SANTA FE INSTITUTE

Update

September 2008

RESEARCH NEWS

Lectures: Human cooperation beyond self interest

Self interest doesn't fully explain human cooperation. According to recent research, genuine altruism could have evolved among humans through a process of intergroup competition in which groups with more altruists won. (Image ©iStockphoto.com/Kendall Griffin)

Many animals cooperate – to hunt prey or defend territory, for instance – but humans alone cooperate in large numbers beyond the immediate family. Self interest, the mantra of biologists and economists alike, doesn't fully explain human cooperation.

Two Institute researchers, SFI Professor Sam Bowles and External Professor Herbert Gintis, have developed an alternative explanation of how humans evolved into such a highly cooperative species.

"We found compelling evidence that genuine altruism – morality, generosity, and civic-minded behavior – could have evolved among humans through a process

of intergroup competition in which groups with more altruists won," says Sam. "Until recently, many biologists believed this was impossible."

Sam will present these findings in a three-part series of Ulam Lectures, titled "A Co-operative Species: How We Got to Be Both Nasty and Nice," on Sept. 16-18. The talks will summarize the researchers' forthcoming book, *A Cooperative Species: Human Reciprocity and Its Evolution*.

Their work has wide-ranging implications, especially for economists and policymakers whose models often neglect morality and altruistic behavior, Sam says. The findings

could suggest ways to revise policies and institutions that mostly try to harness self interest for the public good.

"Sometimes these policies destroy altruistic motivations," he says.

Sam's research is supported by an endowment to the Institute provided by George Cowan, as well as funding from the NSF and other sources. The talks are part of a continuing lecture series dedicated to the memory of the great Polish mathematician Stanislaw Ulam, who died in 1984. Ulam is known for his contributions to a wide range of disciplines including number theory, set theory, and theoretical biology. ■

RESEARCH NEWS

Theorem: Taxing behaviors that harm others benefits all

A new economic theorem may provide an argument for taxation that even tax minimalists could embrace.

The theorem shows how a broad package of taxes levied expressly on consumer choices having significant negative externalities (e.g., choices that impose cost and burdens on others) ends up benefiting everyone in society, and all without the coercive confiscation and paternalism that make taxation a four-letter word for some.

(Image ©iStockphoto.com/Tony Campbell)

Externality-laden behaviors include public smoking, which harms others' health; driving during peak rush hour, which worsens congestion; and building homes on flood plains, where taxpayer-funded rescue is sure to be needed eventually.

"An externality is a violation of somebody else's property rights," says SFI External Professor and Yale economist John Geanakoplos, the theorem's lead author. "Paying a tax on it is just like paying any other market price:

RESEARCH NEWS

Al Gore cites SFI research on NBC's Meet the Press

SFI External Professor Jim Crutchfield got a surprise recently while watching Tom Brokaw interview Nobel Peace Prize winner and former Vice President Al Gore on NBC's Meet the Press.

The occasion for the July 20 interview was Gore's call for a ten-year program to shift the U.S. to non-carbon fuel sources for electric power. Near the end of the interview, Gore cited the devastating effect of beetles on forest health due to increasing global temperatures and mentioned a connection between beetles, deforestation, and climate change.

Last year Jim sent Gore his 2006 SFI white paper, "Insects, Trees, and Climate:

RESEARCH NEWS

Market ecologies workshop draws wide interest

A five-day workshop at SFI July 28-Aug. 1 drew a dozen experts from the fields of economics, physics, ecology, and biology to explore how the principles driving financial markets can be better understood if they are viewed as evolving ecosystems.

Like species, financial strategies compete with one another, adapt, live and die, and spread or go extinct, according to SFI Professor Doyne Farmer, who organized the workshop. (*SFI Update*, August issue)

The workshop's discussions began with a review of traditional views of financial markets, a primer on market ecology concepts, and discussion of potential first steps toward understanding markets through the ecosystem analogy. Subsequent presentations outlined

LIT BITS

Dynamic HIV-1 escape from vicriviroc therapy in vivo; Tsibris, A.M.N.; Arnaout, R.; **Korber, Bette [SFI External Professor];**Russ, C.; Lo, C.C.; Gaschen, B.; Leitner, T.; Paredes, R.; Su, Z.; Hughes, M.D.; Gulick, R.M.; Greaves, W.; Coakley, E.; Flexner, C.; Nausbaum, C.; Birren, B.; Kuritzkes, D.R.; *Antiviral Therapy* 13 (4), 2008, p. A97

The social processes of civil war: The wartime transformation of social networks; **Wood, Libby [SFI Professor];** *Annual Review of Political Science* 11, 2008, pp. 539-561

Thermodynamics of natural selection I: Energy flow and the limits on organization; **Smith, Eric [SFI Professor];** *Journal of Theoretical Biology* 252 (2), May 21, 2008, pp. 185-197

Thermodynamics of natural selection II: Chemical Carnot cycles; **Smith, Eric [SFI Professor];** *Journal of Theoretical Biology* 252 (2), May 21, 2008, pp. 198-212

Folding kinetics of large RNAs; Geis, M.; Flamm, C.; Wolfinger, M.T.; Tanzer, A.; Hofacker, I.L.; Middendorf, M.; Mandl, C.; **Stadler, Peter [SFI External Professor]; Thurner, Stefan [SFI External Professor];** *Journal of Molecular Biology* 379 (1), May 23, 2008, pp. 160-173

Wonderful ediacarans, wonderful cnidarians?; **Erwin, Doug [SFI Professor];** *Evolution & Development* 10 (3), May-June 2008, pp. 263-264

Collateral restrictions and liquidity under-supply: A simple model; Fostel, A.; **Geanakoplos, John [SFI External Professor];** *Economic Theory* 35 (3), June 2008, pp. 441-467

Spontaneous coordinated activity in cultured networks: Analysis of multiple ignition sites, primary circuits, and burst phase delay distributions; Ham, M.I.; **Bettencourt, Luis [SFI External Professor];** McDaniel, F.D.; Gross, G.W.; *Journal of Computational Neuroscience* 24 (3), June 2008, pp. 346-357

Parasites in food webs: the ultimate missing links; Lafferty, K.D.; Allesina, S.; Arim, M.; Briggs, C.J.; De Leo, G.; Dobson, A.P.; **Dunne, Jennifer [SFI Research Fellow];** Johnson, P.T.J.; Kuris, A.M.; Marcogliese, D.J.; Martinez, N.D.; Memmott, J.; **Marquet, Pablo [SFI External Professor];** McLaughlin, J.P.; Mordecai, E.A.; **Pascual, Mercedes [SFI External Professor];** Poulin, R.; Thieltges, D.W.; *Ecology Letters* 11 (6), June 2008, pp. 533-546

Economics and psychology: A promising new cross-disciplinary field; Frey, B.S., Stutzer, A.; **Gintis, Herb [SFI External Professor];** *Journal of Economic Psychology* 29 (3), June 2008, pp. 366-368

Before Darwin; **Smith, Eric [SFI Professor];** *Scientist* 22 (6), June 2008, pp. 32-38

Coalescent analyses support multiple mainland-to-island dispersals in the evolution of Malagasy Triaenops bats (Chiroptera: Hipposideridae); Russell, A.L.; Goodman, S.M.; **Cox, Murray [SFI Postdoctoral Fellow];** *Journal of Biogeography* 35 (6), June 2008, pp. 995-1003

Macroevolution of ecosystem engineering, niche construction, and diversity; **Erwin, Doug [SFI Professor];** *Trends in Ecology & Evolution* 23 (6), June 2008, pp. 304-310

Natural justice; Binmore, K.G.; **Gintis, Herb [SFI External Professor];** *Journal of Economic Psychology* 29 (3), June 2008, pp. 362-365

Population modeling of the emergence and development of scientific fields; **Bettencourt, Luis [SFI External Professor];** Kaiser, D.I.; Kaur, J.; **Castillo-Chavez, Carlos [SFI External Professor];** Wojick, D.E.; *Scientometrics* 75 (3), June 2008, pp. 495-518

AWARDS

Arthur wins IBM Faculty Award
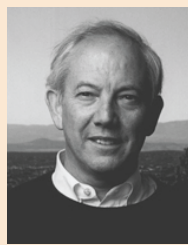
SFI External Professor W. Brian Arthur has been selected to receive a 2008 IBM Faculty Award.

The competitive awards program aims to foster research collaborations between leading researchers and IBM. Along with scientists at IBM's research center at Almaden, Calif., Brian will be investigating technological innovation and its implications for IBM products and services.

Brian is a past member of SFI's Board of Trustees and Science Board and winner this year of the inaugural Lagrange Prize for Complexity Science. He currently is a visiting researcher at the Palo Alto Research Center's Intelligent Systems Lab. His research interests include technological evolution, non-equilibrium models of economics, and theoretical frameworks for economic allocation. He has authored three books and is a noted speaker. ■

Cardenas selected for Harvard post

Former SFI International Fellow Juan-Camilo Cardenas is the Robert F. Kennedy Visiting Professor of Latin American Studies at Harvard this semester.

The professorship, created in 1986 through an endowment from the Edward J. Safra Foundation and the Republic of New York Corporation, was established to invite eminent Latin Americans from any field to utilize Harvard's resources for their own work, and to bring the Latin American experience to the University's community. It is funded by the David Rockefeller Center for Latin American Studies and hosted by Harvard's Government Department of Arts and Sciences.

"I will be teaching a course on collective action in Latin America, and will conduct research on the behavioral and institutional micro-foundations of cooperation and self governance in Latin America," says Juan, an Associate Professor of Economics at Universidad de Los Andes in Bogota, Colombia.

"My research has benefited from both the behavioral sciences program and the international program at SFI," he adds. "At the Institute, I have always found theoretical research that feeds ideas for my field work." ■

INSIDE SFI

# REU wrap-up: Eight students complete eight projects

Eight college students participating in SFI's Research Experiences for Undergraduates (REU) program presented the results of their projects to Institute staff and others as the 10-week summer program came to a close in mid-August. Each REU student paired up with an SFI professor to pursue a custom project for the summer. University of Michigan undergrad Kimira Ruelle produced the graphics below as part of her project with SFI Professor David Krakauer on the complexity of history. The project involved analyzing lengths and word frequencies in novel titles over time and searching for patterns that could be explained by historical and cultural changes.

Keyword Co-occurance Network: 1989

Using function word filter & top 20 words
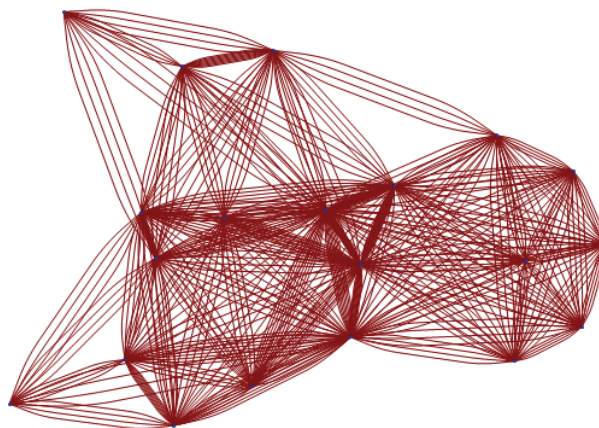
English Novel Title Length Over Time (1600-1850)
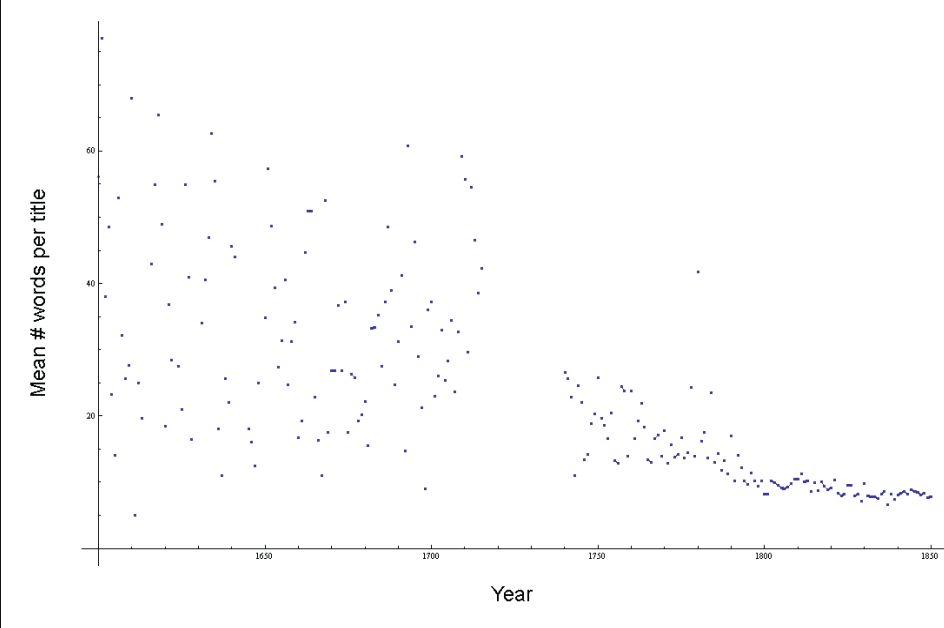
PERSPECTIVES

News media give science short shrift

The Project for Excellence in Journalism recently released "The State of News Media 2008," its annual analysis of the news media.

Its conclusion: Science and technology gets one minute of coverage, on average, for every five hours of cable TV news. That compares with 71 minutes of politics, 26 minutes of crime, 12 minutes of disasters, and 10 minutes of celebrity news.

Newspapers, network news, and online news media all provided more science coverage, but not much more. Economic pressures have forced cutbacks in reporting at newspapers, network news, and online news outlets. Much of the science reporting that remains is carried by specialty publications with limited audiences and doesn't reach mainstream readers.

For the full report, www.stateofthenewsmedia.org/2008/index.php ■

The Bioacoustic Ecology of Deforestation and Entomogenic Climate Change," that reviewed the accumulating scientific evidence of a connection between rapidly expanding insect populations, deforestation, and global climate change.

In the paper Jim and collaborator David Dunn concluded that current insect control strategies are insufficient to cope with the problem's regional scale and its likely future global scale. The paper proposed a bioacoustic interaction between insects and trees as key drivers of infestation population dynamics and the resulting wide-scale deforestation, as well as new control strategies based on this dynamic.

The work behind the paper began when Jim was a research professor at SFI. The areas surrounding his house south of Santa Fe were particularly hard hit by bark beetles from 2002 to 2004. The bioacoustic work stemmed from Jim's discussions with David Dunn, a composer and sound-recordist, about ultrasonic communication in animals, such as bats. After puzzling over the beetle infestation dynamics, they realized drought-stressed pinons emit ultrasound and so attract bark beetles.

Western bark beetle

As they worked to understand the infestation dynamics, the global scale of the problem dawned on Jim. In particular, following one of the principal edicts of nonlinear dynamics, Jim had been largely concerned about sudden climate change, in contrast with the popular view of gradual, proportionate change. Even though system properties and controls change slowly, a complex system can suddenly shift its behavior to a qualitatively new regime. The beetle infestation looked like it could be one of the better candidates for such a sudden shift.

"What impresses me about Gore is his ability to think broadly about complex systems," says Jim, who met Gore years ago during Gore's visit to SFI. "He impressed me then, just as he impressed me this time. He not only cares, he understands complex systems thinking in a constructive way."

Jim is a Professor of Physics at UC Davis as well as Director of its Complexity Sciences Center.

The paper and video clip of the Gore interview are available at http://cse.ucdavis.edu/~chaos/chaos/pubs/ecc.htm. ■

LIT BITS (continued)

Small ncRNA transcriptome analysis from Aspergillus fumigatus suggests a novel mechanism for regulation of protein synthesis; Jochl, C.; Rederstorff, M.; Hertel, J.; **Stadler, Peter [SFI External Professor]**; Hofacker, I.L.; Schrettl, M.; Haas, H., Huttenhofer, A.; *Nucleic Acids* 36 (8), June 2008, pp. 2677-2689

Funnels in energy landscapes; Klemm, K.; Flamm, C.; **Stadler, Peter [SFI External Professor]**; *European Physical Journal* B 63 (3), June 2008, pp. 387-391

How should complexity scale with system size?; Olbrich, E.; Bertschinger, N.; **Ay, Nihat [SFI External Professor]; Jost, Jüergen [SFI External Professor]**; *European Physical Journal* B 63 (3), June 2008, pp. 407-415

Inflation of the edge of chaos in a simple model of gene interaction networks; Stokic, D.; Hanel, R.; **Thurner, Stefan [SFI External Professor]**; *Physical Review* E 77 (6 PT 1), June 2008, pp. 965-972

Predictive information and explorative behavior of autonomous robots; **Ay, Nihat [SFI External Professor]**; Bertschinger, N.; Der, R.; Guttler, F.; Olbrich, E.; *European Physical Journal* B 63 (3), June 2008, pp. 329-339

Why are large cities faster? Universal scaling and self-similarity in urban organization and dynamics; **Bettencourt, Luis [SFI External Professor]**; Lobo, J.; **West, Geoffrey [SFI President and Distinguished Professor]**; *European Physical Journal* B 63 (3), June 2008, pp. 285-293

Identification of functional information subgraphs in complex networks; **Bettencourt, Luis [SFI External Professor]**; Gintautas, V.; Ham, M.I.; *Physical Review Letters* 100 (23), June 13, 2008, pp. 324-327

Policies designed for self-interested citizens may undermine "the moral sentiments": Evidence from economic experiments; **Bowles, Sam [SFI Professor]**; *Science* 320 (5883), June 20, 2008, pp. 1605-1609

Noisy: Identification of problematic columns in multiple sequence alignments; Dress, A.W.M.; Flamm, C.; Fritzsch, G.; Grunewald, S.; Kruspe, M.; Prohaska, S.J.; **Stadler, Peter [SFI External Professor]**; *Algorithms for Molecular Biology* 3, June 24, 2008, pp. 1-10

The Systems Biology Research Tool: evolvable open-source software; Wright, J.; **Wagner, Andreas [SFI External Professor]**; *BMC Systems Biology* 2, June 29, 2008, pp. 1-6

Connection between scale-free networks and nonextensive statistical mechanics; **Tsallis, Constantino [SFI External Professor]**; *European Physical Journal - Special Topics* 161, July 2008, pp. 175-180

HLA class I-driven evolution of human immunodeficiency virus type 1 subtype C proteome: Immune escape and viral load; Rousseau, C.M.; Daniels, M.G.; Carlson, J.M.; Kadie, C.; Crawford, H.; Prendergast, A.; Matthews, P.; Payne, R.; Rolland, M.; Raugi, D.N.; Maust, B.S.; Learn, G.H.; Nickle, D.C.; Coovadia, H.; Ndung'u, T.; Frahm, N.; Brander, C.; Walker, B.D.; Goulder, P.J.R.; **Bhattacharya, Tanmoy [SFI Professor]**; Heckerman, D.E.; **Korber, Bette [SFI External Professor]**; Mullins, J.I.; *Journal of Virology* 82 (13), July 2008, pp. 6434-6446

Pareto improving taxes; **Geanakoplos, John [SFI External Professor]**; Polemarchakis, H.M.; *Journal of Mathematical Economics* 44 (7-8), July 2008, pp. 682-696

NcDNAlign: Plausible multiple alignments of non-protein-coding genomic sequences; Rose, D.; Hertel, J.; Reiche, K.; **Stadler, Peter [SFI External Professor]**; Hackermuller, J.; *Genomics* 92 (1), July 2008, pp. 65-74

An integrated model of traffic, geography, and economy in the internet; Holme, P.; Karlin, J.; **Forrest, Stephanie [SFI External Professor]**; *Computer Communication Review* 38 (3), July 2008, pp. 7-15

GRANT HIGHLIGHTS
LANL grant to help Taos-area youth

A $15,000 grant from the Los Alamos National Laboratory Foundation is helping SFI reach out to middle schoolers in Taos, N.M., says Irene Lee, who is principal investigator of SFI's Project GUTS ("Growing Up Thinking Scientifically") educational effort. Project GUTS aims to engage students in research projects that promote an understanding of complex systems and the value of computer modeling and simulation in scientific research.

In Taos, Project GUTS is being offered this school year as a one-year after-school program. It is free to motivated Taos-area students entering the 7th or 8th grades. Though participants come from diverse backgrounds, they share an interest in scientific inquiry, problem solving, and investigating topics of interest to the local community, Irene says. Once student projects are complete, participants share their results at community roundtables also organized by SFI.

"Seeing middle school youth present their research may encourage the broader community to believe that they, too, can benefit from science," she says.

In New Mexico, she explains, fewer and fewer students in grade K through 12 are taking science, technology, engineering, and mathematics (STEM) courses. In fact, according to the New Mexico Standards-Based Assessments (NMSBA), interest and performance in these subjects drops significantly during the middle school years.

Project GUTS addresses this problem "by offering high quality STEM activities that appeal to a wide range of students, make science relevant, and prepare students for future endeavors in STEM classes and fields," Irene says.

For more information, www.projectguts.org ■

To help promote Project GUTS, SFI and SFI Professor John Miller are offering novelty license plates at a cost of $10. Each plate's proceeds provide one northern New Mexico middle schooler one hour of after-school time in the Project GUTS program. Plates are available at the Institute.

INSIDE SFI
Institute welcomes four new postdocs

Four new researchers have joined the select group of SFI Postdoctoral Fellows exploring independent projects that lie at the boundaries of traditional academic disciplines.

SFI Vice President Chris Wood says that, unlike more traditional fellowship positions in which postdocs typically work exclusively with individual faculty members, SFI Postdoctoral Fellows are encouraged to pursue research questions of their own design and develop collaborations with multiple SFI faculty and researchers from around the world.

The new fellows:

Bela Nagy, from The University of British Columbia's Department of Statistics, is interested in the measurement and forecasting of technological progress and technological evolution. His work takes advantage of recent advances in statistics to provide a framework to address questions of technological evolution systematically and to quantify prediction uncertainty. He hopes to take important steps toward a new, data-driven multidisciplinary frontier science he terms "quantitative futurism."

Tanya Elliott, a graduate student from the University of Oxford's Rudolf Peierls Centre for Theoretical Physics, is pursuing research interests in condensed matter, statistical physics, mathematics, networks, and quantum physics. In particular she is exploring analytic methods for determining quantities of interest of random geometrical objects of interest in physics, such as "random combs," and how they might be extended to diverse scales and problems, such as for understanding quantum gravity.

Nathan Collins, from Stanford University's Department of Political Science, has research interests at the intersection of political science, neuroscience, and cognitive science. He is developing a psychologically grounded model to investigate how the amount and features of a person's experience affect choice, and he applies the model to a recently discovered puzzle regarding spatial voting.

Xingzhi Cheng, from the National University of Singapore, focuses his research at the boundaries of statistical physics, finance, and econophysics. His interests include use of a time-quantified random walk Monte Carlo model to understand non-equilibrium thermodynamic systems. He will work on developing a complex network model that can discover the topology of a financial network as well as mathematical and statistical models that accurately capture the important aspects of the network. ■

SFI IN THE NEWS

KUNM Radio on Aug. 15 featured an interview with SFI President and Distinguished Professor Geoffrey West, who spoke about the Institute's role in the founding of complexity science and his own research in biological scaling laws. "The larger an animal, the longer it will live, the fewer offspring it will have, and the slower it will burn energy, all according to a precise mathematical formula. Moreover, this is true not only for animals but for plants as well," said the show's introduction. http://kunm.org/programs/program.php?progid=EEEkyFZkuppvwVkVUs&bmon=8&bday=15&byear=2008

In *The Scientist*, SFI Professor Eric Smith says that even as political rhetoric and court battles reflect a public struggle over Darwin's theory of evolution as an explanation for the origin of humans, a different struggle is unfolding within science about the adequacy of evolution as a theoretical foundation for biology. On the surface, the two debates seem to have little to do with one another, but in a subtle way both reflect the need for a richer theoretical biology. www.the-scientist.com/article/display/54714/ (subscription required)

A May 30 *Wall Street Journal* article about recent studies of how people choose between acts of private interest versus public good in various cultures quotes SFI External Professor Herbert Gintis. The article notes that social appearances and the good opinion of others do regulate behavior across different societies, but a willingness to retaliate is more prevalent in some cultures. http://online.wsj.com/article SB12120846956 9629951.html?mod=hps_europe_at_glance_columnists

Many bacteria break their metabolic processes into chunks. That may be logically tidy, but it's often metabolically inefficient, according to the June 2 *Science Daily*. SFI Postdoctoral Fellow Elhanan Borenstein and collaborators found that large networks involving many different enzymes tend to be more modular. Also, bacteria that live in many different environments tend to be more modular. Elhanan is quoted: "If your environment is always the same, then you just do whatever you need to do in the most optimal way. If the environment is constantly changing, you might develop one set of processes to cope with one set of environments and another to cope with another." www.sciencedaily.com/releases/2008/05/080529162727.htm

A June 12 *TIME* magazine article on what it means for something to be simple or complex quotes Murray Gell-Mann, a Nobel Prize-winning physicist and co-founder of SFI, who cited the case of physicist Karl Jansky, founder of the science of radio astronomy in 1931. "Jansky was studying the hiss of electromagnetic static that bathes the Earth – part of the same hiss you hear on a car radio – when he realized that the sound was caused not by atmospheric disturbances but by ancient signals streaming to us from the very center of the galaxy. What everyone else heard as noise, Gell-Mann says, Jansky heard as a 'beautiful regularity.'" www.time.com/time/magazine/article/0,9171,1814175-1,00.html

The July 16 *New Scientist* includes an editorial by SFI Professor Doyne Farmer titled "Economic theory just isn't up to scratch." The magazine says Doyne is one economist "making headway in understanding the market's financial collapse through agent-based simulation models. 'The regulation of markets ought to be based on the very best science, even if that does mean abandoning some of economists' most cherished ideas,'" Doyne writes. www.newscientist.com/channel/opinion/mg19926653.400-editorial-economic-theory-just-isnt-up-to-scratch.html (subscription required)

Della Ulibarri among 2008 Spanish Market artisans

Della Ulibarri at her Spanish Market booth

Part-time artist and full-time SFI staffer Della Ulibarri was accepted into this summer's Spanish Market, gaining entry into the exclusive community of artisans on her first attempt.

The Spanish Market is organized by the Spanish Colonial Arts Society, which supports Hispanic artists through education programs, grants, and production of two annual juried public markets in July and December.

Della's selection allowed her to join several dozen artists selling their wares on the Santa Fe Plaza July 26-27. She'll be guaranteed a booth during the winter event as well.

Her specialty is straw appliqué, a genre invented in northern New Mexico villages in the 1700s when Hispanic villagers, as a more affordable substitute for traditional gold inlays on crucifixes and other objects of worship, invented a process for adhering straw to wood.

The straw (from hay, corn, or wheat) is split and flattened, the soft inner pith is scraped away, and the straw is cut and glued to wood and sprayed with varnish. The golden straw provides the look of gold inlay.

Della was born and raised in Truchas, N.M., 35 miles northeast of Santa Fe. She moved to Santa Fe in 1985. She completed her 20th year at SFI this summer.

She also displays and sells her art at the Santuario de Chimayo Gift Shop in Chimayo, N.M., and at local arts and crafts fairs. ■

a taxonomy of financial strategies using the ecosystem approach.

Taking part in discussions over two days of the meeting was noted investor, philanthropist, and political activist George Soros.

One topic was a data set gathered by Doyne's collaborators in Taiwan on how individual investors bought and sold assets over the last 15 years. During the meeting Doyne strategized with participants about how to use this information.

The workshop was supported by the NSF as part of an SFI award, "Financial Markets as an Empirical Laboratory to Study an Evolving Ecology of Human Decision Making." It also is part of a larger initiative on financial risk funded in part by SFI Board of Trustees Chair Bill Miller of Legg Mason Capital Management. ■

SFI researchers' work to be featured in PBS NOVA program Oct. 28

The work of SFI President and Distinguished Professor Geoffrey West and Institute External Professors Jim Brown (University of New Mexico) and Brian Enquist (University of Arizona) will be featured in "Hunting the Hidden Dimension," a special presentation of PBS's NOVA series to be broadcast Oct. 28.

The program will explore the influence of fractal geometry in scientific breakthroughs ranging from wireless communications to cancer research to the search for solutions to global climate change.

It explains how this area of science was considered beyond the limits of mathematical understanding well into the 20th century, but how research that began to reveal the governing principles of fractals opened new vistas.

"Hunting the Hidden Dimension" weaves the latest understanding of fractals into a mathematical detective story that deepens understanding of nature and inspires a new wave of scientific inquiry and innovation, according to the program's summary. ■

You can choose to pay it or you can walk away [from the behavior]."

Because the taxes are on choices, they are non-compulsory; and because they are based on quantifiable harm to others rather than on some presumed self-harm, they are non-paternalistic.

The theorem appears in a paper titled "Pareto Improving Taxes," co-written with University of Warwick economics professor Herakles Polemarchakis and published in the July issue of the *Journal of Mathematical Economics*.

"The idea of taxing an externality is a hundred years old. Our novel contribution here," John explains, "is the idea of a package. We've proven mathematically that when you package these sorts of taxes together, everyone comes out better off."

While any single externality tax may take something of value from some individuals – say, by making it costlier to drive during rush hour, or to smoke – a broad constellation of such taxes guarantees that each and every person's quality of life, as measured by his or her own beliefs, tastes, and preferences, will improve on the whole. ■

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