

## KU RESEARCHER SUGGESTS HUMAN LANGUAGE IS A 'SMALL-WORLD' SYSTEM

A researcher at the University of Kansas is applying tools from the branch of mathematics known as graph theory to human memory to understand how words are stored. This approach may explain why many patients recover language skills after brain trauma such as stroke.

New research by Michael S. Vitevitch [BNCD Investigator], associate professor of psychology and an affiliated scientist with KU's Life Span Institute, employs tools used by physicists and computer scientists to map the complex system of words in the human brain. Vitevitch's work, to be published in the April issue of the *Journal of Speech-Language-Hearing Research*, suggests that when one part of our language network breaks down, the system has the ability to reroute itself.

"Think of the diagram of flights you see in

an in-flight magazine," Vitevitch said. "In bad weather, one or two airports may be shut down but the entire system doesn't come to a halt. You can take out parts of the system but other parts pick up the slack."

A cognitive psychologist, Vitevitch has long studied the mental lexicon — how words are stored and retrieved in the human brain. Though a dictionary approaches words alphabetically, research suggests that the brain organizes words differently — by sound, by word meaning or by a combination of sound and meaning.

Intrigued by a new area called "the science of networks," Vitevitch recently turned to the work of scientists in other disciplines who are using graph theory to illustrate how all sorts of complex systems work.

"Graph theory or network science are mathematical ways of looking at things — whether ecosystems, flight patterns, the Internet or social interactions," Vitevitch said. "Some systems are randomly assembled and some are very structured, like atoms in a crystal."

Using the network analysis and illustration program Pajek, Vitevitch entered a database of about 20,000 English words, slightly more than the average vocabulary of an adult native English speaker. Nodes in the network represented individual words. A link connected two nodes if the words were "phonological neighbors" (if they sounded alike). For example, the nodes hat, cut, cap and scat were connected to the node cat.

*(Language, Continued on page 2)*

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## NEW PROJECT TO HELP KIDS WITH DISABILITIES FORM LANGUAGE SKILLS

Helping infants and toddlers with disabilities develop communication, language and early literacy skills is the goal of a new federally funded project at the Life Span Institute.

Dale Walker, associate research professor at the institute's Juniper Gardens Children's Project, and Steve Warren, vice provost of research and graduate studies [and BNCD Investigator], have been awarded a four-year, \$1.6 million grant to establish a Model Demonstration Center for Promoting Language and Literacy Readiness in Early Childhood. Funded by the U.S. Department of Education's Office of Special

Education Programs, the center will provide staff development and technical assistance to early childhood programs in Kansas City, Olathe, and Topeka, Ks and North Kansas City, Mo. It will be one of only three model demonstration centers in the United States to be funded by the Office of Special Education Programs on the topic of early language.

The center will work with practitioners in home-based and early childhood education and preschool settings on the use of techniques to enhance the communication and early literacy skills of children with disabilities and those at risk for language delays.

*(Project, Continued on page 3)*

## HUMAN LEARNING

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What Vitevitch found is that some nodes had many connections but most had only a handful.

“This disparity is a good thing,” Vitevitch said. “Short cuts are available from one end of this huge system to another.”

Returning to the analogy of airline travel, Vitevitch said the ability to bypass major hubs enables the system as a whole to keep functioning “even when things slow down.”

In fact, the path the network takes and how nodes are clustered in Vitevitch’s illustration show that the mental lexicon has “small-world characteristics,” also known as “six degrees of separation.” This theory, popularized in the 1970s, maintains that it is a small world, and each person is only six people away from everyone else on the planet.

“The small-world phenomenon has been the subject of much attention from mathematicians, physicists and computer scientists who

study networks among collaborators, friends or Web pages on the Internet,” Vitevitch said. “Small-world networks tend to resist damage and disease and are very good at spreading information.”

The graph perspective holds promise for additional work in the mental lexicon, Vitevitch said, which will help researchers understand language development and processing. The small-world quality of language also may explain why word processing is so robust. “You may lose an individual connection but the system doesn’t entirely collapse.”

Michael Vitevitch is one of 146 scientists from 20 academic departments affiliated with the Life Span Institute, one of the largest research and development programs in the nation for the prevention and treatment of developmental disabilities.

*This article can also be viewed online at: <http://www.news.ku.edu/2008/february/5/language.shtml>. Contact Mary-Margaret Simpson, (785) 864-0697; or Karen Henry, (785) 864-0756.*

## BNCD INVESTIGATOR HIGHLIGHT

John Colombo [BNCD Investigator], associate director for cognitive neuroscience at the Life Span Institute and professor of psychology at the University of Kansas, has been named interim director of the Life Span Institute.

A veteran administrator, faculty member and researcher, Colombo will lead one of the nation’s largest research programs on human development and developmental disabilities. He assumed the position held by Steve Warren, who became vice provost for research and graduate studies on March 1.

Colombo came to KU in 1982 as a research associate and then principal investigator for the institute. As associate director for cognitive neuroscience, he has led KU’s multidisciplinary efforts to study the neural process that underlies behavior, thought, language and learning.

In addition, Dr. Colombo is involved with a new bi-campus autism research center, estab-

lished by the University of Kansas through support by a combination of public and private funding.

The Kansas Center for Autism Research and Training, or K-CART, will be a multidisciplinary center that promotes research and training on the causes, nature and management of autism spectrum disorders. It will be the 13th center of KU’s Life Span Institute.

K-CART’s long-term approach is to support research that identifies the causes and neural mechanisms underlying autism spectrum disorders, said John Colombo, who is exploring identifying autism spectrum disorders in infants.

*For the full text of these articles, please visit: <http://www.news.ku.edu/2008/march/4/colombo.shtml>; and <http://www.news.ku.edu/2008/april/29/kcart.shtml>. Contact: Mary-Margaret Simpson, Life Span Institute, (785) 864-0697; or Karen Henry, Life Span Institute, (785) 864-0756.*

### BNCD News Release

A University of Kansas professor has been appointed to the advisory council of the National Institute of Deafness and Other Communication Disorders Institute by U.S. Secretary of Health and Human Services, Michael Leavitt.

Mabel Rice, the Fred and Virginia Merrill Distinguished Professor of Advanced Studies [and BNCD Director], will join a group of 18 appointees that includes 12 leading scientists in the areas of deafness and communication disorders. Her four-year term begins June 1.

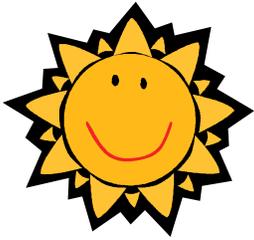
The council advises the secretary of the U.S. Department of Health and Human Service, the director of the National Institutes of Health and the director of the NIDCD on matters relating to the conduct and support of research and research training, health information dissemination and other programs with respect to disorders of hearing and other communication processes.

Rice’s research focus has been a disability called specific language impairment. She is conducting a large study of twins with researchers in Australia, England and Nebraska to look for a genetic component of the disorder in tandem with a longitudinal study of non-twin children in Kansas and Missouri.

Rice directs three research centers at KU’s Life Span Institute: the Merrill Center for Advanced Studies, the Biobehavioral Neurosciences in Communication Disorders Center and the Child Language Doctoral Program.

*The full text of this article can be viewed online at: <http://www.news.ku.edu/2008/april/30/rice.shtml>. Contact Karen Henry, Life Span Institute, (785) 864-0756.*

## Upcoming Events for Parents and Kids!



### Half-Pint Work-shop:

At Science City in KC, enjoy experimenting with different ingredients, using different sized measuring

spoons, and mixing up a fun secret recipe. May 24th at 11 a.m. & 2 p.m. and there is an admission charge. For more information:

Call: (816) 460-2020 or

See: [www.unionstation.org](http://www.unionstation.org)

### A Day Out with Thomas the Train:

Discover Thomas! The classic storybook Engine chugs into Midland Railway. Enjoy a 25-minute ride with Thomas and meet Sir Topham Hatt. Come experience storytelling, live music and build with LEGO DUPLO bricks and much more! This event is located at Midland Railway in Baldwin City. Times are Friday, June 13th and Sunday, June 15th 8 a.m. - 5 p.m., and Saturday, June 14th 8 a.m. - 6 p.m. and there is an admission charge. For more information:

Call: (866) 468-7630 or

See: <http://www.midland-ry.org/index.php?page=thomas-the-train>

### Summer Science Day Camp:

From June 16th - June 26th, follow the trail in a high-tech scavenger hunt, get muddy while learning about wetland creatures, dig for fossils, launch a rocket, or solve a mystery at the museum in our one-day Summer Science Camps. Participants explore nature and science through demonstrations, hands-on activities, and experiments in the museum and out in the field. All programs run one day from 10 a.m. - 3 p.m., are appropriate for 8-11 year olds, and there is an admission charge. For the list of classes and registration information:

Call: (785) 864-4450 or

See: <http://www.nhm.ku.edu/Hdocs/DayCamps.html>

### Celebrate the 4th of July:

July 4th in Lawrence there will be a

picnic, music and fireworks extravaganza! Fireworks begin at dusk and admission is free! For more info:

Call: (785) 749-1504

### Mary Poppins Sing Along:

On July 25, warm up your vocal cords for a Mary Poppins sing along at the Lawrence Public Library. Time is 7 p.m. and admission is free. For more information:

Call: (866) 843-3833 or

Contact: [mbutler@lawrence.lib.ks.us](mailto:mbutler@lawrence.lib.ks.us)

### Build A Mud Fort:

Aug. 11th & 12th, from 9 a.m. - 11 a.m. in Lawrence attend the Civil War on the Western Frontier for kids. Learn how mud forts were built, and then build your own! Admission charges apply. For more information:

Contact: [jellis@ci.lawrence.ks.us](mailto:jellis@ci.lawrence.ks.us) or

See: [www.lprd.org](http://www.lprd.org)



(Project, Continued from page 1)

"This center will evaluate the use of language and early literacy intervention strategies in programs serving infants and toddlers and how to provide continuity of those interventions as children move into preschool," said Walker.

The center will work with early childhood educators to evaluate strategies to promote early language and literacy readiness with 225 children with disabilities. The center will ultimately benefit 1,200 young children and their families. More than 150 early childhood educators and other intervention specialists are expected to participate.

The grant will extend the groundbreaking work by Life Span Institute researchers Betty Hart, professor emeritus, and the

late Todd Risley, former professor and senior scientist. Their 10-year study showed that children who heard more language from infancy through age 3 developed substantially larger vocabularies than those who did not. The differences between children persisted through the third grade according to a follow-up study by Walker, Hart and researchers Charles Greenwood and Judith Carta.

"The early work of Drs. Hart and Risley inspired us to test ways to increase the amount and quality of language learning opportunities for very young children in community-based child care," said Walker. "Their work showed a connection between early educators' use of language-promoting strategies and cor-

responding increases in children's communication. This new center will permit us to extend this work to infants and young children with disabilities."

The Life Span Institute is one of the largest research and development programs in the nation for the prevention and treatment of developmental disabilities. The institute includes 12 centers and more than 140 programs and projects located on the Lawrence and medical center campuses and in Kansas City, Kan., and Parsons.

This article can also be viewed online at: <http://www.oread.ku.edu/2008/april/21/project.shtml>. Contact Mary-Margaret Simpson, Life Span Institute, (785) 864-0697; or Karen Henry, Life Span Institute, (785) 864-0756.



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**About this Newsletter:**

The BNCD newsletter is designed to keep you informed about the ongoing research projects that are being conducted by BNCD researchers at the University of Kansas. Participants who have been part of recent research projects conducted by BNCD researchers, parents who have expressed interest in participating in future research, and individuals from organizations such as schools and daycare centers that have an interest in BNCD studies will receive this newsletter from time to time to keep them up-to-date about the research activities at the BNCD. If you do not wish to receive future newsletters, please call or e-mail the BNCD to have your name removed from our list. Research at the BNCD is supported in part by grant number 5 P30 DC05803 from the National Institute on Deafness and other Communication Disorders (NIDCD) at the University of Kansas.

Find the hidden words within the grid of letters. Have a fun and safe Summer!!

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P D R T D W V S U N N A M F S
G U C G M W X V T B M V S R A
O Z K E Y N O S C H O O L I N
R F L N G R L U I S J K M E D
F L O W E R S M C W H Q H N A
S H O R T S L M E I O D R D L
G K A U U J P E C M T Y W S S
O U T S I D E R R M U P Q R U
P E X B E A C H E I S W F U N
F R E U T P D A A N A Y R I P
B A R E F O O T M G N Z J B B
Q M V Q Y S P E V D D E F V A
G D R V V K C I I C U F G Y U
C H F B V I L K B E T J W Y X
Q Z G N R U H E M B J K U R N
  
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Barefoot	Friends	Ice Cream	Sand	Summer
Beach	Fun	No School	Sandals	Sun
Flowers	Hot	Outside	Shorts	Swimming

*Created with Discovery Channel School's PuzzleMaker.*