Researchers search for patterns in society

Are there rules, akin to the laws of physics, that explain the patterns and regularities that arise in human society?

Participants in a three-day January workshop in Santa Fe, organized by SFI Postdoc Aaron Clauset and Michelle Girvan (former SFI postdoc, now University of Maryland), addressed that question drawing on principles of statistics, physics, computation, chemistry, political science, and sociology.

“The range of typical behaviors in society is narrower than one would expect,” says Aaron. “Embarrassment, peer pressure, and other social factors determine much of what I do.”

On a population-wide scale, these patterns often manifest themselves as predictable regularities, he says. Recent SFI work, for example, has found scaling laws for cities that suggest group-level behavior of residents of a community often is a function of the city’s size.

Much of the workshop discussion explored how social behavior at the individual level aggregates into more predictable group behavior, says Aaron, and how individual choices transitions into population behavior.

“As you increase group size, the range of behaviors narrows,” he says. “When do the laws of the group take over? It’s an important question.”

Dozens of researchers from various fields are gathering at SFI this month to discuss development of computational models that would help linguists understand how languages change and, on a larger scale, possibly address some of humanity’s biggest questions.

“Where do we come from and what’s our history?” says SFI Postdoctoral Fellow Dan Hruschka. “Language can provide a lens through which to view these questions.”

The Feb. 18-20 workshop, Building Integrated Models of Linguistic Change, is organized by Dan, Morten Christiansen (Cornell University), and SFI Professor Steve Lansing. (For more information and a list of speakers: www.santeafe.edu/events/)

In recent years researchers have built linguistic models focusing, typically, on narrow aspects of linguistic structure or on individual agents of linguistic change. Models integrating a greater set of linguistic problems would prove useful, says Dan, particularly if they account for processes occurring across time scales and levels of linguistic structure, as well as those resulting from both internal and external influences.

“There is an emerging cohort of computationally trained experts in linguistic evolution,” he says. “This is a good place to foster conversation among those people.”

Beyond its computational focus, the workshop is a first-of-its-kind opportunity to bring together the many SFI collaborators studying language-related topics from a variety of fields and perspectives. Speakers represent such fields as linguistics, computation, statistics, genetics, and sociology.

SFI President and Distinguished Professor Geoffrey West says the integration of current and potential future projects in language is the subject of an SFI Science Board analysis in 2008.

One central SFI effort, the Evolution of Human Languages (EHL) project, seeks to investigate degrees of genetic relationship among the world’s languages. EHL researchers have begun compiling a comprehensive network of etymological data that could lead to a better understanding of language ancestry dating back many millennia. SFI Distinguished Fellow and Trustee

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Three new researchers joined the select group of SFI Postdoctoral Fellows exploring independent projects that lie at the boundaries of traditional academic disciplines and create new fields of inquiry.

SFI Vice President Chris Wood says that, unlike more traditional postdoctoral positions in which the postdoc works exclusively with a single faculty member, SFI Postdoctoral Fellows are encouraged to pursue research questions of their own design and develop collaborations with SFI faculty and other researchers from around the world.

“We are delighted to have them here and look forward to the intellectual vigor they will bring to the Institute’s community,” he says. “This year’s postdoc cohort continues to expand the breadth of research at SFI.”

The new fellows:

Caroline Buckee recently received a PhD from the University of Oxford. She researches the emergence, organization, and dynamics of living systems, focusing on the evolution and maintenance of pathogen diversity and population structure and evolutionary dynamics of the malaria parasite.

“Part of my work is experimental, measuring immunological responses of children from East Africa to different parasite antigens,” she says. “More generally I am interested in the evolution of antigenic variation as an immune evasion strategy and the effects of immune selection on the evolution of pathogen species.”

Nathan Eagle focuses on machine perception and learning of complex social systems within the research areas of dynamics and quantitative studies of human behavior; emergence, organization and dynamics of living systems; and robustness in biological and social systems.

“Much of my research involves applying machine learning and network analysis techniques to large human behavioral datasets,” he says. “The data I am currently working on ranges from movement and communication data collected on individual mobile phones to social networks and product adoption data of entire nations.”

Nathan earned his doctoral degree from the Massachusetts Institute of Technology.

Willemin Kets joins SFI from Tilburg University in The Netherlands. He uses network science dynamics and quantitative studies of human behavior and robustness in biological and social systems, focusing on game theory, networks, learning, and financial markets.

“My research focuses on the interplay between strategic interaction, networks, and incomplete information in social and economic settings,” she says. “Current projects include work on the formation of diverse groups and on the effect of social structures on income inequality. I am also interested in information diffusion in financial markets and in learning processes.”

Inside SFI - Institute welcomes three new Postdoctoral Fellows

INSTITUTE

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The proposed archaeological approach relies on tic algorithms to find optimum solutions to look at interaction networks between pueblos and people,” Doug says.

“If you had three locations, that would be easy,” he adds. “As you get more and more sites, it becomes much harder to handle the data.”

Suliman’s group is adapting constraint- optimization algorithms developed at UC Riverside to simultaneously analyze multiple data sets to find best-fit solu- tions. The heuristic search methods are borrowed from the traveling sales- man problem — finding the shortest route between many cities by visiting each city only once. As the number of cities grows, the number of possible sequences grows exponentially.

Because pottery artifacts are pre- served only sporadically within their true time and space ranges, the archaeological record has many holes and disagreements.

“Our challenge is to find the global sequence of ancient events that best fits the evidence from all the local excava- tions,” says Suliman.

So far there is great interest in and energy around the approach among the participants, says Doug. Much of the early discussion has focused on construction of archaeological data sets, he says.

Future workshops are expected to build on this discussion and lead to the formation of a modeling network.

Glazed pots made by Southwest In- dian tribes from around 1300 to 1600 were a lot like the Amazon.com ship- ping boxes of today. They were used to transport items to and from locales all over today’s Southwestern United States, and they often were reused many times.

“The classic view that each woman made and used her own pots just isn’t right,” says SFI Professor and Science Steering Committee Chair Doug Erwin. He says glazed pottery shards from a broad region often are found at a single archaeological site. (Doug is Se- nior Scientist and Curator of Paleobiol- ogy at the Smithsonian Institution.)

Doug, Peter Sadler (UC Riverside), Linda Cordell (School of American Re- search), and a small group of research- ers from paleontology and archaeol- ogy are firing up interest in applying correlation methods to questions about the social and trade networks among the Pueblo Indian groups from around 1300 to 1600.

A January 17 working group meet- ing at SFI brought together eight interested researchers to discuss whether data sets about glazed ware unearthed dur- ing archaeological digs in the northern Rio Grande region could be analyzed to improve archaeologists’ under- standing of such interactions. It was the second such meeting on the topic.

Sadler, a geologist, applies probabilis- tic algorithms to find optimum solutions
Author Mitch Waldrop revisits Institute, complexity science

Mitch Waldrop, author of *Complexity: The Emerging Science at the Edge of Order and Chaos* (Simon & Schuster, 1992), spent a week in January at SFI getting reacquainted with the Institute’s people and its work.

His mission: To write an afterward to his book describing the course complexity science has taken since the book’s publication. The new chapter will appear in a reprinting of the book planned for this year.

“The publication of *Complexity* was an important event for the Institute,” says SFI Vice President Chris Wood. “It was the first popular treatment of the emerging sciences of complexity and brought SFI to the attention of many around the world. It’s still the first book people pick up when they are curious about complexity science.”

Waldrop’s book was a narrative incorporating the research and personalities of several key characters at the Institute at the time. Through the people, Waldrop described the growing complexity field. The resulting book was accessible both to scientists and laypersons interested in ideas at the frontiers of science.


*His visit was a chance to get reacquainted with the Institute, explore how the ideas of complexity science have evolved, and see how far the Institute has come since the early 1990s,* says Chris.

During the January visit Waldrop had discussions with dozens of SFI’s researchers about the state of complexity science and the state of the Institute in 2008.

“I believe the Institute has changed significantly since 1992 while maintaining a clear continuity with the Institute of that time. I’ll be interested to learn about Mitch’s impressions following this visit,” Chris says.

Beginning this month Waldrop is joining *Nature* as its editorials editor in charge of official *Nature* opinion and commentary.

He is expected to be the keynote speaker at the June 21-22 Complex Systems Summer School alumni event in Santa Fe.

**IMPACT**

A book edited by SFI Professor Jon Wilkins, *Genomic Imprinting* (Springer and Landes Bioscience, co-publishers), is scheduled to be published this month.

Genomic imprinting refers to a recently discovered phenomenon in which the expression pattern of an allele depends on whether that allele was inherited from the mother or the father. Approximately 100 imprinted genes have been discovered to date.

“The various clinical disorders associated with imprinting – as well as the mechanistic complexity involved in the establishment, maintenance, reprogramming, and interpretation of imprinted gene expression – mean that imprinting poses an interesting set of questions for a broad array of biologists,” notes Jon in the book’s introduction.

Most imprinted genes affect fetal growth, but recent work has begun to focus on other contexts – flowering plants, for example, and cognition and behavior in mammals. The book’s nine chapters, each written by geneticists at the frontiers of imprinting research, “give some indication of the puzzles that we will be faced with,” he says.

In selecting the materials for the book, Jon says he favored depth over breadth. “For some of these questions, we already have a reasonable idea of the answers; for others, we are just beginning to know how to formulate the questions,” he says.

More at [www.landesbioscience.com/books/intelligence_unit_id/945](http://www.landesbioscience.com/books/intelligence_unit_id/945).