

Institute of Cognitive Science Newsletter

Spring, 2014

IN MEMORIAM

Thomas K. Landauer
1932 -2014

Our colleague, mentor, and good friend, Tom Landauer, died on March 26th, 2014, in hospice care after several years of a gradually debilitating illness. He would have been 82 years old in April. As all who knew him will doubtless agree, he was a most unusual person - a man of many pursuits. He was first and foremost a scientist, interested in just about everything that went on around him. What he didn't immediately grasp, he would spend as much time as it took to understand. He was an academician, but unlike most of us he didn't confine his work to the Ivory Tower. He could do excellent experiments and build comprehensive theories, but he was equally committed to pragmatics - to demonstrating that what was discoverable in the laboratory almost always had applications in the real world, often to the benefit of humankind. But that's not all. He loved the environment and immersed himself in it. He was an inveterate hiker and skier, but also a man of the sea who loved activity on the water as much as on the land.

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Accolades from the Acting Director

It is sad to have to begin this newsletter by noting the loss of one of our most well-known cognitive scientists, Tom Landauer. On this page Lyle Bourne pays moving tribute to Tom's life and his significant accomplishments. It is quite fitting that this issue also contains a fascinating discussion of Mike Mozer's efforts to use computational modeling to improve students retention of foreign language vocabulary by providing them with personalized review strategies, as recently published in *Psychological Science*. This is a successful, practical application of cognitive science theory, which was one of Tom's guiding passions.

On a different note, I am very pleased to announce that our top candidate for the ICS faculty opening has accepted the position and we will be welcoming McKell Carter and his wife Karli Watson to our campus in the fall! Many thanks are due to a stellar search committee and Marie Banich's skillful leadership.

The grants awarded to our colleagues continue to abound. Along with John Hewitt, Marie Banich and Tor Wager have received a major new NIH grant to study *Neural Substrates of Executive Function*, and Alice Healy has a new grant from NASA to study *Effects of Long-Duration Spaceflight on Training Retention*. Alaa Ahmed received a prestigious NSF Career award. Two of our more entrepreneurial students have received an NSF Small Business Innovative Research grant to develop *Inherent Games*, which will use game play and augmented reality to help language learners learn new language concepts.

In addition many of our faculty members have been recognized for their achievements. Yuko Munakata received the BFA Faculty Recognition Award, Zygmunt Frajzyngier has been selected the Empirical Foundations of Linguistics (EFL) International Chair by the Paris-based Labex research collaborative, and Christine Yoshinago-Itano is being honored for her research contributions by the Lake Drive Foundation.

Reading the outstanding proposals for novel interdisciplinary research in response to our call for ICS Summer Research Projects was one of my most enjoyable duties this spring. The four distinguished teams of recipients are listed within these pages.

What an amazing year this has been. I will always be grateful for this opportunity to learn more about the variety of impressive activities and people associated with this Institute, a very humbling experience. Thanks to everyone who contributes to making this Institute the exciting and successful organization it is, and who made my year so rewarding.

Best wishes to all for a relaxing and fulfilling summer.

Martha Palmer
Acting Director



RECENT GRANTS AWARDED

Martha Palmer Semlink + (1 year)	BBN Technologies	\$120,000
Martha Palmer PIRE: Investigation of Meaning Representations in Language Understanding for Machine Translation Systems (Prague Machine Translation Workshop) (1 year)	Johns Hopkins-NSF	\$55,020
John Hewitt, PI; Marie Banich and Tor Wager, Co-PI's Neural Substrates of Executive Function: An fMRI Twin Study (5 year)	NIMH	\$3,476,331

Donna Caccamise discusses grant

By Sarah Elsea*

For the past three years, Dr. Donna Caccamise, Director of the Comprehension Research Group and both Academic Director and Associate Director of ICS, has been working on her grant, "Fostering Comprehension and Knowledge Building in Middle School Struggling Readers," in order to move toward a solution to a common problem for many students.

"For kids in secondary levels, the level of reading comprehension that they should have in order to be successful in college and in their careers speaks to skill sets that are far too often underdeveloped these days," said Caccamise. And although the title of the grant mentions, specifically, struggling readers, "The truth is, this is for general population readers."

Drawing from the Construction Integration (CI) Model of Comprehension, a model developed by ICS's own Walter Kintsch, Caccamise and her colleagues have developed BRAVO - The Boulder Reading Intervention curriculum - an eight-week program used to develop reading comprehension skills in middle school students.

"It's a very informative model, as models go," said Caccamise. "But of course, we still don't know all there is to know about the subject, and that's why we do the science in this project, to translate theory into practice. Through laboratory research, you see that this model does a good job describing reading

comprehension behavior. But it's another thing to get it to work in a classroom."

In the classroom setting, explained Caccamise, teachers differ greatly in their pedagogical backgrounds, which in turn affects their efficacy in teaching their specific subjects. Students, too, are highly diverse, coming from differing home situations, socioeconomic spheres, and more.



But what makes BRAVO different - and indeed, what might make it one of the most successful reading comprehension programs to date - is that it fosters the advancement of comprehension by a two-pronged approach.

"We're teaching them advanced reading comprehension skills, and at the same time, we're teaching them content," Caccamise said. "My position is, you can't really exercise those advanced reading skills well unless you're doing it in the service of building knowledge from connected content."

Having recently received a no-cost extension, the study is now moving into its fourth and final year. Although the team is still collecting data, Caccamise is optimistic about their early findings.

"What we're finding is that for kids who had some basic decoding skills, they significantly improved their ability to comprehend after experiencing this program. All of the trends are in the right direction. It's very preliminary data, but it's in the right direction and we're on our way."

Jennifer Jacobs describes her work in the Institute

By Sarah Elsea*

One big problem faced by countless teachers and school districts is the question of professional development - which approach is most effective at improving students' learning, and teachers' classroom instruction? What is the most important skill for teachers to work on? How do we keep teachers engaged?

For the past ten years, ICS researcher Jennifer Jacobs has been working to answer those questions, starting with middle school math educators. The answer? Let the math teachers focus on math.



"The goal is to really focus on math," said Jacobs, explaining her team's work on the *Problem Solving Cycle*, a model of professional development for teachers of mathematics. "This isn't typical. Math teachers don't usually get content-focused professional development - they usually get really general professional development."

Over the course of two grants, Jacobs and her research partners have designed and later implemented a system they call the *Problem Solving Cycle*, or PSC for short. The PSC is a program that has teachers come together to work on math content together as a community, later teach it in their classrooms while videotaping their lesson, and then bring those videos back to the group to discuss their experiences.

"It's a really simple model, really straightforward, and yet, this is something you don't see in schools," said Jacobs. "So, we've come into schools and introduced this model and studied it. What happens to the community of teachers when they start to use this model? How can we tweak it?"

Currently, the team is conducting a field study of the PSC in the Cherry Creek school district, where all eleven middle schools have introduced the program. In their study, the team has focused on the impact of the PSC in a number of ways.

"Are we improving [the teachers'] knowledge of mathematics and how to teach mathematics? Are

we improving their actual instructional practices? And third, are their students showing improved mathematics achievement?"

Although, as a field study, the research is very preliminary, Jacobs said the results so far have been promising. "We have positive results in all three areas," Jacobs said. "Our data shows the promise, the potential of the model, for impacting those three areas."

As the grant draws to a close in the coming months, Jacobs and her team have some very exciting new directions to take in the near future.

"We've published a lot of articles - what is this model, what can teachers do, has it had an impact, how do you prepare facilitators, how do you prepare leaders of professional development," said Jacobs. "We're pulling it all together, and now, we're writing a book."

The book is due for publication some time in 2015. But until then, the team has some other ideas: they hope to provide more online materials for teachers wanting to implement the PSC in their own schools. The team is currently waiting to hear back about two grants that would focus on building this online presence and gathering more data on the implementation of the PSC.

**Sarah Elsea has been a work study student working in the ICS office at Muenzinger for the past three years. One of Elsea's tasks has been to interview two ICS members for each ICS Newsletter. Sarah will be graduating next week and will be sorely missed. For this newsletter Elsea interviewed Donna Caccamise and Jennifer Jacobs.*

Yuko Munakata receives BFA Faculty Recognition Award

Yuko Munakata, a Fellow in the Institute of Cognitive Science, and a Professor in Psychology and Neuroscience, was recently chosen to receive a Boulder Faculty Assembly (BFA) Faculty Recognition Award. She was recognized for being a "productive researcher, faculty member, and graduate advisor who still finds time to devote to ongoing service activities."



2014 Summer Research Funding Winners

Perceptual Retraining of Acoustic and Phonetic Speech Boundaries

Rebecca A. Scarborough, Linguistics

Lewis O. Harvey, Jr., Psychology and Neuroscience

Katherine S. Phelps, Linguistics

Optimizing Financial Decision Making Via Reinforcement Learning Models

Michael Mozer, ICS and Computer Science

John Lynch, Center for Research on Consumer
Financial Decision Making

Adrian Ward, Center for Research on Consumer
Financial Decision Making

Ian Smith, Computer Science

Virtual Assessment of Audio-Visual Speech Perception in Hearing-Impaired Listeners

Anu Sharma, Speech, Language and Hearing
Sciences

Sarel van Vuuren, ICS Research Associate

Hannah Glick, Speech, Language, and Hearing
Sciences Student

Lauren Durkee, Speech, Language and Hearing
Sciences Student

Building Bridges Between Research in Language Processing and Cognitive Modeling of Analogy and Concept Learning

James Foster, Psychology and Neuroscience Student

Matt Jones, Psychology and Neuroscience

Al Kim, ICS and Psychology and Neuroscience

Vicky Lai, Former Student

Mike Eisenberg wins 2013 Gold Best Should Teach Award

The Gold Best Should Teach Award recognizes faculty who represent excellence in all aspects of university work. To receive the Best Should Teach Award they must have 1) already received one or multiple teaching awards, and have consistently high FCQ scores, 2) demonstrated educational

leadership through contributions to improving college teaching on the Boulder campus, or through work to improve teaching in primary and secondary education, and 3) contributed their time to programs that support the improvement of teaching at all levels.

Mike Eisenberg blends art and math to inspire students of all ages. Dr. Eisenberg, CU President's Teaching Scholar, earned his master's and doctoral degrees in computer science at the Massachusetts Institute of Technology. He received the 2010 Thomas Jefferson Award, one of the highest honors conferred on faculty, staff and students at the University of Colorado. He has won other recognition for his teaching and scholarship, including the Charles Hutchinson Teaching Award from the CU Boulder College of Engineering and Applied Science and the Boulder Faculty Assembly Excellence in Teaching Award. Besides distinguishing himself in the classroom, Eisenberg is a playwright and songwriter who inspires his students to incorporate art into learning, and shares his passion for computer science and math with K-12 students through CU Boulder's renowned Science Discovery Class Program. An early adopter of three-D printing, Professor Eisenberg presents workshops for the Graduate Teacher Program and Faculty Teaching Excellence Program on its potential for transforming the classroom.



ICS Fellow Dr. Christine Yoshinago- Itano honored



At this year's *For the Babies Gala* on May 1, 2014, in Wayne, NJ, the Lake Drive Foundation honored Dr. Christine Yoshinago-Itano, a Fellow in the Institute of Cognitive Science and a renowned professor of audiology in the Department of Speech, Language and Hearing. Dr.

Yoshinago-Itano's research sparked universal newborn hearing screenings and revolutionized the early intervention movement.

The Lake Drive Foundation is a not-for-profit 501(C)3 established by community leaders in 1997 to support funding needs of The Lake Drive Programs for Children Who are Deaf and Hard of Hearing. The foundation's mission is to support the identification, evaluation, therapeutic intervention and education of hearing impaired and communication impaired infants, toddlers and children.

Martha Palmer wins 2013-2014 Outstanding Faculty Graduate Advising Award

Martha S. Palmer, Acting Director of the Institute of Cognitive Science and Professor of Linguistics and Computer Science, has been selected as the winner of the Outstanding Faculty Graduate Advising award by the Graduate School. The nomination was submitted by a group of Dr. Palmer's past and present advisees, and the award recognizes Dr. Palmer for her excellent leadership and unreserved commitment to advising and mentorship of her graduate students. As the student nomination letter states, "Professor Palmer's commitment to the professional development of her students is evident in her methods of mentorship. Every advisee is involved in one or more of her many grant-funded projects. What's notable about this is that our involvement in a project is rarely menial or marginal. Under her supervision, we participate in every aspect of the project, having a voice in its direction, development and progress". In the words of Professor Laura Michaelis, acting chair of Linguistics, "It is work like Professor Palmer's that has shown the world what kinds of computer technologies a linguistically informed theory of language understanding can produce-from search engines that enable doctors to retrieve medical data quickly to automatic 'gisting' programs that gather and summarize content from news sources and blogs to automatic translation systems that are now available to anyone on the web. In addition, Prof. Palmer has capitalized the field of data-driven computational semantics by developing resources for the use of all researchers in the field. She is the recognized world leader in annotation science. She has given the field of statistically based computing the VerbNet and PropBank resources, among others. But Professor Palmer's excellence and great value to the Linguistics department stems not merely from her scholarly output, resource development and research prowess but also from the extraordinary energy and passion she puts into the mentorship of both MA and PhD students".



Congratulations Graduates!



UNDERGRADUATE CERTIFICATE:

**JESSICA LYNN BLOISE
SEAN MICHAEL KELLY
EMMA CLAIRE MINTZER
SARAH MARGUERITE MULFORD
CHRISTOPHER SCOTT TRIP
ALYSSA ANN WINCHELL
JENNIFER ASHLEY ZMRHAL**

GRADUATE CERTIFICATE:

**NICHOLAS BYRD*
JENNIFER CARLSON
ALEXIS IZATT RAYKHEL**
ANDREW YOUNG**

HUMAN LANGUAGE TECHNOLOGY CERTIFICATE:

**DANIELLE DETWEILER LAMB-BOOKS
MONIQUE AIDA MITCHELL**

COMBINED PH.D:

(CECILY) JILL DUFFIELD
with Linguistics

KYU HAN KOH
with Computer Science

* Nick Byrd will be pursuing a PhD in Philosophy from Florida State University in the Fall

** Alexis has accepted a position in linguistic annotation with Microsoft

Thomas K. Laudauer 1932-2014

By Lyle E. Bourne, Jr.

The early years

Tom was born north of Chicago, Illinois, into a Jewish family of Austrian decent. He had two brothers, both older than he and successful in their own right, and he never tired of bragging about them. As a family, the Landauer's spent several summers in Rocky Mountain National Park in Colorado, and that experience instilled in Tom a love of the outdoors, the mountains, and Colorado in general. When the time came to leave home, Tom chose the University of Colorado as his place of study. One problem that Tom had in school was that he was interested in everything - music, art, history, science, mathematics - and he had a gift for all of them. He had trouble finding a place to focus but ended up, partly by happenstance, with a dual major in Psychology and Anthropology. Along the way, he found time for extracurricular activities that included both skiing and writing reports and editorials for the student humor newspaper. Tom graduated at the head of his class and, with guidance from his CU professors who declared him to be too good for graduate school at Colorado, he moved on reluctantly to Harvard University, for his PhD in Social Relations. Perhaps not surprisingly, he fell in love with New England, cultivating an abiding interest in the ocean and the opportunities for recreation that it provided.

Maybe the best descriptive phrase for Tom's career, post-PhD, is "itinerant academician." His wanderlust among intellectual disciplines bled over into some trouble deciding where he could make the biggest impact on his chosen field. He picked Psychology as his best shot at success but couldn't find immediately the right venue to develop. He first joined the Department at Dartmouth College, but quickly moved on to teaching positions at Stanford and Princeton. During these years, he didn't publish a lot, but many of the pieces he did write have become enduring gems in the field. Apparently academia wasn't quite the right fit for him. In the late 1960's, he accepted a research position at the Bell Labs (later Bellcore) in New Jersey. There, he flourished, spending 25 years doing basic research in human-computer interaction, human memory, and related cognitive processes, research that was

guided always by attention to pragmatics, possible applications, and ways to improve the human condition.

Personal Connection

Our paths first crossed in the spring in the early 1970's when we both were visiting Brown University.

Tom had been invited to Brown to deliver a colloquium with the announced bulletin board title of something like "A random walk model of memory." Give the Zeitgeist, when most memory models consisted of highly structured boxes and networks, I thought to myself, "what a silly idea." But, dutifully, I attended the talk during which I noted a lot of head scratching going on in the audience around me. But, the more Tom lectured, the more sense he made. At the end, I remember walking out of the lecture hall, muttering to myself and to no one else in particular, "maybe he's right at that." From then on, I made a point of following Tom's work closely, though at

a distance. When he let it be known that he was moving to Boulder, Colorado, sans portfolio, to develop some practical educational applications of his invention, Latent Semantic Analysis, it was a "no brainer" to offer him an appointment in the Psychology Department at CU. And thus, an important circle in his life was closed - undergraduate at CU later in life becomes professor at CU. He seemed grateful for the opportunity a CU appointment provided him to work with interested undergraduate and graduate students (and there were many of them).

But here's an even more interesting connection. Like me, Tom had an affinity for the sea. Our families shared a number of voyages over the years, among others once sailing north from Grenada north through the Lesser Antilles and later sailing south from Athens through the Cyclades islands. You get to know your shipmates really well when you are all more or less confined 24/7 to the space available on a 45 ft. sailing vessel. We all noted how much of his free time Tom spent mentally calculating things, while staying out of other folks' way. He computed, for example, how much time it would take to get from Mykonos to Delos, given wind speed and wind direction, size of sails deployed, and other factors. Or the one I liked best, he tried to parameterize the debris field produced when we emptied bilge tanks (especially important to deciding when it was safe to get back in the water). This kind of activity occupied

so much of his time and so fascinated the rest of us that my kids early on nicknamed Tom, Mr. Data, after the Star Trek android. Thereafter, he was never called Tom, only Mr. Data. Mr. Data was entertaining company to say the least, helping to deflect any risk of getting on other people's nerves.

In the end

So the circle closes. As noted, Tom Landauer was a most unusual man: A man for all seasons or, as his wife Lynn Streeter proclaimed, a man for all of Pascal's quadrants. He was an inventive divergent thinker. He relied a lot on big data and random mental processes. His theories suggest that he was actually trying to describe what he thought was going on in his own mind. He was a generous person, sometimes to a fault. He gave regularly to charities; he used to drop off food packages anonymously on the doorstep of the Boulder Homeless Shelter. He supported many social and political causes, mostly left-leaning. When he sold his company, Knowledge Analysis Technologies, which created educational products based on LSA, such as a way to score essays and text answers to test questions automatically, he willingly shared the proceeds of that sale with his colleagues and employees. He was sometimes cranky, cantankerous, a bit of a curmudgeon. But he was also clever, crafty, and creative. Tom Landauer -- scientist, scholar, journalist, teacher, humanitarian, outdoorsman, and sailor. There were few like him and he will be sorely missed.

Eliana Colunga awarded Innovative Seed Grant



Eliana Colunga, a Fellow in the Institute of Cognitive Science and Assistant Professor in Psychology and Neuroscience, has been awarded a grant through CU-Boulder's Innovative Seed Grant Program (IGP). This campus-wide seed grant program is intended to stimulate new and exciting areas of research and creative work on the CU-Boulder campus.

The projects may take a variety of forms but must represent an investment in the future research, scholarly, or artistic vitality of the University and demonstrate promise for expansion of the project goals in the future. The projects can come from any discipline at the University, with those involving interdisciplinary work that will foster interaction among CU faculty particularly welcome.

Alice Healy Awarded Grant from NASA

Alice Healy, a Fellow in the Institute of Cognitive Science and a CU College Professor of Distinction in the Department of Psychology and Neuroscience, is the Principal Investigator on a new three-year grant (1/1/14-12/31/16) from the National Aeronautics and Space Administration (NASA) to study "Effects of Long-Duration Spaceflight on Training Retention: Background Experiments in the Laboratory."



CU Psychology PhD James Kole is the PI of a subcontract on this project to the University of Northern Colorado. CU Psychology PhD Vicki Schneider and CU Psychology and Cognitive Science PhD Carolyn Buck-Gengler are Research Associates on the project as well. The NASA technical officer on the project is CU Psychology and CU Linguistics PhD Immanuel Barshi.

Recent publications from the Healy/Bourne Lab

- Beer, F. A., Healy, A. F., & Bourne, L. E. (2013, May 13). After Boston: Terrorism and response. *e-International Relations*. <http://www.e-ir.info/2013/05/13/after-boston-terrorism-and-response/>
- Bourne, L. E., Jr., Kole, J. A., & Healy, A. F. (2014). Expertise: Defined, described, explained. *Frontiers in Psychology*, 5, 186. doi: 10.3389/fpsyg.2014.00186
- Healy, A. F., & Bourne, L. E., Jr. (2013). Empirically valid principles for training in the real world. *American Journal of Psychology*, 126, 389-399.
- Healy, A. F., Kole, J. A., & Bourne, L. E., Jr. (2014). Training principles to advance expertise. *Frontiers in Psychology*, 5, 131. doi: 10.3389/fpsyg.2014.00131
- Healy, A. F., Schneider, V. I., McCormick, B., Fierman, D. M., Buck-Gengler, C. J., & Barshi, I. (2013). Which modality is best for presenting navigation instructions? *Journal of Applied Research in Memory and Cognition*, 2, 192-199.
- Healy, A. F., Wohldmann, E. L., Kole, J. A., Schneider, V. I., Shea, K. M., & Bourne, L. E., Jr. (2013). Training for efficient, durable, and flexible performance in the military. In W. Arthur, Jr., E. A. Day, W. Bennett, Jr., & A. M. Portrey (Eds.), *Individual and team skill decay: The science and implications for practice* (pp. 176-204). New York: Routledge.
- Lohse, K. R., Jones, M., Healy, A. F., & Sherwood, D. E. (2014). The role of attention in motor control. *Journal of Experimental Psychology: General*, 143, 930-948.
- Lohse, K. R., Sherwood, D. E., & Healy, A. F. (2014). On the advantage of an external focus of attention: A benefit to learning or performance? *Human Movement Science*, 33, 120-134.

Alaa Ahmed receives prestigious NSF CAREER award



Alaa Ahmed, an Associate in the Institute of Cognitive Science and an Assistant Professor in the Department of Integrative Physiology, was recently awarded an NSF CAREER grant. This is a five year grant for “The Neuroeconomics of Metabolic Cost In Movement Decision Making”.

Nearly every movement we make is a decision under risk. People making economic or movement decisions seek to maximize rewards and minimize costs. However, instead of monetary costs, one of the predominant costs in movement is effort: the metabolic energy required to perform a movement. Surprisingly, there is no good representation of the subjective value that the brain assigns effort or how this valuation may vary across individuals, populations, or environments. In this project, the Principal Investigator will use a neuroeconomic decision making framework to quantify the subjective value of effort and gain fundamental knowledge about the role of effort valuation in movement decision making. Young adults will perform movement tasks requiring significantly different amounts of effort. During these tasks, metabolic cost (objective effort cost) will be measured. They will then make choices between risky effort and monetary lotteries, and perform a movement task that involves a tradeoff between effort costs and monetary costs. Findings will determine whether subjective valuation of effort provides a mechanistic explanation for changes in movement decision making and whether subjective valuation of effort exhibits similarities with the well-documented subjective valuation of monetary outcomes.

In terms of broader impacts, this work can inform studies on the generalization of subjective valuation across motor and non-motor commodities, and how subjective valuation changes across the lifespan. The proposed studies will significantly advance the state-of-the-art in the areas of sensorimotor control, rehabilitation, and decision making and inspire future studies that leverage effort valuation to modulate movement in lieu of error and incentivize better motor and non-motor decisions. Findings will direct future research on the design of rehabilitation therapies and exercise incentive programs that optimize movements and improve decision-making in motor and non-motor domains. Broadening of

participation will be achieved by working to introduce K-12 students at underrepresented schools to basic science and technology concepts related to movement decision making.

Library events concentrate on brain health research

The Institute of Cognitive Science in conjunction with the Intermountain Neuroimaging Consortium (INC) presented public programs featuring the latest research on the impact of life choices on brain health at the Louisville Public Library in January. The event provided a unique opportunity to learn about some of the latest neuroscience research from CU-Boulder scientists.



Researchers from the INC gave an overview of the mechanisms by which healthy lifestyle choices affect the brain and discussed some of their current research exploring the effects of exercise, stress, alcohol consumption, and meditation on brain structure and function.

Marie Banich, Director of the Institute of Cognitive Science, provided an overview of the Center's research and community benefits; Jessica Andrews-Hanna, Research Associate, discussed the effects of stress on the brain and methods to counteract stress; Hollis Karoly, Psychology and Neuroscience Doctoral Student, talked about the detrimental effects of heavy alcohol use on the brain, as well as the latest research indicating exercise has a protective effect for alcohol users.

Neuroscientists engaged kids and families in “Healthy Brains, Healthy Kids”. There, researchers provided hands-on activities for elementary-aged children to learn about how the brain works, how neuroscientists study the brain, and how kids - and parents - can help their brains grow stronger and healthier. Kids decoded MRI images, built neurons, acted like neurotransmitters, and sent eggs on “dangerous” adventures to demonstrate the importance of protecting their brains.

The programs were jointly sponsored by the Louisville Public Library and the Office for University Outreach as part of CU at the Library and the INC outreach initiatives. The INC aims to excite the community about neuroscience research and empower individuals to take charge of their health.

\$150,000 NSF Grant Awarded to Two ICS Graduate Students



Steven Duman and Kevin Gould, both ICS and Linguistics graduate students, were recently awarded an NSF grant to develop a language learning game for mobile devices that uses augmented reality technology. The game will teach foreign language concepts (from

languages like English and Spanish) in a unique, fun way that radically departs from traditional classroom instruction. Inherent Games' unique pedagogical method, called Embodied Categorical Scaffolding, allows for engaging gameplay that utilizes actual physical motion to best reflect the patterns of neurological activation that occur when one uses language. For example, recent research shows that hearing (or reading) verbs of manual motion like throw and toss activates the motor cortex responsible for actually throwing or tossing a physical object. Because touchscreens on mobile devices allow the user to physically touch and manipulate on-screen objects, they provide an unprecedented avenue to harness the potential of this innate cognitive strategy. Furthermore, the game will utilize augmented reality technology so that the user can learn with the help of cues from their surrounding environment. This application of technology ultimately provides an enriched learning experience for the user (whether at home or in the classroom) and represents a novel means for learning a foreign language.

The commercial impact of this venture is potentially enormous. The initial prototype will be fully scalable to accommodate multiple languages, extensive vocabulary domains within a given language (e.g., asking for directions, eating at restaurants, seeing the doctor, etc.), and even more complex language concepts such as tense and aspect. The game will also include a (massively) multiplayer component, where users, classes, schools, or even school districts can compete against one another for achievements and status points. Given skyrocketing demand in the United States and abroad for foreign language instruction, as well as the game's unique utilization of embodiment, this app could be poised to make a huge impact on the language-learning market.



The award is from January 1 to June 30, 2014, and is in the amount of \$150,000.

Zygmunt Frajzyngier selected to EFL International Chair

Zygmunt Frajzyngier, an Associate Member of the Institute of Cognitive Science and Professor in the Department of Linguistics, has been selected as the 2014 International Chair in the [Empirical Foundations of Linguistics](#) (EFL). The position, associated with the Labex research collaborative, is located in Paris at the heart of the most active academic community for linguistics. Labex supports the sharing of linguistic data, empirical methods and theoretical frameworks among all the linguistics fields.



Responsibilities of the chair include a lecture series presented to advance collaboration within the field. Frajzyngier will give a series of four lectures focusing on the work presented in his recently completed book, *Semantic Prerequisites for the Typology of Functional Categories*.

"The fundamental premise is that every language codes in its grammatical system different meanings," said Frajzyngier. "I look forward to expanding the audience for the ideas I am proposing in my book, and collaborating in this academically rich environment."

STUDENTS GRANTED ICS AWARDS SPRING, 2014

TRAVEL

DANIEL PETERSON
Computer Science
\$500

JAMES FOSTER
Psychology
\$ 200

GARRETT CARDON
SLHS
\$500

IN-KI JIN
SLHS
\$500

KYU HAN KOH
Computer Science
\$500

MATT MOLLISON
Psychology
\$500

RESEARCH

KYU HAN KOH
Computer Science
\$500



CU-built software uses big data to battle forgetting with personalized content review

Computer software similar to that used by online retailers to recommend products to a shopper can help students remember the content they've studied, according to a new study by Mike Mozer, Institute of Cognitive Science Faculty and a Professor in the Department of Computer Science, and Robert Lindsey, a CU-Boulder doctoral student.



The software works by tapping a database of past student performance to suggest what material an individual student most needs to review.

For example, the software might know that a student who forgot one particular concept but remembered another three weeks after initially learning them is likely to need to review a third concept six weeks after it was taught. When a student who fits that profile uses the software, the computer can pull up the most useful review questions.

"If you have two students with similar study histories for specific material, and one student couldn't recall the answer, it's a reasonable predictor that the other student won't be able to either, especially when you take into consideration the different abilities of the two students," said Mozer, senior author of the study published in the journal *Psychological Science*.

The program is rooted in theories that psychologists have developed about the nature of forgetting. Researchers know that knowledge—whether of facts, concepts or skills—slips away without review, and that spacing the review out over time is crucial to obtaining robust and durable memories.

Still, it's uncommon for students to do the kind of extended review that favors long-term retention. Students typically review material that was presented only in the most recent unit or chapter—often in preparation for a quiz—without reviewing previous units or chapters at the same time. This leads to rapid forgetting, even for the most motivated learners, Mozer said.

Over the last decade, Mozer has worked with University of California, San Diego, psychologist Harold Pashler, also a co-author of the new study, to

create a computer model that could predict how spaced review affects memory. The new computer program described in the study is an effort to make practical use of that model. Lindsey built the personalized review program and then tested it in a middle school Spanish class.

So far, the program has been tested only in foreign language classes, but Mozer believes the program could be helpful for improving retention in a wide range of disciplines, including math skills.

The research was funded by the National Science Foundation and the McDonnell Foundation.

News from the Intermountain Neuroimaging Consortium

By Nicole Speer

With an award from the Office of Engagement and Outreach, the Intermountain Neuroimaging Consortium (INC) is bringing INC research findings directly to the local community through targeted neuroscience and demonstrations in local K-5 classrooms. The lessons draw on diverse expertise from more than a dozen INC investigators spanning multiple departments and institutes. The lessons are made possible by the breadth of expertise at the INC, which includes not only investigations of brain anatomy and function across the lifespan but also includes theoretical research into the effects a variety of health-related topics such as pain, substance abuse, inhibition, sleep, diet, exercise and stress on the brain. In the fall of 2013, INC researchers and staff selected and trained 20 CU students to deliver the neuroscience lessons and demonstrations to local classrooms. This spring the CU students have reached over 500 K-5 elementary students through lessons in 24 local classrooms. The response from faculty, CU students, and elementary teachers, students and their families is overwhelmingly positive. Elementary students, their parents and teachers gain information about the brain and its development, which they can use to make brain-healthy lifestyle choices. The CU students who lead the lessons gain teaching experience and the opportunity to connect their outreach to their own fields of study. One student stated: "Seeing the enthusiasm in the kids motivates me to do better and be more enthused about the things I chose to study in my life." The INC is hoping to continue this project during the 2014-2015 academic year with returning CU students as well as new CU students who wish to expand upon their typical classroom experiences.