



2014 ANNUAL REVIEW CHARTING OUR PROGRESS

CENTER FOR
VITAL LONGEVITY



THE SCIENCE OF THE AGING MIND

MESSAGE FROM THE CENTER DIRECTOR

It's a great pleasure to introduce the 2013-2014 Annual Review of our Center.

On the following pages you will find brief descriptions of the recent accomplishments of each of the six research groups that are the foundation of the Center, and learn about some of the achievements over the past year of the scientists – all UTD faculty members – who lead each of the groups. A key goal of the Center is to create an environment that leads to the best research possible in the cognitive neuroscience of aging, and I hope you'll agree that we are well on our way to achieving that goal.

As you'll see, we're addressing questions crucial for understanding how to maintain cognitive vitality for life, including how brain aging affects fundamental cognitive functions such as attention and memory, how we might slow or reverse the effects of age on cognition, and what distinguishes healthy brain aging from changes in the brain that are the harbingers of cognitively disabling conditions such as Alzheimer's Disease. We are also tackling basic questions – for example, the organization of the brain's functional networks, and how the brain supports learning and remembering – that are foundational to cognitive aging. Importantly, our research in these topics is regularly published in leading peer-reviewed scientific journals, and citations to some of our recent publications are given on the following pages.



Over the past century, scientific and medical advances have led to tremendous increases in longevity for our physical bodies. But these advances have not been matched by corresponding progress in maintaining the vitality of the aging brain.

The Center for Vital Longevity at the University of Texas at Dallas exists to change that.

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Top L-R: Drs. Gagan Wig, Kristen Kennedy, Karen Rodrigue, and Associate Director Darla Wade. Bottom L-R: Drs. Denise Park, Michael Rugg and Chandramallika Basak.

This has been a good year not just for our Center but for the discipline of cognitive neuroscience much more generally. The cognitive neuroscience community, of which we are part, was thrilled when three of its members were awarded the 2014 Nobel Prize for Physiology or Medicine. The prize was awarded for seminal discoveries about how nerve cells in two different brain regions that are important for memory allow the local environment to be represented and navigated (somewhat whimsically referred to as the brain's "GPS"). The award of the prize is an affirmation of the importance of cognitive neuroscience as a scientific field, and also of the continuing importance of fundamental or "basic" research to biomedical science.

This kind of research provides the foundation for efforts to understand the causes of disease, and to develop effective therapies. In a nutshell, it's much harder to fix something when it goes wrong if you don't know how it works in the first place. Given the enormous complexity of the human brain, the need for basic research in neuroscience and related fields is going to be with us for a long time to come. ☀

Michael D. Rugg, Ph.D.
University of Texas at Dallas
Distinguished Chair in Behavioral and Brain Sciences
Director, Center for Vital Longevity

Structure and Activities



The **Lifespan Neuroscience and Cognition (LiNC) Laboratory**, led by Dr. **Chandramallika Basak**, continued its focus on the interplay between attention and memory, and the effects of cognitive training, including video games and memory exercises, in young and older adults. In particular, Dr. Basak's laboratory has been training adults on real-time strategy video games and determining what effect the training has on a wider range of cognitive abilities. She and her team are currently studying a new model of working memory and determining if cognitive plasticity can be induced with the help of working memory or video game training. In September, the Darrell K. Royal Research Fund for Alzheimer's Disease awarded Dr. Basak a grant totaling \$165,000 over the next three years to support research into mild cognitive impairment (MCI) and how acquiring skills with video games can be associated with improved cognitive performance. The funds will go toward her research into improving cognition in MCI, extending her work into new populations of older adults. Dr. Basak's proposal was one of five research proposals recommended in Texas for the grant by an outside panel of peers led by Ronald C. Petersen, M.D., Ph.D., director of the Mayo Clinic's Alzheimer's Disease Research Center. 🌞

The **Neuroimaging of Aging and Cognition Laboratory**, directed by Dr. **Kristen Kennedy**, has been investigating genetic factors that influence the aging brain with the aim of determining how we can age with minimal cognitive decline. The laboratory studied genetic and lifestyle factors that affect aging, using neuroimaging techniques to investigate brain function and cognitive performance. The laboratory's research, funded through a National Institute on Aging grant, uses structural and functional magnetic resonance imaging (MRI) to understand the brain's white matter, which consists of millions of bundles of nerve fibers that connect neurons in different brain regions into functional circuits. This past year, the laboratory benefited from an unrestricted private gift (see p. 4). Dr. Kennedy was newly appointed to the editorial board for *NeuroImage*, one of the world's leading scientific journals in the field of structural and functional neuroimaging, and was named a Rising Star by the American Psychological Society. She also served as Symposium Chair for Lifespan Development at the Organization for Human Brain Mapping meeting held in Hamburg, Germany in 2014. 🌞

Selected Publications 2013-2014

- Baniqued, P.L., Lee, H., Voss, M.W., Basak, C., Cosman, J., DeSouza, S., Severson, J., Salthouse, T., & Kramer, A.F. (2013). Selling points: What cognitive abilities are tapped by casual video games? *Acta Psychologica*. 142(1): 74-86.
- Basak, C., & Zelinski, E. (2013). A hierarchical model of working memory and its change in healthy older adults. In T.P. Alloway & R.G. Alloway (Eds.). *Working memory: The connected intelligence*. New York, London: Psychology Press. 83-106.
- Chan, M.Y., Park, D.C., Savalia, N.K., Petersen, S.E., Wig, G.S. (2014). Decreased segregation of brain systems across the healthy adult lifespan. *Proceedings of the National Academy of Sciences*. (Online ahead of print.)
- de Chastelaine, M., Rugg, M.D. (2014). The relationship between task-related and subsequent memory effects. *Human Brain Mapping*. 35: 3687-700.
- Elward, R.L., Vilberg, K.L., and Rugg, M.D. (2014, in press). Motivated Memories: Effects of reward and recollection in the core recollection network and beyond. *Cerebral Cortex*.
- Kennedy, K. M., Reese, E., Horn, M., Sizemore, A., Unni, A., Meerbrey, M., Kalich, A., Rodrigue, K. M. (2014). BDNF val66met Polymorphism Affects Aging of Multiple Types of Memory. *Brain Research, Special Issue on Memory and Aging*. (Online ahead of print.)
- Kennedy, K.M., Rodrigue, K.M., Bischof, G.N., Hebrank, A.C., Reuter-Lorenz, P.A., Park, D.C. (2014). Lifespan Age Trajectory Differences in Functional Brain Activation Under Conditions of Low and High Processing Demands. *Neuroimage*. 104: 21-34.
- Kennedy, K.M., & Raz, N. (2014, in press). Normal Aging of the Brain, Ch. 68. In A. W. Toga (Ed). *Brain Mapping: An Encyclopedic Reference*. Elsevier.
- Liu, P., Hebrank, A.C., Rodrigue, K.M., Kennedy, K.M., Section, J., Park, D.C., Lu, H. (2013). Age-related differences in memory-encoding fMRI responses after accounting for decline in vascular reactivity. *NeuroImage*. 78: 415-25.
- Mattson, J.T., Wang, T.H., de Chastelaine, M., Rugg, M.D. (2014). Effects of age on negative subsequent memory effects associated with the encoding of item and item-context information. *Cerebral Cortex*. 24: 3322-33.
- Park, D.C., Lodi-Smith, J., Drew, L., Haber, S., Hebrank, A.C.; Bischof, G.N., Aamodt, W. (2014). The Impact of Sustained Engagement on Cognitive Function in Older Adults: The Synapse Project. *Psychological Science*. 25(1): 103.
- Reuter-Lorenz, P.A., Park, D.C. (2014). How Does it STAC Up? Revisiting the Scaffolding Theory of Aging and Cognition. *Neuropsychology Review*. 24: 355-70.
- Rodrigue K.M., Rieck J.R., Kennedy K.M., Devous M.D., Diaz-Arrastia R., Park D.C. (2013). Risk factors for β -amyloid deposition in healthy aging: vascular and genetic effects. *JAMA Neurology*. 70(5): 600-606.
- Wig, G.S., Laumann, T.O., Petersen, S.E. (2014). An approach for parcellating human cortical areas using resting-state correlations. *Neuroimage*. 93: 276-291.
- Wig, G.S., Laumann, T.O., Cohen, A., Power, J.D., Nelson, S.M., Glasser, M.F., Miezin, F.S., Snyder, A.Z., Schlaggar, B.L., Petersen, S.E. (2014). Parcellating an individual subject's cortical and subcortical structures using snowball sampling of resting-state correlations. *Cerebral Cortex*. 8: 2036-5.

A review of Center activities over the past year, including those within the six laboratories that are the Center's core.

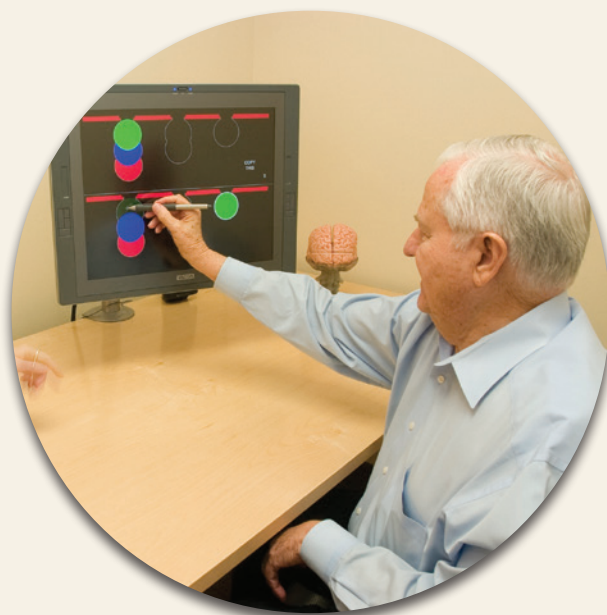
The **Aging Mind Laboratory**, led by Dr. **Denise Park**, continued work on the Dallas Lifespan Brain Study (DLBS) which is focused on predicting the cognitive future of healthy adults by imaging amyloid plaques associated with Alzheimer's Disease that many healthy people carry. Supported by a prestigious NIH MERIT award, as well as funding from Avid Radiopharmaceuticals, the lab has imaged amyloid deposits using florbetapir in more healthy adults than any lab in the world. Findings were featured prominently at the 2014 International Alzheimer's Association Conference held in Copenhagen. A second major study, The Synapse Project, has demonstrated that engaging in mentally demanding leisure activities like quilting, photography, or learning iPad apps, supports memory function in older adults. Both studies, funded by the National Institute on Aging, involve collaboration with other CVL faculty and findings have been published and presented across the globe. The lab continues to study the same participants over many years to unravel the secrets of the middle-aged brain and what it foretells about future aging. Dr. Park participates extensively in NIH review panels and has chaired for nine years the International Scientific Review Committee (Beirat) for the acclaimed Max Planck Institute for Human Development in Berlin Germany. 🌟

The **Healthy Aging Laboratory** is led by Dr. **Karen Rodrigue**, who also received a Rising Star Award from the American Psychological Society. Dr. Rodrigue's laboratory studies the role of vascular risk in neural and cognitive aging. She currently serves as the primary investigator for a National Institutes of Health Pathway to Independence grant awarded to top junior scientists in the country. Her work also focuses on health factors such as hypertension and how high blood pressure can influence aging and the deposition of beta amyloid in the brain, a protein associated with the development of Alzheimer's Disease. Supported by recently awarded funding from UT Dallas, and the provision of the imaging agent florbetapir from Eli Lilly, Inc., her laboratory is studying the relationship between brain iron accumulation and cognitive decline in older adults. Her lab is also investigating links to brain iron accumulation and the accumulation of beta amyloid. Her lab uses a variety of methods to assess brain and cognitive aging, including structural and functional MRI and PET imaging. 🌟

The **Functional Neuroimaging Memory Laboratory**, led by Center Director Dr. **Michael Rugg**, continues to focus on understanding the neural circuits that support the encoding and retrieval of memories, and how these circuits vary in their function across the adult lifespan. With funding from the National Institute of Mental Health and the National Institute on Aging, Dr. Rugg and his laboratory employ the methods of functional and structural MRI, electroencephalography and transcranial magnetic stimulation. Studies described in papers published in the last year addressed a number of questions, including

whether neural activity engaged during successful remembering differs depending on the monetary reward associated with the remembered item, whether brain regions involved in successful retrieval differ in the time-courses of retrieval-related neural activity they manifest, and how neural activity linked to successful memory encoding varies with age. Dr. Rugg is editor-in-chief of the international journal *Neuropsychologia*, and was appointed in June as a standing member of the Neurobiology of Learning and Memory Study Section of the National Institutes of Health. 🌟

The **Cognitive Neuroimaging Laboratory (CNL)**, led by Dr. **Gagan Wig**, is the CVL's newest lab. It uses a combination of structural and functional brain imaging tools to understand the organization of large-scale human brain networks, and determine how these networks change over the adult lifespan. The CNL recruited Neil Savalia, a recent graduate of Washington University's undergraduate program, as its laboratory manager. Two senior graduate students also joined the CNL to contribute to its research on brain networks: Micaela Chan, who also works with Dr. Denise Park, and Shaurabh Nandy, who also works with Dr. Richard Golden of the School of Behavioral and Brain Sciences. In the past year, Dr. Wig was an author of three articles that report studies aimed at understanding how brain areas are organized in the healthy young adult brain. His most recent paper, in the *Proceedings of the National Academy of Sciences*, explored a new way of looking at how the brain operates on a network level, and of understanding the brain basis of differences in memory function among individuals aged 20 to 89. In addition to giving a number of invited lectures to both the general public and scientific audiences, Dr. Wig was re-appointed to the editorial board of the *NeuroImage*. 🌟





The Katy Freiburger Story

Botanists have traced the path of trees from seedlings to maturity – a process that often takes decades; what may start out in the palm of a hand can reach to towering heights completely without help and through a lifespan that exceeds our own.

But sometimes a little fertilizer helps.

As with the case of seed money in science, the effects of a gift can be long-lasting, having a so-called “multiplier effect,” expanding initial avenues of inquiry that might remain unexplored without the catalyst of investment. Once a certain momentum is gained, securing federal or other funding is made easier.

When Katherine Freiburger, Dallasite and community philanthropist, generously donated \$25,000 to the Center this summer, she knew she wanted it to support the research of Dr. Kristen Kennedy, a CVL assistant professor searching for new biomarkers that might show early signs of future Alzheimer’s.

“The study of the genetics involved in Alzheimer’s and other dementia diseases needs to be continued,” Mrs. Freiburger said.



Katy Freiburger
(center) with
husband Larry
Althouse and Dr.
Kristen Kennedy.

The gift lent further support to Dr. Kennedy’s published research. She knew exactly how the gift could be used: to offset the cost of studying participants in a National Institute of Aging grant-funded study that involves DNA samples from some 120 people, and counting.

The gift covered the costs associated with genotyping the group, and the subsequent findings lent further support to the idea that a specific genetic variation present in a brain protein called BDNF was associated with declining age-related memory performance across four types of memory.

The four types of memory – prospective, associative, subjective and episodic – all fared worse among those carrying the variation, which seems to have a negative impact on learning and memory when expressed. That means people who tested positive for the potential biomarker had a harder time remembering verbal information, associating names with faces and remembering to perform an action in the future (e.g., drop off dry cleaning after work). Poorer self-evaluation of one’s memory was also seen.

As part of the next phase of her research, Dr. Kennedy intends to expand both the population size being genotyped, to 240 people – a doubling of her work that could increase the strength and validity of her findings.

“I am thrilled to be a small part of your success in the genetics of memory,” Freiburger told Dr. Kennedy recently. “I’ll look forward to seeing your research grow along with the Center. My hope is that others who wish to join the battle against Alzheimer’s and other forms of dementia can continue to provide funds for your research.” ☀

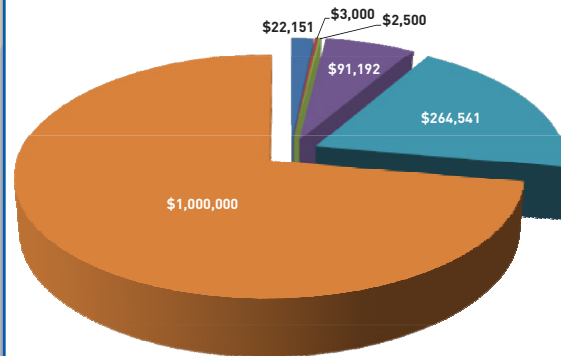
TRACING THE TRAJECTORY OF A GIFT



To learn about
CVL gift-giving
opportunities,
scan this QR code.

Mrs. Freiburger’s
Unrestricted Gift to
Dr. Kennedy Makes Further
Study in the Genetics
of Memory Possible.


Gift Report Sept. 2013 to Sept. 2014



Total \$1,383,384

- Foundations
- Corporations
- Other Organizations
- Planned Giving
- Individual Gifts
- TRIP

TRIP: State funding from the Texas Research Incentive Program



The CVL is home to scientists studying the cognitive neuroscience of aging and ways to maintain cognitive health for life. Founded in 2010, researchers at the Center are addressing numerous issues relevant to cognitive aging. These include the early detection of age-related neurodegenerative disorders such as Alzheimer's Disease, how to slow age-related cognitive decline, and basic research on the cognitive neuroscience of memory and other cognitive functions.

OVERVIEW

Center researchers are supported by several competitively reviewed research grants. These grants support recently completed and ongoing research programs outlined in this review.

The Center's founding director, Dr. Denise Park, transitioned over the summer into her new role as Director of Research. Dr. Michael Rugg is the current director. Drs. Park and Rugg both hold distinguished chairs in the UT Dallas School of Behavioral and Brain Sciences.

Six full-time faculty belong to the Center, with each faculty member leading a research group comprising a mixture of postdoctoral fellows, graduate students and research assistants.

The Center's facilities include research laboratories dedicated to electroencephalography and trans-cranial magnetic stimulation. Center researchers conduct functional and structural neuroimaging studies at the Advanced Imaging Research Center – a collaborative enterprise between UT Dallas, UT Arlington and the UT Southwestern Medical Center – on the nearby campus of UT Southwestern.

Center researchers are supported by competitively reviewed federal and non-federal research grants. These grants support several of the research programs outlined in this report. ☀

2014 CVL Advisory Council

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