition of culture itself and how cultural information is transmitted.

An article in The Atlantic on April 17 posits 11 reasons the United Nations should make cities the focus of its sustainable development goals, mentioning SFI research among the evidence.

In a two-part article in Science News on the 20th anniversary of Shor’s algorithm, writer Tom Sherryfinds an SFI meeting in 1994 that he says captured the thoughts of the world’s best quantum thinkers at a key time in that field’s history.

Cities are the greenest possible way to live together, and perhaps the only way we can blunt climate change, according to an April 11 article in The Guardian that cites SFI cities & urbanization research.

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Yoav Kallus
The geometry of matter

The geometry of matter – how different polyhedral units could form substances of various material properties – fascinated Greek philosophers.

Today, nanotechnology’s promise to make substance from scratch confers new import to questions such as “how many regular polyhedra can be packed into a given space?” The answers could lead to new materials that uniquely respond to pressure or reflect light, for example.

Yoav Kallus, a theoretical physicist with a penchant for mathematics, asks just these sorts of questions. As a PhD student at Cornell, Kallus developed an algorithm for finding the densest possible configuration of 3D tetrahedra using a simpler and more elegant repeating unit than any previous attempts.

“I think there are a lot of really interesting questions at the interface of physics and math that not a lot of people are paying attention to,” Kallus says. “It’s important to have a coherent theory for why structures form out of simple rules, why they sometimes fail to form, and how we can encourage them to form in the way we want.”

While at SFI, Kallus will continue his study of ordered and disordered systems and explore how their statistical properties could be applied to more general complex systems.

He plans to join SFI on September 1.

Justin Yeakel
Webs of complexity

Ecologist Justin Yeakel wants to know how the characteristic complexity of food webs emerges from simple behaviors, sometimes over millions of years.

“Modern food webs are complex systems,” Yeakel says. “Where does this complexity come from? Is it a modern food web similar to a paleontological food web, or were paleontological food webs very different?”

Yeakel’s background is in paleoanthropology. While pursuing a PhD at UC Santa Cruz, he reconstructed the diets of mammals from both the modern Serengeti and the Pleistocene mammoth steppe by analyzing ratios of stable isotopes found in their bones.

He joins SFI following a postdoctoral fellowship at Simon Fraser University, where he researched the spatial dynamics of river ecosystems.

“All of these are examples of complex biological systems, describing how biomass flows on a network,” Yeakel says. “You can study how these systems work using network theoretic approaches.”

While at SFI, Yeakel wants to explore how the local constraints on an animal’s behavior and dietary decisions impact the food web as a whole. “I’m interested in exploring the interplay between individual behavior and the larger communities we observe in nature,” he says.

He also looks forward to collaborating with other scientists from diverse fields. “How similar, sometimes, the questions are,” he remarks.

He joined SFI in June.

Caitlin Stern
Why animals come together

In flocks, herds, prides, and human cities, sociality is a powerful phenomenon. Caitlin Stern, a behavioral ecologist, seeks to understand why animal groups form and evolve over time.

“I am fascinated by questions about the evolutionary implications of sociality,” Stern says. She comes to SFI following a postdoctoral fellowship at the University of North Carolina, where she developed a novel mathematical model for the evolution of competition and social group size begun during her PhD studies at Cornell.

Her model differs from previous group-competition models in that it allows individuals to adjust their degrees of competition as they would in nature. “It’s about adding some of the complexity of natural populations to our mathematical models so we can make better predictions about how social behavior evolves,” she says.

After the extra variables were added, Stern’s model showed that larger social groups feature less competition among individuals. This, she says, contradicts dominant views in evolutionary biology, but is supported by some empirical research.

While at SFI, Stern would like to develop more realistic models that incorporate heterogeneity in group size and rates of movement between groups.

“The way SFI allows researchers to interact across disciplinary boundaries will let me use the best approaches in science, not just in my own field,” she says.

She plans to join SFI on September 1.

Vanessa Ferdinand
Cognition and culture

For cognitive scientist Vanessa Ferdinand, bygone expressions such as “mine eyes” and its modern equivalent “my eyes” provide windows into quantifiable structures of thought and culture.

Through language, Ferdinand explores the relationship between human cognition and cultural evolution. For her PhD at the University of Edinburgh, she used an artificial language learning task to model how some words fall out of use in favor of synonyms. The process of eliminating variation from a language results from patterns in our cognitive structure, which is partly shaped by culture and language, she says.

“I am interested very broadly in what is an appropriate framework for understanding cultural evolution,” Ferdinand says. “In a sense, language is discreet: we have the data we can access, digital corpora, and we can calculate the entropy of a synonym set.”

While at SFI, she plans to use information theory to explore the co-adaptation of individual and environment. “When you do cognitive science research and neuroimaging, you see structural reorganization in the brain — different connectivity emerges when you teach someone a new task, like how to juggle,” she explains.

“The structure of these culturally transmitted systems change, like in language,” she notes. “So what I want to do is study these things in parallel to see if we can really understand cause and effect.”

She plans to join SFI sometime this fall.
Laurent Hébert-Dufresne
How social systems grow

New SFI Postdoctoral Fellow Laurent Hébert-Dufresne wants to understand, through the lens of network theory, how social systems expand.

“By looking at the distribution of things like sexual activity or art production, we try to predict how likely the activity is to happen in the future based on our models,” he says.

He recently completed his PhD at Laval University in Quebec, his lifelong home. But he has spent time in New Mexico, collaborating with SFI scientists. He comes to SFI as part of a James S. McDonnell Foundation postdoctoral fellowship in complexity.

He’s looking forward to developing his own project here at SFI, which he hopes will be a long-term study regarding network theory.

“In a recent laboratory experiment, I and my colleagues were surprised to find that fish use “a much more simple and robust” navigation mechanism than they had originally imagined. “The more real systems we look at, the more we find these neat lessons ‘learned’ by evolution,” he says.

At SFI, he hopes to develop more causal and predictive theories by working with increasingly sophisticated datasets. “Now that we’re getting individual trajectory data from video, remote sensing, and tagging technology, we can apply information-theoretic measures to these trajectories to pull out or suggest things like causality,” Berdahl says. “I think this has the potential to reshape the way people understand animal swarms.”

He plans to arrive at SFI September 1.

Cody Ross
Satisfying interests through anthropology

New SFI Postdoctoral Fellow Cody Ross’ research includes everything from evolutionary immunogenomics to cultural anthropology, but it is computer modeling and Bayesian statistics he finds most fascinating. He uses anthropology as a vehicle to satisfy his many interests.

“My dissertation focused on the cultural and evolutionary dynamics of female genital modification—although I’ve worked on a lot of other projects while at UC Davis,” Cody says. “My research is pretty wide-ranging and integrative.” He believes he will feel very much at home within SFI’s community of like-minded thinkers.

Ross says he plans to expand the statistical and modeling side of his research at SFI.

He arrives at SFI in August, and will work with SFI Professor Sam Bowles and Monique Borgerhoff Mulder on a project concerning the evolutionary origins and persistence of wealth inequality, broadly conceived.

Andrew Berdahl
How animals find their way

Physicist-turned-ecologist Andrew Berdahl studies collective behavior, specifically how groups of animals navigate during their annual migrations. He combines computer modeling with empirical data.

In his recent PhD work at Princeton, Berdahl discovered that a salmon’s ability to return to its natal stream depends on the size of the school it travels in: more fish, more accuracy.

“If animals’ abilities to find their way is dependent on group size, there could be population thresholds below which they won’t be able to migrate at all,” Berdahl explains. “So there are ramifications for conservation.”

He joined SFI in June.

Josh Grochow
Computation meets complexity

Where computation meets complexity, expect to find Joshua Grochow. With a background in math and theoretical computer science, Grochow wants to apply rigorous mathematical techniques to real-world complex systems and pursue problems at the frontiers of theoretical computer science.

“I recognize that although I do very theoretical things, there are really important problems today that are not theoretical,” Grochow says. “We have problems of overpopulation and climate change and poverty and global epidemics. I look forward to working with people who work on those topics and bringing some heavy math tools to bear on them.”

Grochow holds a PhD in computer science from the University of Chicago, as well as a master’s degree in computational biology from MIT.

He comes to SFI following a postdoctoral fellowship at the University of Toronto, where he has devoted much of his research to a nascent branch of mathematics called geometric complexity theory, whose tools, he anticipates, will prove useful for studying other complex systems.

“I like to think of even an individual algorithm as a complex system,” Grochow says. “Oftentimes people study complex systems using a computer simulation, so what they’re really looking at is the behavior of an algorithm. In that sense, anything you can ask about computational complexity is a question about complex systems.”

He arrived at SFI in August.
Analysis: Regardless of our city’s size, we all live in ‘villages’

Intuitively, the close community spirit of village living and the crowded bustling of the big city suggest very different qualities of social life. A paper published July 6 in the journal of the Royal Society Interface finds, however, that the social networks of city dwellers are not so different from those of village dwellers.

To examine social relationships of people living in towns and cities in Portugal and the UK, researchers from SFI, the MIT Senseable City Lab, British Telecommunications, and Orange Labs obtained a dataset comprising the majority of landline telephone calls made in the UK during a one-month period in 2005, and another dataset of millions of mobile phone calls in Portugal during a 15-month period in 2006 and 2007. Together, these two datasets represent several billion phone calls.

The researchers then constructed networks of phone interactions for each town in the UK and Portugal, with each individual user represented by a node, and connections between them indicated by a link.

The team’s analyses of the resulting network data revealed that the number of calls made by an individual, as well as his or her total number of connections, depends on the town’s size according to a mathematical relation: the larger the town you live in, the more people you call. Interestingly, this relation is “superlinear,” meaning that as average, as the total number of social interactions will more than double in a predictable way.

The team also found, however, that the group clustering of social circles (the odds that your friends mutually know one another) does not change with city size, regardless of whether you live in the five square-mile town of Lixa in northern Portugal or the bustling capital city of Lisbon.

The findings point to the conclusion that human beings living in small towns and large cities alike instinctively form tight social communities. But if you live in a small community, your social circle is more or less determined by those who live around you, whereas in a large city you have more freedom to select which of the thousands of people around you will constitute your social circle.

“It seems that even in large cities we tend to build a tightly-knit community, or ‘village,’ around ourselves,” says Carlo Ratti, director of the MIT Senseable City Lab. “In a real village, connections might be defined by proximity, while in a large city we can elect a community based on affinity, interest, or sexual preference, for example.”

This points to what is fundamental about a city, says SFI Professor Luis Bettencourt who, along with SFI Distinguished Professor Geoffrey West, leads SFI’s cities and urbanization research team. “People tend to think of cities as buildings, roads, pipes, and so on,” Bettencourt says. “But at a more fundamental level, cities are really about connections. These connections form networks of people and organizations that enable the production of all outcomes of civilization, from modern economies and fast innovation to complex bureaucracies and political institutions.”

That social interactions per person increase with city size begins to explain how so many socioeconomic quantities, from GDP to violent crime, scale superlinearly, he adds. “We had developed theory that predicts the superlinear growth of social connections in the way we observe here, but this is the first time that we can observe this phenomenon directly and explore it in detail.” In a 2013 paper in the journal Science, Bettencourt derived a series of mathematical formulas that describe how cities’ properties vary in relation to their population sizes.

SFI Postdoctoral Fellow Markus Schlöpfer of MIT’s Senseable City Lab, the paper’s corresponding author, said the team’s findings have important implications for the way information and ideas diffuse throughout a city. Ultimately, this may also help researchers understand phenomena such as the prevalence of certain contagious diseases.

“This was an incredible opportunity, made possible by today’s widespread use of mobile communication technologies,” he says. “Data of this type keep getting better and better. It will be extraordinary to use them in the future to see how cities around the world reproduce the patterns we observed for Portugal and the UK, and watch fast-growing cities develop as immense social networks. It throws open lots of possibilities to study the organization and dynamics of entire cities.”

Co-authors of the paper, titled “The scaling of human interactions with city size,” include Schlöpfer, Bettencourt, West, Ratti, Matthias Raschke of Riaschke Software Engineering, Sébastian Grauwin of the Senseable City Lab, Rob Claxton of British Telecommunications, and Zoglbir Smoreda of Orange Labs. The project was developed as part of Ericsson’s “Signature of Humanity” project.
Mathematician Nihat Ay joined SFI’s resident faculty on July 1, 2014. “Nihat brings training in mathematics as well as deep expertise and wide-ranging curiosity to topics at the intersection of information theory, artificial cognition, robustness, and quantitative theory of causality,” says SFI Chair of Faculty Jennifer Dunne. “His ability to formalize fundamental aspects of empirical science is outstanding, and he is deeply committed to complex systems research. As a former SFI postdoc and external faculty member, he has already collaborated with a diverse set of SFI scientists.” Ay will spend three months of the year at SFI and nine months in his current position as the Information Theory of Cognitive Systems group at the Max Planck Institute for Mathematics in the Sciences in Leipzig, Germany.

Recent faculty, board appointments

SFI President Jerry Saltz has approved five-year resident faculty re-appointments for Geoffrey West (full-time, beginning August 1) and Sam Bowles (part-time, began July 1). Seven new external faculty members have been selected. Their three-year appointments began July 1, 2014. They are:

- Simon DeDeo, Assistant Professor, School of Informatics & Computing, Indiana University, and former SFI Research Fellow and Omidyar Fellow
- Ross Hammond, Senior Fellow in economic studies and Director of the Center on Social Dynamics and Policy, Brookings Institution
- Helmut Katzgraber, Associate Professor, physics & astronomy, Texas A&M University
- Mahzarin Banaji, Richard Clarke Cabot Professor of Social Ethics, Harvard University, and former SFI Cowan Professor
- Rob Boyd, Professor, School of Human Evolution and Social Change, Arizona State University, and former SFI Cowan Professor
- Ricardo Hausmann, Director, Center for International Development, Harvard University, and former SFI Cowan Professor
- John Padré, Professor, political science, University of Chicago, and former SFI Research Professor

Two people have been selected to join SFI’s Science Board. Their terms began July 1, 2014. They are:

- Margaret (Molly) Jahn, Discovery Fellow, Wisconsin Institutes for Discovery, Professor, Department of Agronomy and Laboratory of Genetics, Faculty Affiliate, Nelson Institute for Environmental Studies, Center for Sustainability and the Global Environment, University of Wisconsin-Madison, and Chief Scientist, Knowledge Systems for Sustain-ability, U.S. Department of Energy Oak Ridge National Laboratory
- Thomas Lovejoy, University Professor for Environmental Science and Policy, Biodiversity Chair at the Heinz Center for Science, Economics and the Environment, George Mason University.

New ways to think about greenhouse gases

An April 25 paper in Nature Climate Change by SFI External Professor Jessika Transik and MIT collaborator Morgan Edwards notes that past methods of accounting misvalue the relative contributions of methane and carbon dioxide to climate change. A more nuanced view of the long-term effects of methane suggests a second look at policies intended to reduce the climate effects of greenhouse gas emissions.

Ambiguous words probably make communicating easier

As counterintuitive as it may seem, ambiguity in language, including words with multiple meanings, actually makes communicating easier and could be an inevitable consequence of a language’s evolution, according to an SFI working paper by External Professor Ricard Sole and Pompeu Fabra University physicist Luis Seoane, who used computer simulations to evolve vocabulary networks until they reached optimal states. When speakers’ and listeners’ needs were perfectly balanced, the authors note, optional languages evolved that followed Zipf’s Law — some ambiguous words, but mostly terms with single meanings.

Geoglyphs in Peru likely marked cultural event sites

An archaeological site in Peru features mounds and linear geoglyphs likely used to mark the summer solstice and other cultural activities in an ancient society, according to a May 5 PNAS study co-authored by SFI External Professor Charles Stanish.

Climate change will shift malaria to higher elevations

In a March 6 paper in Science, SFI External Professor Mercedes Pascual and collaborators show that malaria creeps to higher elevations during warmer years, suggesting that climate change will bring the mosquito-borne disease to higher, more densely-populated regions. In Africa and South America — and outbreaks likely will be more severe in part because the newly exposed populations in these areas lack protective immunity.

Variable distributions for systems at the edge of chaos

A new paper co-authored by SFI External Professor Miguel Fuentes shows that the distribution of the variables of dynamical systems at the edge of chaos has a very different shape than previously reported. The paper appeared in the European Physical Journal B in February 2014.
People-driven for three decades

The Santa Fe Institute is, above all else, a collection of people – from our visionary founders, to the young scientists who spend formative time here under the guidance of world-class mentors, to the middle school students who experience their first sparks of scientific passion through our educational programs. To understand SFI’s impact, you need look only at the people who have passed through this institution, and what they’ve achieved since then.

Take our Omidyar Fellows, for example. Established by Pam and Pierre Omidyar in 2008, SFI’s Omidyar Fellowship provides some of the world’s brightest young scientists with the intellectual freedom to ask the big questions they’re most passionate about.

Omidyar Fellows have come from disciplines spanning the sciences, and they spend their time here not only advancing their own research interests but also collaborating with peers and mentors on theirs. Omidyar Fellows are here for a relatively short time (up to three years), but they emerge from the experience prepared to take their places among the next generation of complexity thinkers.

Many past Omidyar Fellows have gone on to top positions in major academic institutions around the world. Others are building new tools that apply the lessons of complexity science to critical societal challenges. Caroline Buckee (2007-2010), for example, is at Harvard University’s School of Public Health studying the spread of malaria and gaining important insights with the potential to transform public health. Jessika Traniók (2005-2009) is at MIT evaluating new approaches to adoption of low-carbon energy technologies that help address the challenges of climate change. And Nathan Eagle (2007-2010) has founded Jana, an innovative global company that is developing a mobile platform that taps the expertise of emerging-market consumers while providing much-needed income in the developing world. These are but a few examples demonstrating the power of the Institute and the Omidyar Fellowship experience.

Omidyar Fellows are just one group within our diverse SFI community, built around an unwavering commitment to asking – and seeking to answer – some of mankind’s most pressing questions. As an SFI supporter, you are also part of this unique community, and by backing the Omidyar Fellowships and our other programs, you’re helping ensure that our community and our influence continue to grow – one person at a time.

Best regards,

Nancy Deutsch, Vice President for Advancement

NEW BOOKS BY SFI AUTHORS

People-driven for three decades spanning the sciences, and they spend their intellectual freedom to ask the big questions. SFI’s Omidyar Fellowship provides some of the world’s brightest young scientists with the power of the Institute and the Omidyar Fellowship experience.

Omidyar Fellows are just one group within our diverse SFI community, built around an unwavering commitment to asking – and seeking to answer – some of mankind’s most pressing questions. As an SFI supporter, you are also part of this unique community, and by backing the Omidyar Fellowships and our other programs, you’re helping ensure that our community and our influence continue to grow – one person at a time.

Best regards,

Nancy Deutsch, Vice President for Advancement

**My postdoc was an incubation period. I actively made efforts to be intellectually promiscuous at SFI – becoming enamored with all sorts of ideas, many good and some laughably bad. Ultimately, the exposure to clever people and a diversity of ideas provided the direction I needed to develop a technology capable of instantly putting money into the pockets of 3.48 billion people. Now with the responsibilities and burdens associated with running a company, I do find myself reminiscing about that unique time of responsibility-free idea generation. Are we allowed to reapply?**

SFI COMMUNITY LECTURE - Is time travel possible? Testing the ‘Grandfather Paradox.’ Wednesday, July 16, 7:30 p.m., James A. Little Theater (1060 Cerrillos Road). Time travel is a science fiction staple, inspiring the plots of countless books, movies, and Star Trek episodes. But while basic physics allows for the possibility of moving through time, practical concerns like the “Grandfather Paradox” – in which a traveler jumps back in time, kills his grandfather, and therefore prevents his own existence – seem to stand in the way. Self-described “quantum mechanic” and SFI External Professor Sabre Kais explores the latest research findings, applications, and directions in quantum computation and quantum information that are related to or intersect with key topics in chemical physics. Expert reviews address both what chemistry can contribute to quantum information and what quantum information can contribute to the study of chemical systems, surveying both theoretical and experimental quantum information research within the field of chemical physics.

Starting Up Silicon Valley: How ROLM Became a Cultural Icon and Fortune 500 Company (Emerald, 2014) by Katherine Maxfield tells the story of how ROLM Corporation went from a four-person startup operation headquartered in a prune-drying shed to one of Silicon Valley’s most important companies – and set the benchmark for a company culture that was very different from that of corporate America.

NEW BOOKS BY SFI AUTHORS

Quantum Information and Computation for Chemistry: Advances in Chemical Physics Volume 154 (John Wiley & Sons, 2014) edited by SFI External Professor Sabre Kais explores the latest research findings, applications, and directions in quantum computation and quantum information that are related to or intersect with key topics in chemical physics. Expert reviews address both what chemistry can contribute to quantum information and what quantum information can contribute to the study of chemical systems, surveying both theoretical and experimental quantum information research within the field of chemical physics.

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CAMPAIGN NEWS – SFI’s Omidyar Challenge

Through the SFI Omidyar fellowship, we are identifying the most promising early career scholars working on important problems and providing them with the skills, opportunities, and resources to become tomorrow’s leaders.

Gifts supporting the Omidyar Fellowship are matched dollar for dollar by Pierre and Pam Omidyar through the Santa Fe Institute’s Omidyar Challenge Campaign. By contributing to the Omidyar Challenge, you double your giving power.

We still have nearly $70,000 to raise by the end of 2014, and almost $800,000 between now and the end of the Campaign to meet the challenge established by the Omidyars.

To date, SFI’s 30th anniversary campaign – New Science, New Horizons. – has raised more than $12 million toward our $30 million goal.

Other opportunities to support SFI include:

- President’s Circle Member: $1,000 per year – Annual giving club with special programing for members.
- Science on Screen series sponsorships: $2,500 for shared recognition during the 2014/2015 series.
- Education program scholarships: $3,500 will fully fund a deserving complexity scholar for 2015.

There also are opportunities to establish a permanent legacy, from named buildings and open spaces to endowed funds supporting science, education, and outreach. We welcome multi-year commitments and gifts of appreciated assets to fund your chosen program. Contact the Office of Advancement at 505.946.8718 to discuss how you can help us attain new horizons.

SFI’s 2014 Community Lectures are made possible through the generous support of Thornburg Investment Management. Lectures are free and open to the public, but seating is limited. To watch a lecture as it happens, visit SFI’s YouTube page; participate in the discussion live on Twitter at #SFI live.