SANTA FE INSTITUTE

Update

July/August 2010

RESEARCH NEWS

Grant furthers research on science of cities, companies

Tokyo at night (Image: istockphoto.com/George Clerk)

The Rockefeller Foundation has awarded an SFI research team a $230,000 grant to develop their studies of the quantitative properties and behavior of cities and companies.

The work builds on earlier research by SFI External Professor Luis Bettencourt and his colleagues that found that cities change in predictable ways as they grow. Per capita figures for infrastructure, such as miles of roads and electrical cable, decrease as cities get larger, for example, whereas figures related to social productivity, such as income, patents, and crime, increase with city size.

A team led by SFI Distinguished Professor Geoffrey West is continuing the Institute's efforts to describe and explain these scaling patterns. The researchers are investigating why some cities outperform others of the same size and extending their studies to companies – which, as the team is beginning to show, also have properties that scale predictably as companies grow. Geoffrey hopes the Rockefeller support will lead to a conceptual umbrella for a wide range of research into institutions past and present, from hunter-gatherer groups and ancient cities to high-tech companies and online societies. The work also might suggest policies to make institutions and communities more robust and sustainable in the face of climate change, population growth, and other challenges.

As a first step towards such a project, the Institute is holding a meeting in Bellagio, Italy, in July to bring together researchers from a number of fields who are working on various aspects of urban life. ■

RESEARCH NEWS

Are we flying the economy by the seat of our pants?

Presumably our elected officials are using sophisticated models to manage the economy, right?

Wrong. The problem is they don't have reliable models to turn to. Instead, they in large part draw on common sense and loose analogies with past crises, says SFI Professor Doyne Farmer. "The leaders of the world are flying the economy by the seat of their pants," he says.

Doyne and SFI External Professor Rob Axtell of George Mason University say they have a better way. They want to build an agent-based model of the entire US economy.

Traditional econometric models use past data to forecast future trends, so they fall far short when facing an unprecedented crisis. General equilibrium models, the other kind of traditional model, start by assuming a perfect, static world in which crises don't happen.

Agent-based models avoid these pitfalls because they don't make assumptions about how the whole economy behaves, instead building that behavior from the actions of individual actors. "It'll be a huge undertaking," Doyne says, "but the stakes are enormous."

Doyne and Rob convened a late-June NSF-sponsored conference on the topic in Washington, D.C. ■

(Image: istockphoto.com/Alex Nikada)

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RESEARCH NEWS

Why we fight: Explaining conflict

Three SFI researchers have developed a new way to examine the criteria we use to decide whether to fight.

Quantitative studies of conflict traditionally rely on game theory, which seeks to find strategies that maximize payoffs for individuals making decisions in uncertain conditions. Although game theory has been useful for determining which of a predefined set of strategies – for example, "tit for tat" – will be advantageous to the players given certain assumptions, it has not proven as useful for determining what the natural strategy set is, or which strategies individuals are using when conditions are in flux.

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RESEARCH NEWS

Reckoning with multiple reasoners

Managing such complex systems as the stock market or a battlefield is particularly challenging because each agent in the system chooses how to behave, not only by following the rules of the game but also by predicting how all the other agents around them will behave and adjusting their own actions accordingly.

"Decentralized Control in a System of Strategic Actors," an August 16-18 workshop at SFI, will draw on experts from a number of fields to explore ways to manage multiple-player systems.

"The agents in the system are all using 'I know what you know what I know' kinds of reasoning, and we have to try to control behavior starting from that," says NASA senior computer scientist David Wolpert, who is collaborating with SFI Professor Eric Smith to organize the conference.

Creating something that can take so many factors into account with as little error as possible is a worthwhile undertaking. Beyond the stock market, he says, it could have broad uses for the management of complex systems like the power grid, air traffic, and national economies. ■

LIT BITS

Mapping the similarity space of paintings: Image statistics and visual perception; Graham, D.J.; Friedenberg, J.D.; **Dan Rockmore**; Field, D.J.; *Visual Cognition* 18 (4), 2010

Biological stoichiometry of plant production: Metabolism, scaling, and ecological response to global change; Elser, J.J.; Fagan, W.F.; Kerkhoff, A.J.; Swenson, N.G.; **Brian Enquist**; *New Phytologist* 186 (3), 2010

Record-breaking earthquake intervals in a global catalogue and an aftershock sequence; Yoder, M.R.; Turcotte, D.L.; **John Rundle**; *Nonlinear Processes in Geophysics* 17 (2), 2010

On nestedness in ecological networks; Joppa, L.N.; Montoya, J.M.; **Ricard Solé**; Sanderson, J.; Pimm, S.L.; *Evolutionary Ecology Research* 12 (1), January 2010

Specialization can drive the evolution of modularity; Espinosa-Soto, C.; **Andreas Wagner**; *PLOS Computational Biology* 6 (3), March 2010

Mosaic vaccines elicit CD8(+) T lymphocyte responses that confer enhanced immune coverage of diverse HIV strains in monkeys; Santra, S.; Liao, H.X.; Zhang, R.J.; Muldoon, M.; Watson, S.; Fischer, W.; Theiler, J.; Szinger, J.; Balachandran, H.; Buzby, A.; Quinn, D.; Parks, R.J.; Tsao, C.Y.; Carville, A.; Mansfield, K.G.; Pavlakis, G.N.; Felber, B.K.; Haynes, B.F.; **Bette Korber**; Letvin, N.L.; *Nature Medicine* 16 (3), March 2010

Reply to Adams: Multi-dimensional edge inference (letter); **Nathan Eagle; Aaron Clauset**; Pentland, A.; Lazer, D.; *Proceedings of the National Academy of Sciences* 107 (9), March 2010

Approximate methods for state-space models; Koyama, S.; Perez-Bolde, L.C.; **Cosma Shalizi**; Kass, R.E.; *Journal of the American Statistical Association* 105 (489), March 2010

Measurement invariance, entropy, and probability; **Steven Frank; D. Eric Smith**; *Entropy* 12 (3), March 2010

Generalization of symmetric alpha-stable Leacutevy distributions for q > 1; Umarov, S.; **Constantino Tsallis; Murray Gell-Mann**; Steinberg, S.; *Journal of Mathematical Physics* 51 (3), March 2010

Finding conjugate stabilizer subgroups in PSL(2; q) and related groups; Denney, A.; **Cris Moore**; Russell, A.; *Quantum Information & Computation* 10 (3-4), March 2010

The strategic calculus of terrorism: Substitution and competition in the Israel-Palestine conflict; **Aaron Clauset**; Heger, L.; Young, M.; Gleditsch, K.S.; *Cooperation and Conflict* 45 (1), March 2010

The primary transcriptome of the major human pathogen Helicobacter pylori; Sharma, C.M.; Hoffmann, S.; Darfeuille, F.; Reignier, J.; Findeiss, S.; Sittka, A.; Chabas, S.; Reiche, K.; Hackermuller, J.; Reinhardt, R.; **Peter Stadler**; Vogel, J.; *Nature* 464 (7286), March 11, 2010

Physics and complexity; **David Sherrington**; *Philosophical Transactions of the Royal Society A – Mathematical Physical & Engineering Sciences* 368 (1914), March 13, 2010

Identifying the roles of race-based choice and chance in high school friendship network formation; Currarini, S.; **Matthew Jackson**; Pin, P.; *Proceedings of the National Academy of Sciences* 107 (11), March 16, 2010

PEOPLE

Awards & honors

SFI External Professor Simon Levin, Moffett Professor of Biology at Princeton University, has received the Eminent Ecologist Award for 2010 from the Ecological Society of America, ESA's top award.

SFI Professor Libby Wood, a political science professor at Yale University, has been named a Fellow of the American Academy of Arts and Sciences (www.amacad.org).

Archaeologist and historian Sander van der Leeuw, an SFI external professor, has been appointed dean of Arizona State University's School of Sustainability, part of ASU's new Global Institute of Sustainability. ■

SFI awards go to eight students, one teacher

The Institute has honored eight Santa Fe-area high school seniors and one teacher with its annual Awards for Scientific Excellence. The prize is co-sponsored by the Santa Fe Alliance for Science.

The winning teacher for 2010 is Anita Gerlach, a longtime science teacher and science club sponsor at Santa Fe High School. Her former students have won several national science and math competitions.

Names of the winning students can be found at http://www.santafe.edu/news/.

During the May award ceremony at SFI, Omidyar Fellow Jeremy van Cleve, a former award winner and 1999 graduate of Santa Fe High, gave a keynote talk in which he stressed the importance of "thinking about problems in a big way." Alliance for Science President Bob Eisenstein also spoke.

SFI's Prize for Scientific Excellence was established in 1996 at the suggestion of SFI Distinguished Fellow and Trustee Murray Gell-Mann. The teacher award was begun in 2005. ■

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The *SFI Update* is published bi-monthly by the Institute to keep its community informed. Please send comments or questions to John German at *jdg@santafe.edu*.

The Institute is on the web at **www.santafe.edu.**

RESEARCH NEWS

Coordinated punishment benefits us all

Ganging up on slackers is good for the group. That's the conclusion, in part, of a recent study by SFI External Professors Robert Boyd (an anthropologist at UCLA) and Herb Gintis (an economist at Central European University), and SFI Professor Sam Bowles.

Punishment of the thefts at Masaniello's time. Painting by Micco Spadaro. (Image: Wiki Commons)

Humans are a cooperative species. In even the simplest societies, unrelated people cooperate in large groups. But every group has its mooches – those who take advantage of the cooperation of others and do nothing. Every group also has those individuals who are happy to punish free loaders by shunning, gossiping about, ostracizing, or (in some societies) even executing them.

Recent theoretical work suggests that because groups with more punishers can sustain more cooperation, they are more likely to survive crises and prevail in conflicts.

Current models of the evolution of cooperation assume that individuals decide on their own whether they punish a free rider, and do so no matter how many other punishers are around. These models, though, cannot explain the evolutionary emergence of punishment, Sam says, because when individuals who punish are rare, they are outnumbered by their targets and often they – not their targets – suffer heavy costs. This makes it nearly impossible for lone punishers to get started.

Research by ethnographers Chris Boehm (University of Southern California) and Polly Wiessner (University of Utah) – frequent participants in SFI's Behavioral Sciences Program – shows that in foraging societies similar to those of our ancestors, the punishers' rule of thumb is "don't go it alone."

To incorporate this aspect of real world social control the SFI researchers, in their recently published mathematical model, allowed punishers to signal their willingness to punish and to do so only when a "quorum" of ready punishers is present. They show that coordinated punishers don't go out on a limb when there are only a few of them in a group.

"Our model shows that punishment can proliferate when rare, and when it is common it increases the group's average fitness, helping to explain why both punishment and cooperative norms could have evolved," Sam says.

The work was published in the April 30 issue of *Science*. ■

RESEARCH NEWS

Workshop examines surprising results of interacting networks

When you think about it, a package's arrival on your front porch is no simple matter.

Your click on the World Wide Web (a network) passed through the physical internet (a network) that is powered by the power grid (a network), which itself relies on its own private communications network. Finally, your package traveled through the postal network to come to your door.

Had any of these networks broken down, your delivery could never have happened.

"We depend on interacting networks every day, and we're hugely susceptible if they fail," says SFI External Professor Raissa D'Souza, who organized a conference on the topic in June at SFI.

Despite our dependence on interacting networks, their emergent properties are hardly understood, even though the science of networks has come of age over the last decade or so, she says.

The gathering brought together network theorists and practitioners to develop new tools to identify and understand the unforeseen consequences of these interactions.

"We are developing theoretical techniques to model interdependent networks," she says. "Bringing theorists and practitioners together will help ensure the models are realistic." ■

RESEARCH NEWS

Phone diversity: It's not just who you know, but who *we* know

Employing the mathematics of network analysis, a team including SFI Omidyar Fellow Nathan Eagle has found that communities in which people have more diverse social networks, at least as gauged by their phone calls, also tend to be more prosperous.

Previous research has suggested that individuals with richer social circles tend to find jobs more easily, earn higher salaries, and have more success as entrepreneurs. But is there a similar link between the diversity of a townspeople's social connections and the prosperity of the whole community?

To find the answer the researchers combined data from two sources: a government index of relative prosperity of 32,482 communities in the U.K., and phone records of most cell phone and landline activity in the U.K. for August 2005. They then developed a vast mathematical network, with each of the 65 million nodes denoting a phone and each of the 368 million edges denoting phone contact. They calculated two measures of diversity for each phone.

Their data show that those communities registering more social diversity also tended to *have* more.

Nathan notes that the researchers cannot tell whether social diversity promotes prosperity or the other way around. "The causality probably works both ways," he says.

He hopes the results will influence public policy officials to consider not just giving aid to poor communities but also supporting ways to help people foster relationships outside their own communities. ■

LIT BITS (cont.)

Genotype networks in metabolic reaction spaces; Samal, A.; Rodrigues, J.F.M.; **Jüergen Jost**; Martin, O.C.; **Andreas Wagner**; *BMC Systems Biology* 4, March 19, 2010

The role of recombination in the emergence of a complex and dynamic HIV epidemic; Zhang, M.; Foley, B.; Schultz, A.K.; Macke, J.P.; Bulla, I.; Stanke, M.; Morgensterm, B.; **Bette Korber**; Leitner, T.; *Retrovirology* 7, March 23, 2010

Evolutionary establishment of moral and double moral standards through spatial interactions; **Dirk Helbing**; Szolnoki, A.; Perc, M.; Szabo, G.; *PLOS Computational Biology* 6 (4), April 2010

Performance of modularity maximization in practical contexts; Good, B.H.; de Montjoye, Y.A.; **Aaron Clauset**; *Physical Review* E 81 (4), April 2010

The walking behaviour of pedestrian social groups and its impact on crowd dynamics; Moussaid, M.; Perozo, N.; Garnier, S.; **Dirk Helbing**; Theraulaz, G.; *PLOS One* 5 (3), April 7, 2010

Robust dynamical pattern formation from a multifunctional minimal genetic circuit; Rodrigo, G.; Carrera, J.; **Santiago Elena**; Jaramillo, A.; *BMC Systems Biology* 4, April 22, 2010

Challenges in experimental data integration within genome-scale metabolic models; Bourguignon, P.Y.; Samal, A.; Kepes, F.; **Jüergen Jost**; Martin, O.C.; *Algorithms for Molecular Biology* 5, April 22, 2010

Coordinated punishment of defectors sustains cooperation and can proliferate when rare; **Robert Boyd; Herbert Gintis; Sam Bowles**; *Science* 328 (5978), April 30, 2010

The bootstrap; **Cosma Shalizi**; *American Scientist* 98 (3), May-June 2010

Inductive game theory and the dynamics of animal conflict; **Simon DeDeo; David Krakauer; Jessica Flack**; *PLOS Computational Biology* 6 (5), May 2010

High multiplicity infection by HIV-1 in men who have sex with men; Li, H.; Bar, K.J.; Wang, S.Y.; Decker, J.M.; Chen, Y.L.; Sun, C.X.; Salazar-Gonzalez, J.F.; Salazar, M.G.; Learn, G.H.; Morgan, C.J.; Schumacher, J.E.; Hraber, P.; Giorgi, E.E.; **Tanmoy Bhattacharya; Bette Korber; Alan Perelson**; Eron, J.J.; Cohen, M.S.; Hicks, C.B.; Haynes, B.F.; Markowitz, M.; Keele, B.F.; Hahn, B.H.; Shaw, G.M.; *PLOS Pathogens* 6 (5), May 2010

Evolutionary innovation and stability in animal gene networks; Davidson, E.H.; **Doug Erwin**; *Journal of Experimental Zoology Part B – Molecular and Developmental Evolution* 314B (3), May 15, 2010

Defector-accelerated cooperativeness and punishment in public goods games with mutations; **Dirk Helbing**; Szolnoki, A.; Perc, M.; Szabo, G.; *Physical Review* E 81 (5 pt 2), May 21, 2010

Autosomal and X-linked single nucleotide polymorphisms reveal a steep Asian-Melanesian ancestry cline in eastern Indonesia and a sex bias in admixture rates; Cox, M.P.; Karafet, T.M.; **Steve Lansing**; Sudoyo, H.; Hammer, M.F.; *Proceedings of the Royal Society B – Biological Sciences* 277 (1687), May 22, 2010

HIV classification using the coalescent theory; Bulla, I.; Schultz, A.K.; Schreiber, F.; Zhang, M.; Leitner, T.; **Bette Korber**; Morgenstern, B.; Stanke, M.; *Bioinformatics* 26 (11), June 1, 2010

Empirical study of the tails of mutual fund size; Schwarzkopf, Y.; **J. Doyne Farmer**; *Physical Review* E 81 (6 pt 2), June 18, 2010

PEOPLE

Four researchers to join six current Omidyar Fellows

The Institute has named four new Omidyar Fellows. They will join the six current Omidyar Fellows now at SFI. The 2010 cohort of four was selected from more than 200 applicants.

A gift from eBay Founder Pierre Omidyar in 2008 established the Omidyar Fellowship, which aims to attract to SFI early-career scholars from the social, physical, and natural sciences. Omidyar Fellows spend two to three years at SFI as postdoctoral fellows, delving into the major questions facing science and society using a multidisciplinary, systems-thinking approach.

The 2010 Omidyar Fellows are:

Rogier Braakman holds a PhD from Caltech on interstellar chemistry. For the last year he has been an SFI program postdoc working with SFI faculty on the physics of chemical reaction networks and the evolution of autotrophic metabolism. He plans to contribute to the Institute's studies of the origins of life and the evolution of metabolism, as well as general principles of complex systems.

Anne Kandler holds a PhD in applied mathematics from the Chemnitz University of Technology in Germany. She currently is a postdoc in the AHRC Centre for the Evolution of Cultural Diversity at University College London. She plans to pursue a modeling framework to study the dynamics of competition between, and associated evolution within, languages under various environmental and social circumstances.

James O'Dwyer holds a PhD in theoretical physics from the University of Cambridge. He currently is a postdoc in SFI External Professor Jessica Green's lab at the University of Oregon. Starting with quantum field theory, he is developing a many-body field theory approach to addressing foundational questions in ecology such as how stochastic processes at the smallest scales feed into large-scale phenomena.

Scott Ortman, current director of research at the Crow Canyon Archaeological Center in southern Colorado, holds a PhD in anthropology from Arizona State University. His research on prehispanic Pueblo societies unifies the traditional subfields of anthropology. At SFI he plans to develop a rigorous way of isolating conceptual imagery, model its effects on group-level patterns in decision-making and behavior, and test the extent to which this imagery exerts recognizable effects at large spatial and temporal scales. ■

PEOPLE

'Quantum mechanic' Seth Lloyd is SFI's second Miller Scholar

Self-described "quantum mechanic" Seth Lloyd, a professor of mechanical engineering at MIT and an SFI external professor, is the Institute's second Miller Scholar. He will be in residence at the Cowan campus from July 19 to September 1.

Former Institute Board Chair Bill Miller is underwriting the Miller Scholars program to bring to SFI high-profile senior academics whose research spans the physical sciences, social sciences, and humanities. The goal is to catalyze scientific interactions and crystallize ongoing research activities at SFI. Daniel Dennett, renowned philosopher of science, consciousness, and evolutionary theory, was the first Miller Scholar this spring.

Seth's research centers on the interplay of information with complex systems, especially quantum systems. He has made contributions to the field of quantum computation and proposed a design for a quantum computer.

In his book "Programming the Universe" he contends that the universe itself is one big quantum computer producing what we see around us, and ourselves, as it runs a cosmic program. Once we understand the laws of physics completely, he says, we will be able to use small-scale quantum computing to understand the universe completely as well.

He is principal investigator at the MIT Research Laboratory of Electronics and directs the Center for Extreme Quantum Information Theory (xQIT) at MIT.

More about Seth is available at http://en.wikipedia.org/wiki/Seth_Lloyd. ■

Trustee John Chisholm a pioneer in online marketing research

John Chisholm has been named to the Institute's Board of Trustees. His three-year appointment began July 1.

A pioneer in online marketing research, John has three decades of experience as a general manager and entrepreneur. In 1997 he founded and for ten years served as CEO and chairman of CustomerSat (acquired by MarketTools), a leading provider in enterprise feedback management.

In 1992 he founded and for five years served as CEO and chairman of Decisive Tech (now part of Google), publisher of the first desktop and client-server software for online surveys. Earlier he worked at HP, Xerox, and Grid.

He serves on numerous boards and development committees, holds degrees in electrical engineering and computer science, and has an MBA from Harvard. An avid mountain climber, he has summited Mts. Rainier, Shasta, Whitney, and St. Helens and climbed live volcanoes in Chile and Indonesia.

More information about John is available at www.johndchisholm.com.

More trustee news

Two trustees have rotated back onto the SFI Board of Trustees after serving one-year mandatory hiatuses following previous three-year terms.

- Michael Mauboussin (term begins November 1), chief investment strategist, Legg Mason Capital Management
- Bill Sick, chairman and CEO, Business Resources International ■

Science Board, steering committee, and faculty appointments

SFI's Science Board has elected two new co-chairs (three-year terms began July 1):

- **Marcus Feldman**, Wohlford Professor, biological sciences, Stanford University
- **Stephanie Forrest**, professor & department chair, computer science, University of New Mexico

The Institute has named three new members to its Science Board (three-year terms began July 1):

- **Derek Smith**, professor, infectious disease informatics, University of Cambridge
- **Geoffrey West**, distinguished professor and past president, SFI
- **Peter Wolynes**, Francis H. Crick Chair in physical sciences and professor of physics, UC San Diego

Walter Fontana has begun a three-year term on SFI's Science Steering Committee. Walter is a professor of systems biology at Harvard Medical School.

Jennifer Dunne, formerly an SFI research professor, has been appointed to a five-year term as an SFI professor. Jennifer is co-director of the Pacific Ecoinformatics and Computational Ecology Lab in Berkeley, California.

SFI has selected nine new members to its external faculty (three-year terms began July 1):

- **Aviv Bergman**, professor and chair, Department of Systems & Computational Biology, Department of Pathology, Albert Einstein College of Medicine
- **David Campbell**, provost, Boston University
- **Linda Cordell**, senior scholar, School for Advanced Research
- **Steven Frank**, professor, ecology and evolutionary biology, UC Irvine
- **John Harte**, professor, environmental science, policy, and management, UC Berkeley
- **Simon Levin**, Moffett Professor of Biology, Princeton University
- **Lord (Robert) May** of Oxford, professor, zoology, Oxford University
- **Van Savage**, assistant professor, Department of Systems Biology, UCLA School of Medicine
- **Wojciech Zurek**, laboratory fellow, Theory Division, Los Alamos National Laboratory ■

PEOPLE

Four new postdoctoral fellows join Institute community

SFI has selected four new postdoctoral fellows. Program postdocs collaborate with SFI faculty members on current research.

Marcus Hamilton holds a PhD in anthropology from the University of New Mexico. His research centers on the structure and dynamics of human social organization from a macroecological perspective. Marcus will work with SFI Distinguished Professor Geoffrey West and External Professor Luis Bettencourt.

HyeJin Youn is a PhD candidate in statistical physics and complex systems at the Korea Advanced Institute of Science and Technology. Her work focuses on the quantitative assessment of human behaviors in traffic networks, the structure of human populations and linguistic semantic space, and development of theory and model-building of cities and corporations. She will work with SFI Distinguished Professor Geoffrey West and External Professor Luis Bettencourt.

Fabio Caccioli is a PhD candidate in statistical physics at the International School for Advanced Studies (SISSA), Italy. His research focuses on interdisciplinary applications of statistical mechanics, statistical physics of interacting agent systems, complex networks, and non-equilibrium statistical mechanics. He will work with SFI Professor J. Doyne Farmer.

Bryan Daniels holds a PhD in physics from Cornell University. His work centers on simulation of supercoiled DNA, statistical analysis of biological models with unknown parameters, analysis of extreme value statistics in fracture, and models to predict the behavior of biological networks. He will work with SFI Professor Jessica Flack and Faculty Chair David Krakauer. ■

BUSINESS NETWORK NEWS

SFI, New America explore conflict

How might scientists, with their attention to measurement and general principles, contribute to better management of human conflict in the policy arena, in which the lessons of near-past experiences often dominate? A small group of policy analysts and scientists met May 19 to address this question.

Terra Cotta warriors of Qin Shi Huang, first emperor of China, Shaanxi province, China.
(Image: istockphoto.com/Simon Podgorsek)

SFI's Business Network and the New America Foundation co-organized the event at the urging of former SFI postdoc Eric Bonabeau, founder, CEO, and chief scientific officer at Icosystem, a Business Network member. The meeting was held in Washington, D.C., at New America's headquarters. New America nurtures policy ideas to address national challenges.

SFI VP Chris Wood, who leads the Business Network, says the meeting was an exploration of commonalities and differences between scientific and policy approaches to understanding and managing conflict.

Three SFI scientists – Professor Jessica Flack, Omidyar Fellow Aaron Clauset, and External Professor Dan Rockmore – presented their conflict-related work, each followed by a panel discussion with New America fellows and staff. The session ended with a broad discussion of the applicability of complexity science approaches to the management of global conflict.

Videos of the presentations and discussions are available at www.santafe.edu/event/detail/business-network/145/

"We are grateful to New America and its president, Steve Coll, for a very productive meeting," Chris says. "I look forward to further explorations." ■

> *Why we fight* continued from page 1

Game theoretic models also are not practical for studying strategies involving multiple players interacting simultaneously.

Omidyar Fellow Simon DeDeo, SFI Professor Jessica Flack, and Faculty Chair David Krakauer developed the new method, which they call Inductive Game Theory, and applied it to a series of fights gathered during 160 days of field observations of pigtailed macaques at the Yerkes National Primate Research Center.

What they found, David says, is that fights are not explained by rogue actors or single aggressive individuals, but by complex interactions among groups of three or more, and the decision to fight is very much dependent on memory about what occurred in previous conflicts.

"These results suggest that individual agency has been over-emphasized in social evolution," says Jessica. "We need to re-examine the idea that a single individual or nation can cause turbulent periods in history, and consider the possibility that what predicts long periods of conflict is how we respond to the actions of our friends and enemies in their conflicts."

"This new empirically-grounded approach to conflict is a step towards designing better methods for conflict prediction, management, and control," she says.

The work appeared in *PLOS Computational Biology* on May 13. ■

SFI IN THE NEWS

Forbes on May 27 mentioned External Professor W. Brian Arthur's book "The Nature of Technology" in an article about innovation.
www.forbes.com/2010/05/26/ipad-apple-intel-intelligent-technology-arthur.html?boxes=financechannelforbes

On May 28 *Medical News Today* mentioned work by a research team including External Professor Mercedes Pascual to understand the cyclical reemergence of seasonal flu viruses each year.
www.medicalnewstoday.com/articles/190182.php

The May 30 *Solutions Journal* covered Omidyar Fellow Nathan Eagle's efforts to put nearly 4 billion cell phone users in the developing world to work via their phones.
www.thesolutionsjournal.com/node/623

Distinguished Professor Geoffrey West is interviewed in the June 1 *Alliance* magazine on scaling relationships scientists are finding in a range of systems, from biological systems to cities and companies.
www.alliancemagazine.org/node/3321

MSN.com Money on June 4 reviewed a paper co-authored by External Professor John Geanakoplos that argues that credit cards contribute to inflation.
http://articles.moneycentral.msn.com/Banking/CreditCardSmarts/weston-do-credit-cards-hurt-the-economy.aspx

A June 21 *New Scientist* article notes recent research showing that chimps wage war for territorial acquisition. The article quotes SFI Professor Sam Bowles, who points out that more altruistic groups tend to fare better than less altruistic groups over time. A June 21 *New York Times* article covering the research also quotes Sam.
www.newscientist.com/article/dn19064-chimpanzees-kill-to-win-new-territory.html

www.nytimes.com/2010/06/22/science/22chimp.html

Lectures: Terrorism, climate, bias, & the heart

SFI Omidyar Fellow Aaron Clauset spoke to some 400 Santa Feans in a June 16 public lecture. He explored surprising regularities about world terrorism that shed light on the likelihood of future attacks, the differences between secular and religious terrorism, how terrorist groups live and die, and whether terrorism is getting worse. The lecture was underwritten by Los Alamos National Bank and the Peters Family Art Foundation.

Dennis Meadows, co-author of the 1972 report *Limits to Growth*, on July 13 discussed the inevitability of societal effects of climate change, recent research on future growth limits, and ways for society to adapt. The lecture was underwritten by Los Alamos National Bank and the Peters Family Art Foundation.

Mahzarin Banaji, a professor of Social Ethics at Harvard University, on July 14 described the human mind's automatic beliefs about gender, age, class, race/ethnicity, sexuality, nationality, and religion and why well-intentioned people and institutions behave in ways that deviate from their own stated intentions. The lecture was underwritten by Los Alamos National Bank and the Peters Family Art Foundation. ■

Upcoming Public Lecture

August 18, "Secrets of the Heart: The Electrocardiogram, Complex Systems Science, and Fundamental Laws of Biology" - SFI External Professor Tim Buchman, Emory University School of Medicine, will show how the 75-year-old ECG is still giving up its secrets. He will turn to complex systems science for hidden structure within the ECG's signals and ways the ECG might point towards fundamental laws of biology. Underwritten by Los Alamos National Bank and Maureen Mestas Abrams, Prudential of Santa Fe. **The lecture is at 7:30 p.m. at the James A. Little Theater, 1060 Cerrillos Road, in Santa Fe. Admission is free, but seating is limited.**

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