Ancestral tongues: Understanding language migration

Human languages spread as glaciers retreat
ed from their latest maximum some 20,000 years ago. Explorations of the descent and global flow of such languages formed one component of a mid-November workshop held at SFI.

The workshop, “The Human Impact of the Last Glacial Maximum,” convened a dozen linguists, archaeologists, and geneticists to survey what has been learned in recent years about how humanity recovered from the last glacial maximum (LGM).

It was organized by SFI Distinguished Fellow and Trustee Murray Gell-Mann, SFI External Professor Henry Wright (University of Michigan), and visiting researcher Ili Peros.

“We are looking for evidence of the wide expansion of one language’s descendants that we think happened between 15 and 20 thousand years ago,” explains Murray.

During the LGM, people likely survived in pockets of friendly environments, or refugia, and later spread their cultures and languages when conditions favored expansion.

“We have preliminary indications that one particular tongue was ancestral to many languages throughout the Old World — and subsequently the New World,” he says.

“What genetic and cultural markers accompanied that language set’s expansion? Can we detect them in the archaeological or genetic record?”

Bantu languages emerged in West Africa nearly 4,000 years ago, and spread across the continent, accompanied by familiarity with certain metals and food plants. Indo-European languages swept most of Europe nearly 6,000 years ago, rolling wagon, wheel, and axle across the steppes. In Australia, where people first arrived 50,000 years ago, the aboriginal languages may have descended from one spoken around 10,000 to 12,000 years ago.

How does a swarm of bees select a new spot for a hive? How do schools of fish decide which way to swim next?

John Miller, SFI Professor and Professor of Economics and Social Sciences at Carnegie Mellon University, is organizing a January 8-11 workshop, “Collective Decision Making: From Neurons to Societies,” with social insect specialists Nigel Franks (University of Bristol) and Tom Seeley (Cornell University).

The meeting will bring together some 20 experts to find common theories among their fields of microbiology, immunology, social insect behavior, neuroscience, political science, and engineering.

With bees, scouts find and communicate sites, and hive members act as a “super-organism” in reaching a choice without a central authority. By understanding how such decentralized systems make decisions, the researchers hope to gain insight into how societies form, how they function, and how they break down. Common themes, as well as decision-making differences, may shed light on complex adaptive systems such as stock markets and voting. They also may offer strategies to improve how human organizations make decisions.

As John puts it, “Bees find new homes, and political systems find new presidents. Maybe they aren’t all that different.”

RESEARCH NEWS
Secrets of collective decision making

How does a swarm of bees select a new spot for a hive? How do schools of fish decide which way to swim next?

John Miller, SFI Professor and Professor of Economics and Social Sciences at Carnegie Mellon University, is organizing a January 8-11 workshop, “Collective Decision Making: From Neurons to Societies,” with social insect specialists Nigel Franks (University of Bristol) and Tom Seeley (Cornell University).

The meeting will bring together some 20 experts to find common theories among their fields of microbiology, immunology, social insect behavior, neuroscience, political science, and engineering.

With bees, scouts find and communicate sites, and hive members act as a “super-organism” in reaching a choice without a central authority. By understanding how such decentralized systems make decisions, the researchers hope to gain insight into how societies form, how they function, and how they break down. Common themes, as well as decision-making differences, may shed light on complex adaptive systems such as stock markets and voting. They also may offer strategies to improve how human organizations make decisions.

As John puts it, “Bees find new homes, and political systems find new presidents. Maybe they aren’t all that different.”

RESEARCH NEWS
NSF grant continues SFI scaling work

Institute President and Distinguished Professor Geoffrey West has received a National Science Foundation grant of $225,000 over three years to continue SFI’s work in biologically inspired science, and engineering.

The grant renewal builds on research that began at SFI more than a decade ago to find principles that explain the mathematical regularities discovered in the metabolic processes of all organisms.

In 1999 Geoffrey and his colleagues, SFI External Professors Jim Brown (University of Arizona) and Brian Enquist (University of Arizona), showed that the most efficient way to supply blood to any size animal was to have capillaries, the finest possible vessels in the circulatory system, be the terminal units of what mathematicians call a fractal network.

They also showed that because of this arrangement, the relation between energy consumption and body size had a universal mathematical description, the scaling law: $\ln(M) = \ln(C) + 2\ln(n)$.

For plant growth, it was $\ln(M) = \ln(C) + ln(n) + \ln(1/\sqrt{3})$.

This scaling law has since been used in many areas of science and society.

In 2005 SFI President and Distinguished Professor Geoffrey West began at SFI more than a decade ago to find principles that explain the mathematical regularities discovered in the metabolic processes of all organisms.

In 1999 Geoffrey and his colleagues, SFI External Professors Jim Brown (University of Arizona) and Brian Enquist (University of Arizona), showed that the most efficient way to supply blood to any size animal was to have capillaries, the finest possible vessels in the circulatory system, be the terminal units of what mathematicians call a fractal network.

They also showed that because of this arrangement, the relation between energy consumption and body size had a universal mathematical description, the scaling law: $\ln(M) = \ln(C) + 2\ln(n)$.

For plant growth, it was $\ln(M) = \ln(C) + ln(n) + \ln(1/\sqrt{3})$.

This scaling law has since been used in many areas of science and society.

In 2005 SFI President and Distinguished Professor Geoffrey West announced the Omidyar Challenge, a $7.5 million three-year effort that establishes the Omidyar Fellows Program at SFI.

With a gift from eBay Founder Pierre Omidyar, an SFI Trustee, the Institute has announced the Omidyar Challenge, a $7.5 million three-year effort that establishes the Omidyar Fellows Program at SFI.

The program aims to attract creative and curious scholars from the social, physical, and natural sciences to spend two to three years as postdoctoral fellows at SFI, delving into the major questions facing science and society.

> more on page 4

INSIDE SFI
SFI accepts $7.5 million Omidyar challenge gift

With a gift from eBay Founder Pierre Omidyar, an SFI Trustee, the Institute has announced the Omidyar Challenge, a $7.5 million three-year effort that establishes the Omidyar Fellows Program at SFI.

The program aims to attract creative and curious scholars from the social, physical, and natural sciences to spend two to three years as postdoctoral fellows at SFI, delving into the major questions facing science and society.

> more on page 2

> more on page 2
Wayne Cote to leave SFI

Institute Events Manager Wayne Cote has announced that he plans to leave SFI at the end of January to become Far East regional events manager for the St. Regis Hotel group.

People

Wayne Cote

Newman cartograms help describe 2008 election results

Election cartograms made by SFI External Professor Mark Newman (University of Michigan) were part of the presidential election-night coverage on several major news networks including ABC and BBC. Later Mark was interviewed about the work on NPR’s All Things Considered.

The maps, called cartograms, are similar to the red-and-blue state maps commonly used during election coverage to show nationwide voting patterns. But the standard state-by-state maps don’t tell the whole voting story because they depict voting results in terms of geographic area.

For the last few presidential elections Mark and collaborators have created special cartograms — maps in which the sizes of states are visually rescaled to incorporate population distribution, electoral college votes, county-by-county voting percentages, or other more telling patterns.

RESEARCH NEWS

Answer to cyber threats: immunity

The greatest threat to computer systems is no longer the mischievous techie but adversarial nations and organized computer criminals.

To protect against such threats, computer security systems need to be far more sophisticated than they are today, says SFI External Professor Stephanie Forrest, Professor and Chair of Computer Science at the University of New Mexico. Like the human immune system, tomorrow’s systems need to automatically detect threats, defeat them, and protect against them in the future.

Stephanie is co-director of a five-year, multi-university research initiative grant from the U.S. Air Force to develop such systems. She and her collaborators will meet at SFI January 6-9 to discuss “Self-Regenerative Approaches to Computer Security.”

“Computer systems are vulnerable to attack because they’re all genetically identical,” she says. When a virus infects one computer, it can easily go on to infect millions of others. Human populations are much more robust than computers because human immune systems vary, so you may be naturally immune to a bug that lays your spouse low.

The workshop will explore ways software can be systematically wired to create analogous protection for computer systems. Also to be considered are techniques by which computer systems can heal themselves when a virus does manage to break through their defenses.

Better networks for better insights

Networks, which have helped illuminate a variety of complex relationships from gene regulation to terrorist interactions to ecological food webs, are flexible, powerful, and widely applicable. But their full power can only be realized with a better understanding of networks themselves, says SFI Postdoctoral Fellow Aaron Clauset.

“Most people in the field believe that networks are much more complex than our simple models give them credit for,” he says. Improved future models will be more complex and will use data more directly to test the theories, he says. Machine learning techniques are pointing the way.

Leverage cycles and the anxious economy

Fostel, A.; Gsanakolopis, John (SFI External Professor); American Economic Review 98 (4), September 2008, pp. 1311-1344

Strictly and asymptotically scale invariant probabilistic models of N correlated binary random variables having q Gaussians as N >> q limiting distributions; Rodriguez, A.; Schwarmr, V.; Tsallis, Constantino (SFI External Professor); Journal of Statistical Mechanics-Theory and Experiment, September 2008, pp. 51-70

Developmental autonomy and somatic niche construction promotes robust cell fate decisions; Bensch, A.K.; Fuentes, Miguel (SFI Postdoctoral Fellow); Kraeuter, David (SFI Professor); Journal of Theoretical Biology 254 (2), September 20, 2008, pp. 408-418

Large-scale reconstruction and phylogenetic analysis of metabolic environments; Borenstein, Elhanan (SFI Postdoctoral Fellow); Ruppin, E.; Felsenstein, J. (SFI External Professor); PLoS Computational Biology 4 (8), September 2008, pp. 108.6-110.8

Generation of hierarchically correlated multivariate stochastic sequences with an application to the assessment of bootstrap confidence in phylogenetic analysis; Turimovida, M.; Ulloa, Fabrizio (SFI External Professor); Martegna, R.N.; European Physical Journal B 65 (3), October 2008, pp. 319-325

Statistical properties of thermodynamically predicted RNA secondary structures in virus genomes; Spano, M.; Ulloa, Fabrizio (SFI External Professor); Moccioli, S.; Martegna, R.N.; European Physical Journal B 65 (3), October 2008, pp. 323-331

Evolutionary emergence of responsive and unresponsive personalities; Wolf, M.; van Doom, Sandar (SFI Postdoctoral Fellow); Weissing, F.J.; Proceedings of the National Academy of Sciences of the United States of America 105 (41), October 14, 2008, pp. 15825-15830

Energy uptake and allocation during ontogeny; Hou, Chen (SFI Postdoctoral Fellow); Zhu, W.Y.; Mossie, M.E.; Woodruff, Woody (SFI External Professor); Brown, Jim (SFI External Professor); West, Geoffrey (SFI President and Distinguished Professor); Science 322 (5902), October 31, 2008, pp. 738-739
INSIDE SFI

SFI undergoes FY09 belt tightening

The worldwide economic downturn is prompting the Institute to do some preemptive belt tightening for 2009. SFI is bracing for possible decreases in funding during the coming months as a result of the economic crisis, says Institute Vice President Chris Wood. Historically, in times of hardship, funding for basic research has been sacrificed in favor of projects and research that will produce immediate results, so it is possible that public and private funding could contract.

"SFI’s existing donors and sponsors have reiterated their commitment to SFI, but finding new sources of funding in 2009 could be very difficult," says Chris. "We are adopting prudent plans to prepare for this possibility."

Among the belt-tightening measures are a 10 percent cut to the Institute’s 2009 budget.

RESEARCH NEWS

Universals in ancient worldviews

A society’s complexity is reflected in its conception of the earth’s surface and its place in the cosmos. Comparing worldviews, or “cosmologies,” across cultures may offer glimpses into universal human traits that constrain individual cultures.

“We are not Homo sapiens, per se, as other sophologists did some form of thinking,” says SFI External Professor and archaeologist George Gumerman of the School for Advanced Research, Anthology, and Anthropology.

“We’re Homo spiritualis. All societies we know had a belief system. So what’s the adaptive value of that worldview?”

To explore this notion, he joined SFI Distinguished Fellow and Trustee Murray Gell-Mann to organize “Cosmology and Society in the Ancient Amerindian World,” a late October meeting of 11 researchers in several fields including astronomy, linguistics, physics, anthropology, and folklore.

Participants explored human universals in prehistoric societies of the southeastern and southwestern United States and Mesoamerica.

Cultures in all three areas see the world as three fundamental domains: land, sea, and sky. "All have a figure that doloves to the nether worlds. All see the coyote as a trickster spirit. But, in a cosmological difference linked to subsistence methods, hunter-gatherer societies place greater spiritual value on the individual than do their agricultural counterparts."

The group aims to gather its collective knowledge and ultimately see whether its members can predict the cosmology at stages of cultural evolution.

"It’s such a maelange maybe we will never get universals,” says George. “But maybe we will.”

This Late Classic Mayan plate depicts the sacrificial death and resurrection of a maize god, this one left to the gods by other societies. (Image: Justin Kant)
To achieve happiness, people must do two things: predict how they will feel in a variety of possible futures, and act to bring about the best future and avoid the worst. Although knowing what to want seems simple, research in psychology and behavioral economics shows that people not only have trouble predicting the future, they have trouble predicting how much they will like it when they get there, according to Daniel Gilbert, author of Stumbling on Happiness (Vintage Press, 2007).

In a November 17 SFI public lecture in Santa Fe, Gilbert described to a standing-room-only crowd what science has to teach us about why we have so much trouble making ourselves happy. More about Gilbert’s work can be found at www.wjh.harvard.edu/~dtg/gilbert.htm.

Gilbert is the Harvard College Professor of Psychology at Harvard University and Director of Harvard’s Hedonic Psychology Lab. His research with University of Virginia psychology professor Tim Wilson, author of Strangers to Ourselves: Discovering the Adaptive Unconscious (Harvard University Press, 2004), investigates how and how well people make predictions about the emotional impact of future events.

The event, the final lecture in the 2008 SFI public lecture series, was supported by Wayne and Barbara Coleman.

Oil paintings by SFI staff member Laurie Innes, Assistant to SFI Distinguished Fellow and Trustee Murray Gell-Mann, have been on exhibit in recent weeks in Santa Fe.

“Beauty and the Demon,” a 12-in. by 9-in. oil on canvas, was on display October 31–November 22 at the Owings-Dewey North Gallery as part of its shrine group show, themed Explorations in the Garden of Good & Evil. The annual benefit show is a chance for local contemporary artists to show their works in a high-profile gallery. Many use the opportunity to experiment, make a statement, or honor something dear to them, says Laurie. This year’s show benefited the Santa Fe Rape Crisis and Trauma Treatment Center.

The annual benefit show is a chance for local contemporary artists to show their works in a high-profile gallery. Many use the opportunity to experiment, make a statement, or honor something dear to them, says Laurie. This year’s show benefited the Santa Fe Rape Crisis and Trauma Treatment Center.

Laurie Innes, “Beauty and the Demon,” oil on canvas

Laurie created “Beauty and the Demon” specifically for the show. The oriental still life is typical of her paintings, which often feature brief, early era poetry pieces painted into the work.

A self-taught painter who began at an early age, Laurie says her current collection of work reflects the interest she has always had in Chinese and Japanese painting, drawing, prints, calligraphy, and poetry. She has been invited to exhibit two drawings at the Community Gallery in the Civic Center during the holiday season. In January she will have a one-person show at the Main Branch of the Santa Fe Library; on display will be nearly 40 works, paintings, and drawings.

Laurie Innes, “Beauty and the Demon,” oil on canvas

The SFI public lecture series, facilitated by Cris Moore, was supported by Wayne and Barbara Coleman.

> Better networks continued from page 2

Aaron and SFI Professor Cris Moore organized a December 3-5 workshop, “Statistical Inference for Complex Networks,” to identify the big problems that might yield to these new methods.

Workshop participants were experts drawn from machine learning, physics, and several other domains who are doing interesting and productive work with networks, particularly from a methodological perspective, he says.

“Studying networks has been a lot like the story of the three blind men and the elephant – one studied the tail, one the ears, one the trunk, and none could agree on what kind of animal it was,” he says. “To really understand the complexity of networks, we need new approaches that look at the whole animal.”

> Scaling grant continued from page 1

usage and mass will follow a power law, helping to explain, among other things, why all mammals have the same number of heartbeats in a lifetime no matter their size, or why humans sleep eight hours a day while a mouse sleeps 18 and an elephant three.

The work also suggests, Geoffrey says, that a quantitative theory describing how organisms age and die is possible. Subsequent work has extended the theoretical framework for biological scaling and found hundreds of examples of regularities at multiple scales, not only in the biological world but in social organizations as well. Cities and large corporations, for example, can be thought of as organisms exhibiting regularities that mirror those found in biology.

Geoffrey and colleagues will continue to examine the implications of a power law for metabolic rate, apply scaling models to tumor growth and vascularization, and further define biological network characteristics.