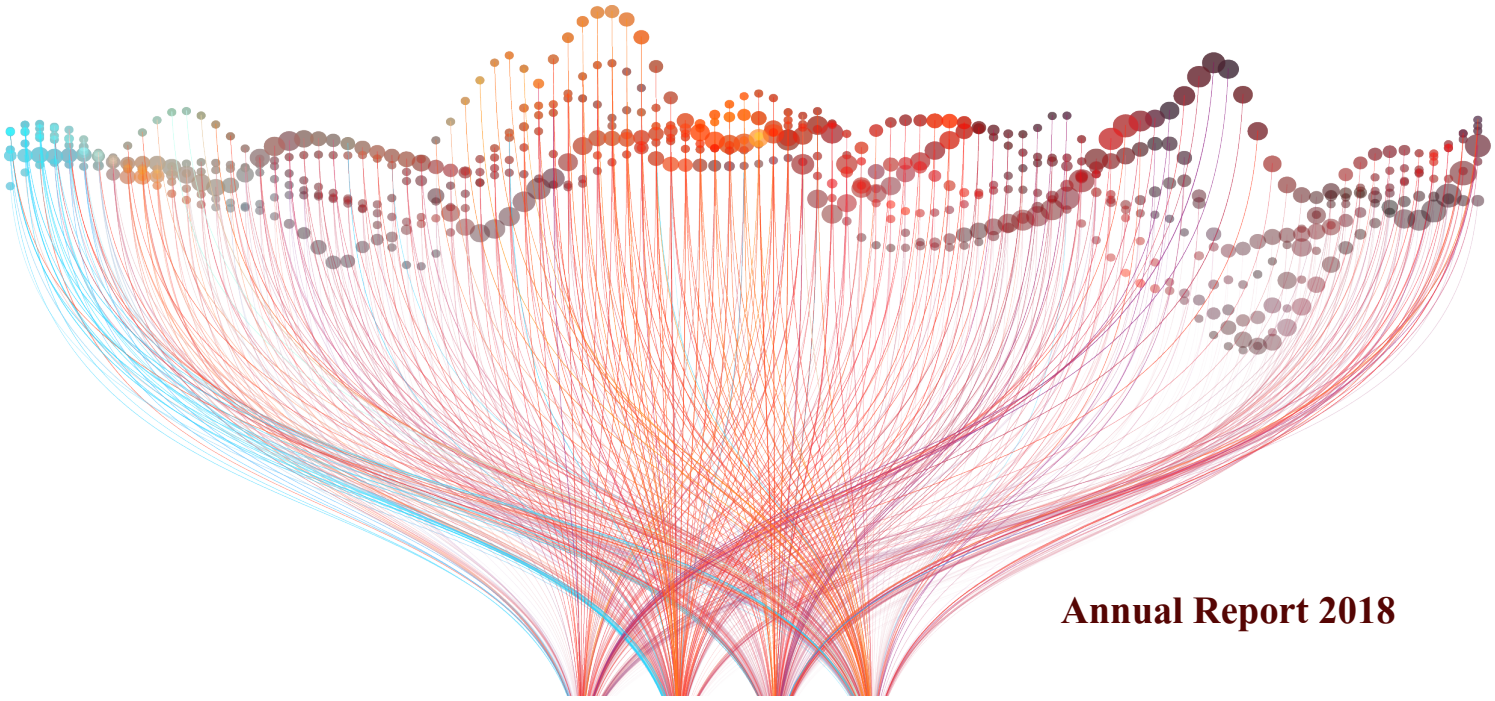
THE UNIVERSITY OF ARIZONA

Evelyn F. McKnight Brain Institute

Full Lives Through Healthy Minds



Annual Report 2018

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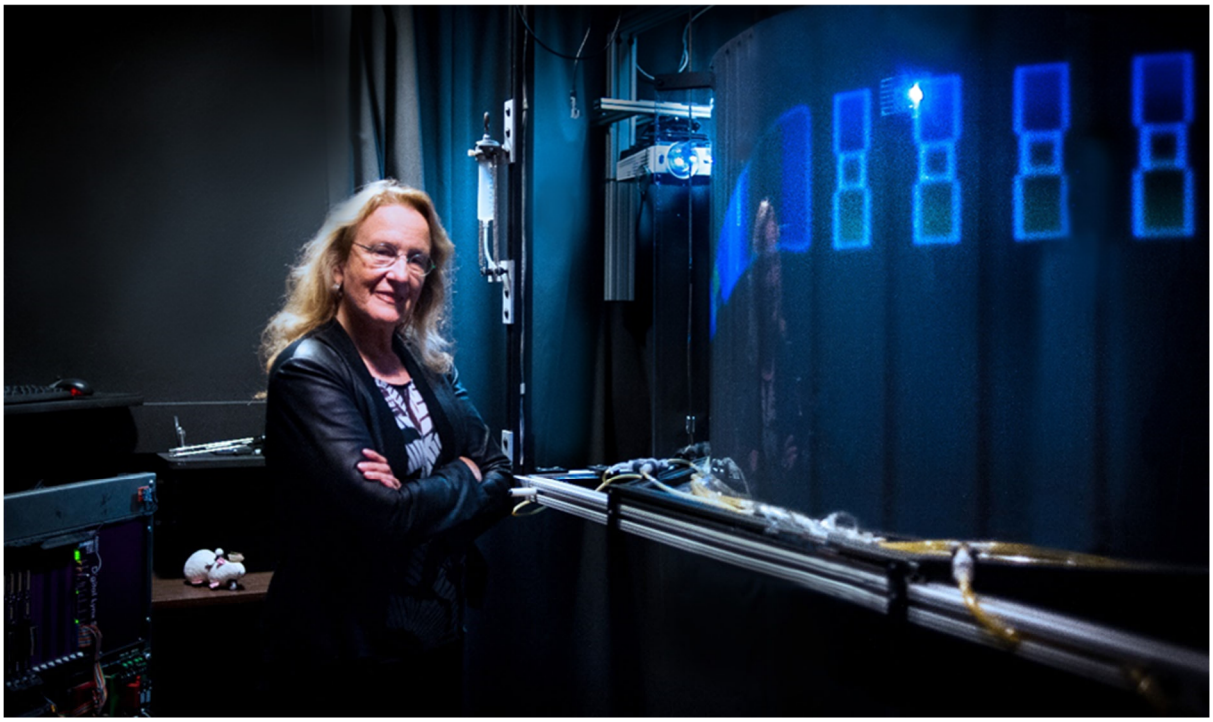
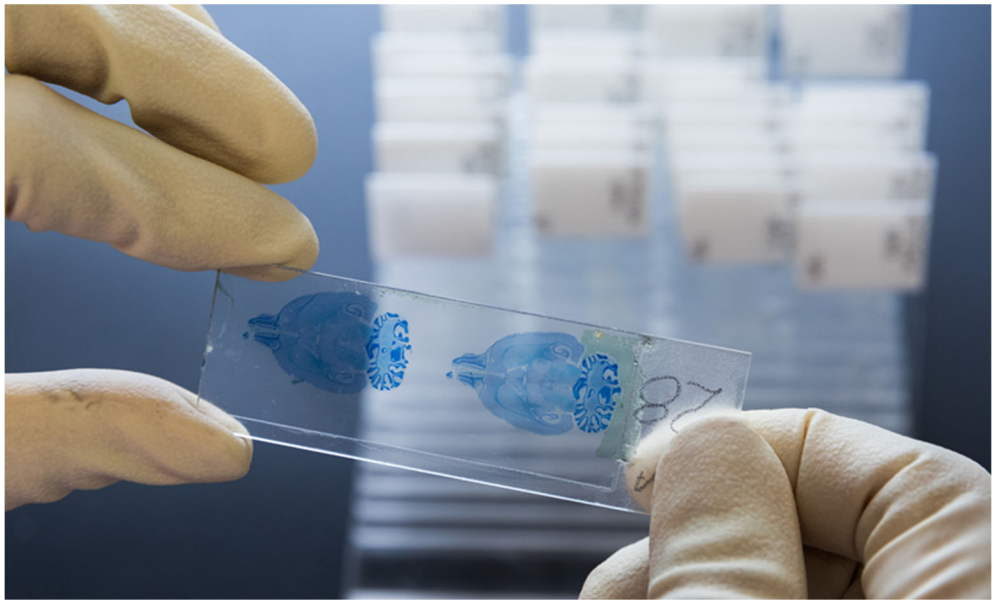
Summary of scientific achievements since last report

The director and other members of the Evelyn F. McKnight Brain Institute at the University of Arizona have had another productive year. The full list of publications can be found on pages 8 through 11. The following outlines some of these accomplishments that **directly relate to mechanisms of age-related memory loss**, first from the director's and associate director's laboratories, and then from other Evelyn F. McKnight Brain Institute (**EMBI**) affiliate faculty's laboratories.

Barnes

The Barnes laboratory collaborated with Ekstrom (UC Davis) and Bennett (UC Davis) to develop methods that will allow us to translate knowledge gained from MRIs obtained from nonhuman primates into a deeper understanding of the human brain and cognitive processes. There have been a number of large recent efforts directed towards more accurately identifying boundaries that define all of the substructures within the human hippocampus. One of the problems of the human work is that there is no 'ground truth' for defining these regions from histological sections to guide MRI boundary assignment. There is substantial evidence that the component parts of the hippocampus and surrounding regions of cortex make unique computational contributions to the function of the circuit. Thus, being able to accurately define these regions is a first step in understanding where age-related changes may be originating. To advance the field, a novel method was developed to merge actual hippocampal boundaries derived from histological sections from 5 young and 5 old monkeys, onto the MRIs obtained from each of these animals (**reported in Kyle et al., 2018**). Refinement of these methods will likely contribute to more accurate identification of hippocampal subfield boundaries in human MRI studies.





The Barnes laboratory collaborated with Smith (MIT) to assess the details of learning and memory performance in two species of macaques, using sensitive linear mixed models. These two species (*Macaca* mulatta and *Macaca radiata)* are frequently used as models of cognitive aging and we sought to determine whether these models are equivalent with respect to acquisition and retention of information in frontal lobe- and temporal lobe-dependent behavioral tasks (**reported in Comrie et al., 2018**). The cognitive functions that were tested included visuospatial short-term memory, object recognition memory, and object-reward association memory. In general, the bonnet macaques at all ages outperformed the rhesus macaques on tasks thought to rely primarily on the prefrontal cortex and were more resilient to age-related deficits in these behaviors. On the other hand, both species were comparably impaired by age on tasks thought to preferentially engage the medial temporal lobe. These observations will serve to inform the choice of species for future experiments aimed at understanding changes in cognition across the lifespan.

Barnes and Ryan from the Tucson EMBI collaborated with Burke, Bizon, Bauer and Gaynor from the Gainesville EMBI, and Roberson from the Birmingham EMBI to propose a new model of the function of the perirhinal cortex (PRC) and postrhinal/parahippocampal cortex (PHC/POR) in cognition, and the implications of this for cognitive aging (**reported in Burke et al., 2018**). We proposed that the PRC and PHC/POR participate in two computationally distinct cortical-hippocampal networks – one network tuned to process coarse information quickly, forming gist-like representations of scenes/environments, and the latter network tuned to process information about the specific sensory details that are necessary for discrimination across sensory modalities. It is the 'detail' network that appears to be more vulnerable in advanced age.

The Barnes laboratory collaborated with the Madhavan (Tucson EMBI) laboratory to explore the mechanisms that underly the decline in regenerative capacity that stem cells undergo during aging. We discovered that the Nrf2 transcription factor is extremely important for promoting the regenerative ability of stem cells in the dentate gyrus of the hippocampus (**reported in Ray et al., 2018**). Furthermore, we showed that the 'age effect' on regeneration occurs by middle age, and that enriching the stem cell environment with cells overexpressing Nrf2 can mitigate the decline in neurogenesis and can improve cognition.

The Barnes laboratory collaborated with Ba (MIT), Smith (MIT), Burke (Gainesville EMBI)) to develop a two-dimensional random field model of binary response data from multi-day behavioral experiments. We developed an analytical method to estimate performance within a day from young and old monkeys performing object discrimination and reversal learning tasks, and the learning rate across days for each monkey (**reported in Malem-Shinitski et al., 2018**). We found that, as a group, the older monkeys require more trials to learn the object discriminations than do the young

monkeys, and that the cognitive flexibility of the younger group is higher. Interestingly there were exceptions to this pattern – for example, one young monkey's data clustered with those of the 5 older animals.

The Barnes laboratory collaborated with Rapp (NIA Intramural) to examine the behavioral impact of long-term chronic implantation of neural recording devices in the monkey. While there is widespread use of invasive recording methods with animal models and humans, little is known of their effect on behavior in healthy populations. We were able to quantify the effect of chronic electrode implantation that targeted the hippocampus on recognition memory performance in macaques ranging in age from 7 to 26 years. Memory on the delayed non-matching-to-sample task was not significantly affected by chronic electrode implants targeting the hippocampus in healthy monkeys (**reported in Kyle et al., 2018**). These data indicate that the tissue damage and subsequent foreign body response caused by hyperdrive implantation was not sufficient to disrupt hippocampal circuits and impair memory performance, even though small lesions have been shown to influence this behavior.

The Barnes laboratory collaborated with Trouard (Tucson EMBI) and Burke (Gainesville EMBI) to assess brain white matter correlates of age-related reward devaluation deficits in monkeys. This study used diffusion magnetic resonance imaging methods to investigate whether the condition of the white matter associated with amygdala and orbitofrontal cortex connectivity changes with age and relates to reward devaluation behavior. Aged monkeys were impaired both on a reversal learning task, and a reward devaluation task, and showed reduced fractional anisotropy measures in the amydalofugal pathway – this white matter measure was correlated with reinforcer devaluation performance, but not the reversal learning task performance (**reported in Gray et al., 2018**). This suggests that the condition of the white matter that connects the amygdala and orbitofrontal cortex selectively impacts reward devaluation behaviors.

The Barnes laboratory collaborated with Smith (MIT) to develop methods to compare young and old rats on the W-track continuous spatial alternation task that can be used to evaluate the interactions between the hippocampus and prefrontal cortex. The results while both age groups were able to learn the hippocampus-dependent inbound component of the task, most aged animals remained just above chance on the outbound component (**reported in Kapellusch et al., 2018**). We hypothesize that the aged rats may be more impaired on the outbound part of the task because it requires cooperation of both the hippocampus and medial prefrontal cortex – each of which is compromised with age. We also determined that hierarchical modeling is the most appropriate for assessing performance on this task, and that a state-space model better captures the behavioral responses.

Ryan

Ryan and Grilli collaborated on a study examining the impact of carrying the APOE4 allele on autobiographical memory in normal middle-aged and older adults – a population at increased risk for Alzheimer's disease. On a comprehensive battery of neuropsychological tests, the E4 carriers did not perform worse than the non-E4 carriers, however, the E4 carriers produced fewer episodic details from an autobiographical memory test than did non-carriers. This suggests that the autobiographical test may be a sensitive marker for cognitive decline associated with risk for AD.

The Ryan laboratory collaborated with Glisky and Huentelman (EMBI Tucson) on a study in which the association between KIBRA gene alleles and brain volume and cognition in healthy older adults. The single nucleotide polymorphism – T carriers versus CC homozygotes – was found to impact cognition, such that the T carriers maintained verbal memory performance with increasing age, while the CC homozygotes declined. The T carriers also had greater frontal white matter volume (and other regions) with age. The differences between the allele carrier groups was particularly pronounced among the oldest old individuals.

Alexander

The Alexander laboratory collaborated with other laboratories to study people who habitually exercise, versus those who do not in a genome-wide association study. The sample came from the UK Biobank, and from several hundred thousand self-reports of physical activity, as well as nearly 100,000 who wore wrist activity monitoring devices (**reported in Klimentidis et al., 2018**). They found genetic correlations of physical activity with educational attainment, chronotype, psychiatric traits and obesity-related traits across self-report and objective activity measures – as well as variants in the APOE gene and the CADM2 genes. The data provide new insight into the genetic basis of habitual physical exercise and its relationship to traits and disease.

The Alexander laboratory collaborated with Reiman (Tucson EMBI) on a study to combine MRI and FDG PET measures of brain volume and activity to predict changes in cognitive status in those who progress to MCI or Alzheimer's disease (**reported in Stonnington et al., 2018**). Compared to non-progressors, those who did progress to MCI or AD had significantly reduced MRI and PET measurements in brain volume, particularly hippocampal volume. These combined methods will be useful in predicting imminent progression to clinically significant memory decline.

The Alexander laboratory collaborated with Woods and Cohen from the Gainesville EMBI and Czaja at the Miami EMBI on a study of cognitive training in older adults (The ACT Study). They report the Phase III adaptive multisite randomized clinical trial design that uses transcranial direct current stimulation of frontal cortex to achieve reduced cognitive decline (**reported in Woods et al., 2018**). This study will enroll 360 participants aged 65 – 89 for an initial 12 week training session, and then a 12 month follow-up on their outcome measure (NIH Toolbox Fluid Cognition Composite Score, and other neurocognitive tests, and imaging measures). This study is designed to find ways to ameliorate cognitive aging.

Andrews-Hanna

The Andrews-Hanna laboratory has explored how age alters the temporal focus and self-referential content in off-task 'spontaneous' cognition (referred to as mind-wandering). They used a validated experimental paradigm in which discrete facets of inner thought can be quantified along a conceptual continuum using open-ended report. Participants also completed the subscale of the Imaginal Process Inventory that measures the propensity to mind-wander. The data suggest a reduction of mind-wandering in off-task self-generated thought processes with increasing age (**reported in Irish et al., 2018**).

Brinton

The Brinton laboratory reported the results of a study of segesterone acetate (Nestorone) or Nestorone combined with estradiol to increase human neural stem cell proliferation and survival both in vitro and in vivo in a mouse model (**reported in Chen et al., 2018**). Their results demonstrate that chronic Nestorone increased neurogenesis, and that estrogen did not facilitate or diminish this effect. These findings provide preclinical evidence for a potential role of Nestorone as a neuroregenerative therapy to promote intrinsic regenerative capacity in female brains to protect against aging.

The Brinton laboratory reported the results of a study designed to assess the safety, tolerability and single-dose pharmacokinetics of the physoSERM preparation on stimulating the estrogen receptor beta (ERbeta). Women between 45 to 60 years were used in this study, and a single-dose oral administration of the phytoSERM formulation was well-tolerated and did not elicit any adverse events in these perimenopausal and postmenopausal women (**results reported in Hernandez et al., 2018**).

The Brinton laboratory studied the impact that the apolipoprotein E4 genotype in combination with poor metabolic profiles has on cognitive performance in healthy postmenopausal women (**reported in Karim et al., 2018**). In 497 women, verbal memory was lowest in the poor metabolic group, and more apparent in women who carry an APOE4 genotype, suggesting a strong effect of this combination of risk factors on poor cognition in aging.

The Brinton laboratory wrote a position paper on the effect that menopause has on the biological mechanisms of brain and cognitive health (**reported in Mosconi and Brinton, 2018**). Their thesis is that the menopause transition is a midlife state unique to the female resulting in a potential bioenergetic crisis in female brain that leads to an adaptive activation of ketone body metabolism to generate ATP. Over time they propose that this continued reliance on ketone bodies can lead to white matter catabolism, compromised mitochondrial energetic function and increased risk of cognitive decline and risk for AD.

Chou

The Chou laboratory studied the suitability of using MRI methodology, specifically diffusion tensor imaging (DTI) for detecting changes in brain tissue structure due to brain aging or disease. To accomplish this, they studied early stage Parkinson's disease individuals and healthy controls to compare parameters obtained from DTI methods such as fractional anisotropy (**as reported in Chen et al., 2018**). They found distinct differences between normal versus patient populations and suggest that certain brain regions are more sensitive than others to revealing changes between these populations. Interestingly, some of the relationships show higher FA, some lower FA in the patient populations.

Cowen

The Cowen laboratory collaborated with the Barnes laboratory to examine hippocampal sharp-wave ripples during waking states in young and aged rats. Several novel observation emerged from these studies, including the fact that aged rats express more ripples, but that young rats express higher ripple rates, and that while during periods of rest ripple frequencies were lower, aged rats could increase ripple rates during behavior to levels equivalent to young rats. The suggested role played by waking ripples in memory may indicate that slower movement speeds of aged rats may provide more opportunity to replay task-relevant information, and thus may result in some reduction of age-related declines in memory.

The Cowen laboratory examined the effect of low-dose ketamine on cross-frequency coupling in the motor cortex, striatum and hippocampus of behaving rats. Although a single dose of ketamine increases gamma and other high frequency interactions, it is not known whether interactions among brain areas are affected. They found that ketamine exposure does not enhance oscillations in corticostriatal circuits but does enhance coordination between low and high frequency is in the striatum and reduces synchrony in the hippocampus (**reported in Ye et al., 2018**). They propose that this may contribute to ketamine's clinical benefits.

Ekstrom

The Ekstrom laboratory conducted a study concerning how global and local network topology varies as information is encoded as a representation versus when the representation is subsequently reinstated, using MRI methods. They found that when memory networks were generated by navigating a 'virtual city', brain networks are in a state of heightened integration, especially when encoding demands are highest. During reinstatement of the representation the brain reconfigures to a state of localized processing (**reported in Arnold et al., 2018**). This reconfiguration is associated with changes in hippocampal centrality, revealed as decreases in functional interactions between other regions.

The Ekstrom laboratory conducted a study to examine temporal encoding strategies that result in a boost to free recall to levels comparable to spatial strategies. It is well known that the method of loci is a highly effective mnemonic that uses spatial locations as a scaffold for remembering lists of items. They predicted that because the neural mechanisms are present to support both spatial and temporal coding within the hippocampus, they predicted that temporal encoding strategies might also enhance memory. They found that temporal representation can be used effectively to boost memory performance, comparable to spatial methods, although the spatial methods appear to be easier to master than the temporal methods (**reported in Bouffard et al., 2018**).

The Ekstrom laboratory conducted a study using direct brain stimulation methods implanted for intracranial EEG to try to understand mixed results in deep structure stimulation on memory, with some reporting improvement, some impairment and others no consistent change. They tests patients who performed a spatiotemporal memory retrieval task, while stimulation was applied to two target regions. Stimulation selectively impaired spatial retrieval, but did not affect temporal retrieval, and the impairment was associated with theta decoupling of the spatial retrieval network (**Kim et al., 2018**). This suggests that stimulation has the potential to disrupt or enhance memory retrieval based on the nodes stimulated and the task performed.

Fernandez

The Fernandez laboratory reviewed the literature of the use of precision light for the treatment of brain disorders. They review the experiments that established the important of synchronizing light on human circadian systems, and the efficacy of prolonged bight light exposure for rescuing symptoms associated with seasonal affective disorder. They conclude that there is much promise for the use of precision light flashes, which could create neuroadaptive changes in brain function with a wide variety of applications (**reported in Kaladchibachi and Fernandez, 2018**).

The Fernandez laboratory conducted a study to determine the effect of nanowatt pulses of ultraviolet light on circadian rhythms. Because twilight progressions of irradiance and color are important stimuli in circadian pacemaker processes, they hypothesized that ultraviolet A radiation as present at twilight might play an important role in the 24 hour circadian cycle. They obtained results consistent with this hypothesis using a Drosophila model and suggest that UVA light has the potential to function as an important time cue in people (**reported in Negelspach et al., 2018**).

Glisky

The Glisky laboratory along with Grilli explored the effects of self-reference on two kinds of relational memory – internal source memory and associative memory – in young and older adults. Both young and older adults showed memory benefits in the self-reference conditions compared to other-reference conditions in both of these kinds of memory (**reported in Hou et al., 2018**). They conclude that self-reference may be a method that can benefit memory in older adults.

The Glisky laboratory conducted an experiment investigating the causes of declines in working memory and episodic memory with aging. To assess the relationship between working memory and episodic memory during healthy cognitive aging, they examined a sample of 310 community-dwelling older adults. They found that working memory may be a useful predictor of declines in future episodic memory performance (**reported in Memel et al., 2018**).

Grilli

The Grilli laboratory conducted an experiment on autobiographical memory to explore the idea that this type of memory is organized into 'life chapters' that represent major themes across one's life. Data from individuals with medial temporal lobe damage has suggested that both episodic and some aspects of personal semantic memory are impaired. They compared the number of life chapters and

their quality in patients with early-life onset and later life onset damage, and the data suggest that both groups are impaired on the temporal relation among retrograde chapters, but not in thematic relation or richness of individual life chapters. The amnestic group also generated fewer anterograde life chapters than controls and less richness (**reported in Grilli et al., 2018**). These findings provide insight into what structures contribute to autobiographical content and the temporal relations among life chapters.

Mehl

The Mehl laboratory along with Sbarra examined the immune system risk following marital separation, using objective measures of social integration. They used Mehl's novel method of observation called the Electronically Activated Recorder (the EAR). They examine the associations among objectively measured social integration, psychological distress and biomarkers of immune health in recently separated adults. They found that the behaviors measured using the EAR were associated with immune function biomarkers over and above the effects of psychological distress and suggest that these biomarkers may be effective in predicting social integration (**reported in Hasselmo et al., 2018**).

The Mehl laboratory participated with a group of investigators to examine the effects of office workstation type on physical activity and stress. They conducted a wearable, sensor-based observational study of 231 workers in four office buildings. They found that open bench seating workers were more active at the office than those in private offices and cubicles, and experienced lower perceived stress at the office than did those in cubicles. Additionally, higher physical activity was related to lower physiological stress outside the office (**reported in Lindberg et al., 2018**). These data suggested that office configuration could be a way to promote health.

The Mehl laboratory and collaborators collected data from a larger cohort to attempt to replicate and extend his earlier findings, using the EAR methodology, that individuals with higher well-being tend to spend less time alone and more time interacting with others, engage in less small talk and more substantive conversations. They tested this in an expanded, more diverse cohort of ~500 individuals. In replication, they found associations between life satisfaction and amount of alone time, conversation time and substantive conversation time, but did not replicate the association with reduced small talk (**reported in Milek et al., 2018**).

O'Connor

The O'Connor laboratory along with Sbarra proposed a framework for future intervention research to study maladaptive repetitive thought – a process of frequent and repetitive revisiting of negative thoughts or internal experiences. In addition to previously studied forms of maladaptive repetitive thought (worry, rumination and obsession) their expanded framework also includes yearning and interoceptive repetitive thoughts (**reported in Kapan et al., 2018**). A better understanding of these negative thoughts and the psychopathologies they lead to should allow improved psychotherapeutic approaches to overall mental and cognitive health.

Rance

The Rance laboratory extended their study of the effects of estrogen withdrawal at menopause that is associated with the activation of heat dissipation effectors that cause hot flashes and is mediated by neurokinin 3 receptor expressing neurons in the median preoptic nucleus. They report the effect of estradiol treatment during different phases of the light/dark cycle in mice using telemetric core temperature probes over long periods of time. The results suggest that estradiol treatment of ovariectomized mice decreases core temperature during the light phase (when mice are active) and changes thermoregulation, and that this

shows a different pattern than that previously reported in rats (**reported in Krajewski-Hall et al., 2018**). This is consistent with the idea that hot flushes in women and genetic variation can lead to differences in hot flash production.

Sbarra

The Sbarra laboratory along with Mehl examined psychological distress in a sample of separated and divorced adults. They evaluated 133 adults over five months and were able to identify variables reflecting "loss of self". They found that the more that these adults spontaneously differentiated and distinguished their identities form their former partners, the smaller the declines in psychological distress and loss of self over time (**Manvelian et al., 2018**).

Wilson

The Wilson lab has studied the idea that throughout the lifespan humans are able to make predictions with simple stimuli that suggest mechanisms of top-down processing. It is not known, however, whether an infant's ability to predict is different from an adult's, qualitatively or quantitatively. They used the pupil dilation response to measure performance on an identical implicit learning task designed to assist in learning associations between sounds and pictures. The data suggest that there is prediction in infants as well as adults using this procedure (**reported in Zhang et al., 2018**). These methods should be amenable to studying this process across the entire lifespan.

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Alexander GE. McKnight Inter-Institutional Brain Aging Registry Update. McKnight Brain Research Foundation Site Visit, University of Arizona, Tucson, AZ, February 2018.

Andrews-Hannah J. Internally-Guided Cognition Across The Lifespan (Harness Beneficial Aspect To Live Happier, Healthier Lives). McKnight Brain Research Foundation Site Visit, University of Arizona, Tucson, AZ, February 2018.

Brinton R. Vision for the Center for Innovation in Brain Science and Interactions with EMBI. McKnight Brain Research Foundation Site Visit, University of Arizona, Tucson, AZ, February 2018.

Brinton RD. Keynote Speaker: The Center for Innovation in Brain Science: Neurological Disease, Aging and Vulnerability. Core Facilities Fair, University of Arizona Discovery Days, Tucson, AZ, February 2018.

Barnes CA. Normal Brain Aging: Impact on Circuits Critical for Memory. Georgia Tech Neuro Seminar Series Speaker, Georgia Tech University, Atlanta, GA, February 2018.

Chou Y-H. Development of Image-guided Transcranial Magnetic Stimulation Protocols for Memory Therapeutics. McKnight Brain Research Foundation Site Visit, University of Arizona, Tucson, AZ, February 2018.

Ekstrom A. How Virtual and Altered Reality Can Help Us Understand the Neural Basis of Human Spatial Navigation. McKnight Brain Research Foundation Site Visit, University of Arizona, Tucson, AZ, February 2018.

Grilli M. The Psychology Department/Evelyn F. McKnight Satellite Neuropsychology Clinic at The Hacienda. McKnight Brain Research Foundation Site Visit, University of Arizona, Tucson, AZ, February 2018.

Grilli MD, Wank AA, Bercel JJ, and **Ryan L.** Evidence of Reduced Autobiographical Memory Specificity in Individuals at Increased Genetic Risk for Alzheimer's Disease Dementia. International Neuropsychological Society Annual Meeting. Washington, DC, February 2018.

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Mehl MR. Relationships in Action: Conducting Observational Relationship Research in the Real-World. Relationship Pre-Conference of the Society for Personality and Social Psychology Conference, Atlanta, Georgia, February 2018.

McVeigh KS, Moseley SA, Polsinelli AJ, and **Glisky EL.** Associations Between Social Isolation and Cognitive Function in Older Adults. International Neuropsychological Society, Washington, D.C., February 2018.

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Wank AA, Bercel JJ, and **Grilli MD.** Disrupted Retrieval Fluency for Remote Autobiographical Events in Cognitively Healthy Apolipoprotein E e4 Carriers. Poster Presentation. International Neuropsychological Society Annual Meeting. Washington, DC, February 2018.

Andrews-Hanna JR. Age-Related Changes in Mind-Wandering: Preliminary Findings and Clinical Relevance. Arizona Alzheimer's Consortium Retreat, Sedona, AZ, March 2018.

Barnes CA. Neural Mechanisms of Age-Dependent Memory Loss: Depends on Where You Look. Hebb Lecture, Dalhousie University, Halifax, Nova Scotia, Canada, March 2018.

Brinton RD. Neuro-regenerative Therapeutics for Alzheimer's Disease. National Institute of Health Alzheimer's Disease Research Summit, Bethesda, MD, March 2018.

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Brinton RD. Keynote Speaker: The Neurological and Immunological Transitions of the Perimenopause: Implications for Post-menopausal Neurodegenerative Disease. 18th World Congress of Gynecological Endocrinology (ISGE), Firenze, Italy, March 2018.

Brinton RD. Allopregnanolone as a Therapeutic to Regenerate the Degenerating Brain. 18th World Congress of Gynecological Endocrinology (ISGE) Firenze, Italy, March 2018.

Brinton RD. Perimenopause is Personal: Precision Hormone Therapy to Make It Precise. 18th World Congress of Gynecological Endocrinology (ISGE) Firenze, Italy, March 2018.

Brinton RD. Putting Gender into the Equation: Sex-specific Bioenergetic Aging and Windows of Opportunity for Estrogen or Neurosteroid Treatment of Neurodegenerative Disorders. Nature Medicine Advances in Neuroscience for Medical Innovation, Chantilly, France, March 2018

Brinton RD. Panel Speaker. Alzheimer's Drug Discovery Foundation Premier Women's Luncheon, Palm Beach, FL, March 2018.

Chou Y-H. Transcranial Magnetic Stimulation and Mild Cognitive Impairment. Arizona Alzheimer's Consortium Retreat. Sedona, Arizona, March 2018.

Cowen SL. Brain Oscillations, Drugs, and Pain. Psychology Undergraduate Research Conference, Arizona State University, Tempe, AZ, March 2018.

Rance NE. KNDy (Kisspeptin, Neurokinin B, and Dynorphin) Neurons, Thermoregulatory Circuits and The Etiology of Hot Flushes. Annual Meeting of the Endocrine Society, Chicago, IL, March 2018

Stickel A, McKinnon A, Ruiz J, and **Ryan L.** Memory and Processing Speed Predict Functional Independence Differentially in Non-Hispanic And Hispanic White Middle-aged and Older Adults. Cognitive Neuroscience Society Annual Meeting, Boston, MA, March 2018.

Wilson RC. (2018) The Role of Information and Randomization in Exploration and Exploitation. Neuroscience Seminar, University of Minnesota, Twin Cities, MN, March 2018.

Andrews-Hanna JR. The Neuroscience of Internally-Guided Cognition, Neuroscience Community Data Blitz, Museum of Contemporary Art, Tucson, AZ, April 2018.

Alexander GE. Modifiable Risk Factors in Cognitive Aging: Influence of Vascular Health and Physical Activity. McKnight Inter-Institutional Meeting, Birmingham, AL, April 2018.

Andrews-Hanna JR, Wilcox R, Ives L, Renger J, and Arch JJ. Time is of the Essence: The Costs and Benefits of Temporally-oriented Thinking in Daily life. 2018 International Conference on Learning and Memory, Huntington Beach, CA, April 2018.

Brinton RD. Keynote Speaker: Metabolic-Inflammatory Axis in Brain Aging and Neurodegeneration. Women's Health Research Day, Wake Forest University, Winston-Salem, NC, April 2018.

Brinton RD. Expert Panel Speaker: Identifying and Prioritizing Chronic Disease Drug Therapies for Reducing Alzheimer's Disease Risk. RAND Corporation, Santa Monica, CA, April 2018.

Chou Y-H. Transcranial Magnetic Stimulation for Mild Cognitive Impairment. 2018 Transcardial Magnetic Stimulation Workshop. April 2018.

Comrie AE, Lister JP, Chawla MK, and **Barnes CA.** Sparser Representation of Experience with Age in Rate Entorhinal Cortex. 2018 International Conference on Learning and Memory, Huntington Beach, CA, April 2018.

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Mehl MR. The Sounds of Social Life Project: Conducting Naturalistic Observation Research in Everyday Life. Technology to Measure Behaviors and Health in Everyday Life Workshop, University of Texas at Austin, Austin, Texas, April 2018.

Stickel A and **Ryan L**. Adiposity Measures Uniquely Impact Memory, But Not Executive Functions, Among Young Old and Older Adults. International Conference of Learning and Memory, Huntington Beach, CA, April 2018.

Rance NE. Menopause and the Human Hypothalamus: From LH Pulses to Hot Flashes. Neuroscience and Behavior Colloquium, University of Massachusetts Amherst, Amherst, MA, April 2018

Barnes CA. Age-Related Changes in Memory Across Species: Brain Circuit Specificity. UC Davis Perspectives in Neuroscience Seminar Series Speaker, Center for Neuroscience, University of California at Davis, Davis, CA, May 2018.

Chou Y-H. Introduction to Transcranial Magnetic Stimulation. Cancer Center Retreat, University of Arizona, May 2018.

Chou Y-H. Cortical Excitability in Alzheimer's Disease: A Systematic Review and Meta-Analysis of TMS Studies. Arizona Alzheimer's Consortium Annual Conference, Phoenix AZ, May 2018.

Chou Y-H, **Rapcsak SZ**, Chen N-K, Sundman MH, Lim K, Ugonna CP, Lindley MD, Fuglevand AJ, Mohler J, and Huang Y-Z. Cortical Excitability in Alzheimer's Disease and Mild Cognitive Impairment: A Systematic Review and Meta-analysis. Arizona Alzheimer's Consortium Annual Scientific Conference, Phoenix, AZ, May 2018.

Chudoba RA, Moseley SA, Polsinelli AJ, and **Glisky EL**. Association Between Loneliness, Social Isolation, and Health in Older Adults. Cognitive Aging Conference, Atlanta, GA, May 2018.

Matijevic S, Walther K, and **Ryan L.** Relationship Between Diffusion Tensor Imaging Metrics and White Matter Hyperintensity Volume in Aging. Cognitive Aging Conference, Atlanta, GA, May 2018.

Mizell J-M, Wang S, Franchetti M-K, Keung W, Sundman MH, **Chou Y, Alexander G,** and **Wilson RC**. Explore-exploit Behavior in Older Adults. Arizona Alzheimer's Consortium Annual Scientific Conference, Phoenix, AZ, May 2018.

O'Connor MF. Complicated Grief Through a Physiological Lens. Association for Psychological Science, San Francisco, CA, May 2018.

Wank AA, **Andrews-Hanna JR**, and **Grilli MD.** The Efficiency of Direct and Generative Retrieval Routes in Normal Cognitive Aging. Arizona Alzheimer's Consortium Annual Scientific Conference, Phoenix, AZ, May 2018.

Wank AA, **Andrews-Hanna JR**, and **Grilli MD.** The Efficiency of Direct and Generative Retrieval Routes in Normal Cognitive Aging. Poster presentation. Cognitive Aging Conference. Atlanta, GA, May 2018.

Andrews-Hanna JR. Spontaneity and Awareness. Peter Wall Institute International Research Roundtable, Vancouver, BC, Canada, June 2018.

Tirambulo C, Sutherland-Mills C, Toosizadeh N, Lindley M, Golden T, Chen N-K, Mohler J, and **Chou Y-H.** fMRI and Upper-extremity Function: The Effect of Dual-tasking. Cognitive Aging Conference. Atlanta, GA, May 2018.

Barnes CA. Interrogating the Navigation Circuit: Many Paths to the Final Destination. Medial Temporal Lobe Computations Session. 2nd Interdisciplinary Navigation Symposium, Quarter Tremblant, Canada, June 2018.

Brinton RD. Differences in Vulnerability To and Resilience Against Alzheimer's Disease. The Glenn Foundation for Medical Research Aging, Sex, Santa Barbara, CA, June 2018.

Lindley M, Bernstein A, Ugonna C, Bruck D, Johnson K, Altbach M, Ryan L, Chen, **Chou Y-H**, Guzman G, **Trouard T**, and Weinkauf C. Impact of Carotid Endarterectomy on Functional Connectivity. Abstract submitted to the Joint Annual Meeting ISMRM-ESMRMB, Paris, France, June 2018.

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Moseley SA, Polsinelli AJ, **Glisky EL**, and **Mehl MR.** Everyday Language as a Window into the Cognitive Functioning of Older Adults. American Academy of Clinical Neuropsychology, San Diego, CA, June 2018.

Chou Y-H. Effects of Repetitive Transcranial Magnetic Stimulation on Cognitive Function in Mild Cognitive Impairment: A Systematic Review and Meta-analysis. Alzheimer's Association International Conference. Chicago, IL, July 2018.

Mehl MR. Mobile Psychological Science. European Summer School of Social Psychology, Zürich, Switzerland, July 2018.

Rance NE. Menopause and the Human Hypothalamus: From LH Pulses to Hot Flashes, International Congress of Neuroendocrinology, Toronto, Canada, July 2018.

Wilson RC. The Role of Information and Randomization in Exploration and Exploitation. Understanding Exploration-Exploitation Trade-offs Workshop, Cog Sci 2018, Madison, WI, July 2018.

Alexander GE. Viewing the Aging Brain: Looking at Lifestyle, Health & Cognition. APA Division 40, Society for Clinical Neuropsychology, San Francisco, CA, August 2018.

Cowen SL. Neural Synchrony, Memory, Aging, and Parkinson's Disease. New Mexico EEG, Translation, and Behavior Meeting, Albuquerque, NM, August 2018.

Rance NE. Menopause and the Human Hypothalamus. 22nd Annual Australasian Menopause Society Congress, Brisbane, Australia, August 2018

Barnes CA. Normal Lifespan Changes in Brain Circuits Critical for Memory. Aging of Memory Functions: Where are we Now? International Bordeaux Neurocampus Conferences, University of Bordeaux, September 2018.

Cowen SL. Ketamine and Neural Synchrony. Cognitive Science Colloquium, University of Arizona, Tucson, AZ, September 2018.

Glisky EL. Strategies to Enhance Cognition and Well-being in Normally-aging Older Adults. Advances in Aging Lecture Series, Arizona Center on Aging, University of Arizona, Tucson, AZ, September 2018.

O'Connor MF. Complicated Grief: A Multi-Method Approach. Heymans Institute for Psychological Research Colloquium, University of Groningen, Groningen, Netherlands, September 2018.

Ugonna C, Chen N-K, Sundman M, and **Chou Y-H.** Hippocampal Functional Connectivity in Healthy Older Adults. Sixth Biennial Conference on Resting-State and Brain Connectivity, Montreal, Canada, September 2018.

Alexander GE. Modifiable Health & Lifestyle Factors in Brain Aging and Alzheimer's Disease. University of Arizona Alzheimer's Consortium Meeting, Tucson, AZ, October 2018.

Alexander GE. Neuroimaging of the Aging Brain: Implications for Successful Aging and the Risk for Alzheimer's Disease. Clinical Psychology Program Brown Bag, Department of Psychology, University of Arizona, Tucson, AZ, October 2018.

Brinton RD. The Neurological and Immunological transitions of the Perimenopause: Implications for Post-menopausal Neurodegenerative Disease, North American Menopause Society (NAMS), San Diego, CA, October 2018.

Brinton RD. Sex Differences in Onset of Prodromal Phase of Alzheimer's Disease. Bright Focus Foundation Alzheimer's Fast Track Workshop, San Diego, CA, October 2018.

Cowen SL. Neural Synchrony, Memory, Aging, and Parkinson's Disease, Georgetown University, Washington, DC, October 2018.

Cowen SL. Aging, Oscillations, and Memory Formation. Psychology Colloquium, University of Arizona, Tucson, AZ, October 2018.

Mehl MR. Mobile Psychological Science. Department of Psychology, Free University, Berlin, Germany, October 2018.

Mehl MR. Using Wearable Audio and Photo Capture for Social Environment Sensing: Insights from the Sounds of Social Life Project. Data Acquisition with Novel Technologies, Berlin, Germany, October 2018.

O'Connor MF. Complicated Grief: A Multi-Method Approach. Behavioural and Molecular Neurobiology Seminar, University of Regensburg, Regensburg, Germany, October 2018.

Rance NE. KNDy Neurons, Neurokinin 3 Receptor Signaling and the Etiology of Hot Flashes. Annual Meeting of the North American Menopause Society, San Diego, CA, October 2018

Ashar J-M, Wang S, Franchetti M-K, Keung W, Sundman MH, **Chou Y**, **Alexander G**, and **Wilson RC.** Differential Effects of Healthy Aging on Directed and Random Exploration. Program No. 608.24. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Ashar J, **Andrews-Hanna,** Dimidjian, Wager D. Brain Models of Empathy and Compassion in a Randomized Trial of Compassion Meditation. Program No. 795.05. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Barnes CA. Spatial Cognition in Animal Models of Aging. DZNE Interdisciplinary Symposium on Spatial Cognition in Aging & Neurodegeneration (iSCAN), Magdeburg, Germany, November 2018.

Bharadwaj PK, Nguyen LA, Hishaw GA, **Trouard TP**, Moeller JR, Habeck CG, and **Alexander GE.** Relation of White Matter Lesion Load to Cortical Gray Matter Thickness in Healthy Aging. Program No. 515.05. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Bleul C, Chawla MK, DeBoth MD, **Barnes CA**, and **Huentelman MJ**. Specificity of Activity-regulated Transcript Localization in Somatic and Dendritic Neuronal Compartments. Program No. 245.09. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Brinton RD, Do L, Bernstein AS, Mishra A, Yin F, Desai MK, and **Trouard TP.** Effect of Sex and Apo# Genotype on Regional Brain Volumes and White Matter Integrity in Mice Using High Resolution MR Imaging. Program No. 205.22. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Chen S, Kumar N, Mao Z, Wang T, Sitruk-ware R, and **Brinton RD.** Chronic Exposure to the Therapeutic Progestin Nestorone Promotes Neurogenesis: Implications for Sustaining Regeneration in Female Brain. Program No. 205.15. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Comrie A, Lister JP, Chawla MK, and **Barnes CA.** Lateral but not Medial Entorhinal Cortex Population Representations Become More Sparse with Age. Program No. 245.08. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Cowen SL. Neural Synchrony and Parkinson's Disease. Neuroscience Community Data Blitz on Parkinson's Disease, Tucson, AZ, November 2018.

Carey NJ, Zempare MA, Nguyen CJ, Bohne KM, Chawla MK, Sinari S, **Huentelman MJ**, Billheimer D, and **Barnes CA.** Age-dependent Correlation Between Spatial and Working Memory Does Not Extend to Object Recognition. Program No. 245.05. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Cook SM, Keung W, and **Wilson RC**. Does Raising the Stakes Reduce Mistakes? Reward Affects Some, But Not All, Suboptimalities in a Perceptual Evidence Accumulation Task. Program No. 427.05. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Crown L, Wohlford L, Bartlett MJ, Wiegand J-P, Eby AJ, Monroe E, Gies K, Falk T, and **Cowen SL.** Six month-old LRRK2 GS019S Knock-in Mice Do Not Express Motor Learning Deficits on the Rotarod Task. Program No. 050.04. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

De La Pena NM, Gray DT, Umapathy L, Burke SN, **Trouard TP**, and **Barnes CA.** Tract-specific White Matter Correlates of Age-related Reward Devaluation Deficits in Macaque Monkeys. Program No. 245.02. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Desai M, Irwin RW, Prajapati M, Pathak K, Pirrotte P, and **Brinton RD.** Allopregnanolone Restores Cognitive Function in APOE4+ Females and Males and Promotes Metabolism of Fuels Required for ATP Generation. Program No. 205.19. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Eck RJ, Chawla MK, Siddegowda B, Carey NJ, Zempare MA, Nguyen CJ, **Barnes CA**, and Zarnescu DC. Dynamic Expression of RNA Stress Granule Components in Behaviorally Characterized Young, Middle Aged and Old Rats. Program No. 245.07. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Franchetti M, Bharadwaj PK, Nguyen LA, Klimentidis YC, Hishaw GA, **Trouard TP**, Raichlen DA, and **Alexander GE.** Relation Between Physical Sport Activity and White Matter Hyperintensity Volume in Older Adults. Program No. 515.07. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Glisky EL. Enhancing Memory in Normally Aging Older Adults. Cognitive Science Brown Bag, University of Arizona, Tucson, AZ, November 2018.

Gray DT, Burke SN, Engle JR, Umapathy L, **Trouard TP,** and **Barnes CA.** Thalamocortical White-matter Integrity and the Relationship Between Auditory Function and Cognitive Decline in Aged Macaque Monkeys. Program No. 245.03. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Harootonian SK, Ziskin E, Erlenbach E, **Wilson RC,** and **Ekstrom AD.** Modeling Path Integration in Large-scale Space and with Novel Geometries. Program No. 085.25. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Hernandez GD, Lopez CM, Solinsky CM, Kono N, Irwin RW, Rodgers KE, Aydogan B, Shi Y, Law M, Mack W, Schneider L, and **Brinton RD.** Allopregnanolone as a Regenerative Therapeutic for Alzheimer's Disease: Phase 1 Clinical Train Outcomes. Program No. 205.21. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Hill DF, Olsen Z, Heien ML, and **Cowen SL.** Encoding of Phasic Nucleus Accumbens Dopamine Release by Ventral Tegmental Area Neurons Revealed Through Simultaneous Single-unit Recording and Fast-scan Cyclic Voltammetry. Program No. 556.15. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Keung W, Hagen T, and **Wilson RC.** A Divisive Model of Evidence Accumulation Explains Unequal Weighting of Evidence Over Time in an Auditory Perceptual Decision Making Task. Program No. 333.22. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Kyle C, Stokes J, Meltzer J, Permenter MR, Vogt JA, **Ekstrom AD**, and **Barnes CA.** Convolutional Neural Networks for Fast and Accurate 3D Reconstruction of Histological Sections. Program No. 245.01. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Lester AW, Blum CJ, Kapellusch AJ, and **Barnes CA.** Aged-related Impairments in Spatial Reference Frame Updating. Program No. 245.06. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Mao Z, Yin F, Shang Y, and **Brinton RD.** Hormone Loss and Intervention Initiated at Different Endocrine Status Differentially Regulate Brain Bioenergetic Function: Implications for Alzheimer's Disease. Program No. 205.19. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Mishra A, Yin F, Mao Z, Shang Y, Do L, **Trouard TP**, and **Brinton RD.** Sex Differences in Metabolic and Inflammatory Aging in Humanized APOE-e4 Knock-in Rat Brain. Program No. 205.17. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Mizell J-M, Wang S, Franchetti M-K, Keung W, Sundman MH, **Chou Y**, **Alexander G**, and **Wilson RC.** Differential Effects of Healthy Aging on Directed and Random Exploration. Program No. 608.24. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Pyon, W, Gray DT, Ashford S, and **Barnes CA**. A Direct Comparison of Dye- and Imaging-based Removal of Lipofuscin-induced Autofluorescence from Primate Brain Tissue. Program No. 245.04. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Shang Y, Berghout J, Lussier Y, Yin F, and **Brinton RD.** Perimenopausal Aging Brain is Characterized by a Bioenergetic-inflammatory Transition State that Indicates Alzheimer's Vulnerability. Program No. 205.13. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Talboom JS, Haberg AK, DeBoth M, Naymik M, Siniard AL, **Ryan L**, **Glisky EL**, and **Huentelman MJ.** NPTX2 Knockout Rats: A Novel Model for Protection of Synaptic Function in Aging and Disease. Program No. 245.10. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Terrazas A, Zempare M, Carey NJ, Bohne KM, Do L, **Trouard TP**, Worley PF, and **Barnes CA**. NPTX2 Knockout Rats: A Novel Model for Protection of Synaptic Function in Aging and Disease. Program No. 245.10. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Van Etten E, Bharadwaj PK, Nguyen LA, Hischaw GA, **Trouard TP**, and **Alexander GE.** Hippocampal Mediation of Subjective Memory Complaints Differs by Hypertension Status in Healthy Older Adults. Program No. 515.06. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Wang S, Gilliland A, Calder M, and **Wilson RC.** Deep Exploration Accounts for Stopping Threshold and Behavioral Variability in an Optimal Stopping Task. Program No. 111.09. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Wang T, Yao J, Solinsky CM, Chen S, and **Brinton RD.** Allopregnanolone Rescues Mitrochondrial Dysfunction in Ovariectomized Triple-transgenic Alzheimer's Mouse Brain and Familial Alzheimer's Neural Stem Cells. Program No. 205.16. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Wang Y, Solinsky C, Hernandez G, Schneider L, and **Brinton RD.** Combining Mitrochondrial Haplogroup, APOE Genotype, and Sex as a Predictive Responder Identifier to Regenerative Therapeutic Allopregnanolone for Alzheimer's Disease. Program No. 205.20. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Wilhite CA, Witte RS, and **Cowen SL.** Peak Activation of the CA2 Subregion of the Hippocampus Precedes Peak Activation of CA3 Following Performant-path Stimulation. Program No. 731.07. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

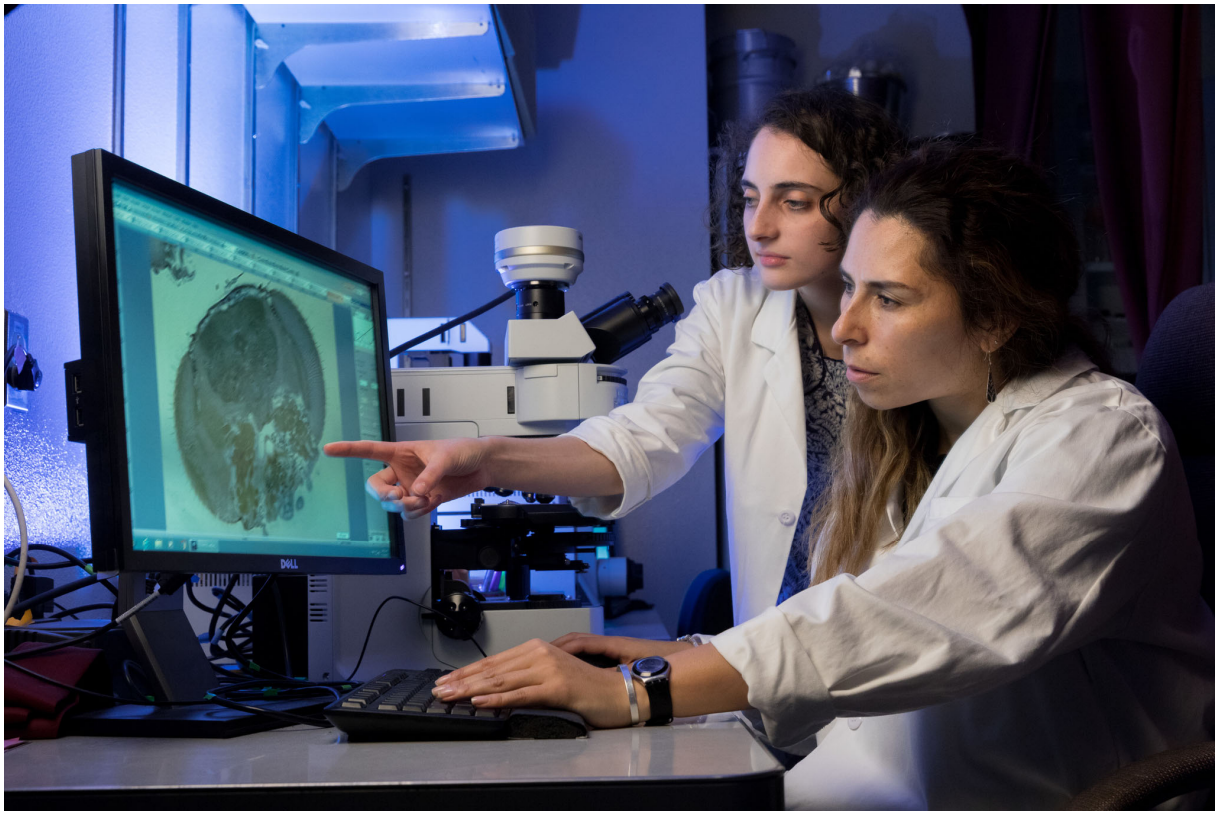
Wilson RC and Cohen JD. Deep Exploration as a Unifying Account of Explore-exploit Behavior. Program No. 111.08. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Wilson RC, Calderon K, Frisvold A, Hakim Z, Mizell J-M, Pena N, Skupny A, and Sylvester S. The CogNeuro Bootcamp – An Education and Outreach Project for High Schoolers and College Students. Program No. 022.06SA. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Ye T, Bartlett MJ, Falk T, and **Cowen SL.** L-DOPA-induced Striatal Gamma Oscillation Split into Low- and High- Frequency Components Following Ketamine Exposure in an Animal Model of L-DOPA-induced Dyskinesia. Program No. 756.21. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Yin F, Desai M, Shang Y, Wang Y, Mao Z, Mishra A, and **Brinton RD.** Impact of APOE Genotype on the Sex Differences in Bioenergetics and Alzheimer's Risks in Aging Mouse Brain. Program No. 205.14. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience. Online, November 2018.

Wilson RC. The Role of Information and Randomization in Exploration and Exploitation. Third Interdisciplinary Symposium on Curiosity: Emerging Sciences and Educational Innovations, University of Pennsylvania, December 2018.



Presentations at public (non-scientific)meetings or events

O'Connor MF. Stress and the Immune System. Southern Arizona Psychological Association Back to School Continuing Education Day, Tucson, AZ, January 2018.

Ryan L. Good for the Heart, Good for the Brain; Maintaining Brain Health as We Age. Sun City, Oro Valley, AZ. January 2018.

Ryan L. The Changing Narrative of the Self. Spirit of the Senses Art Salon, Scottsdale, AZ, February 2018.

Ryan L. Age-Related Changes in Memory. Arizona Senior Academy, Tucson, AZ, February 2018.

Andrews-Hanna JR, Cazarez K, DeStefano N, and Renger J. The Science of Imagination. Outreach talk to College Academy for Parents, University of Arizona, Tucson, AZ, May 2018.

Barnes CA. Memory and the Aging Brain. Museum of Contemporary Art, Tucson, AZ, June 2018.

O'Connor MF. Understanding Grief and Loss: A Practical Half-day Interactive Workshop. Co-presented by University of Arizona, Tu Nudito and Casa de la Luz, June 2018.

Palitsky R, **O'Connor MF**, and Sullivan D. Daily Diary Assessment of Emotion Regulation Flexibility. Annual Meeting of the Association for Assessment and Research in Counseling, Richmond, VA, September 2018.

Barnes CA. Memory and the Aging Brain. Tucson Philanthropic Education Organization, Tucson, AZ, October 2018.

Alexander GE. Exercise and Brain Aging: The Surprising Links Between Your Brain and Body. Sun City, Oro Valley, AZ, November 2018.

Glisky EL. Strategies to Enhance Cognition and Well-being in Normally-aging Older Adults. Arizona Senior Academy, Academy Village, Tucson, AZ, November 2018.

Barnes CA. Memory and the Aging Brain. Freethinkers Groups, Saddlebrooke, AZ, December 2018.

Awards

Jessica Andrews-Hanna, Ph.D., Elected Fellow of the Psychonomics Society (2018)

Carol Barnes, Ph.D., Elected to the National Academy of Sciences (2018)

Carol Barnes, Ph.D., Museum of Contemporary Art Local Genius Award (2018)

Heather Bimonte-Nelson., Ph.D., Michael A. Cusanovich Arizona Bioscience Educator of the Year (2018)

Katalin Gothard, M.D., Ph.D., Outstanding Teaching Award, College of Medicine, University of Arizona (2018)

Meredith Hay, Ph.D. Elected President, National Physiological Society (2018 - currently President-Elect)

Matthew Huentelman, Ph.D., Appointed Standing Member of the Molecular Neurogenetics (MNG) NIH Study Section (2018)

Matthias Mehl, Ph.D., Fellow, Collegium Helveticum & Digital Society Initiative, University of Zürich (2018)

Matthias Mehl, Ph.D., Miegunyah Distinguished Visiting Fellow, University of Melbourne (2018)

Mary Francis O'Connor, Ph.D., American Psychosomaitc Society 7th Anniversary Award, 2017 (Awarded 2018)

Mary Francis-O'Connor, Ph.D., Elected Fellow, Association for Psychological Sciences

Faculty

Complete Faculty List

Director

- Carol A. Barnes, Ph.D., Regents' Professor, Psychology, Neurology and Neuroscience; Director, Evelyn F. McKnight Brain Institute; Evelyn F. McKnight Chair for Learning and Memory in Aging; Director, Division of Neural Systems, Memory and Aging

Associate Director

- Lee Ryan, Ph.D., Professor and Head, Psychology; Director, Cognition and Neuroimaging Labs, University of Arizona

Strategic Advisory Committee

- Martha A. Brumfield, Ph.D., President and Chief Executive Officer, Critical Path Institute; Research Professor, Pharmacology and Toxicology, University of Arizona
- Eric M. Reiman, M.D., Ph.D., Professor, Psychiatry; Associate Head for Research and Development(Phoenix Campus), University of Arizona; Director, Arizona Alzheimer's Disease Consortium; Executive Director, Banner Alzheimer's Institute; Clinical Director, Neurogenomics Program, Translational Genomics Research Institute (TGen)
- Leslie P. Tolbert, Ph.D., Regents' Professor, Neuroscience and Cellular and Molecular Medicine, University of Arizona

Scientific Advisory Committee

(Biographical sketches included in following pages; all scientific advisors are also affiliate faculty)

- Geoffrey L. Ahern, M.D., Ph.D., Professor, Neurology, Psychology and Psychiatry; Medical Director, Behavioral Neuroscience and Alzheimer's Clinic; Bruce and Lorraine Cumming Endowed Chair in Alzheimer's Research, University of Arizona
- Gene E. Alexander, Ph.D., Professor, Psychology, Psychiatry and Neuroscience; Director, Brain Imaging, Behavior and Aging Lab, University of Arizona
- Carol A. Barnes, Ph.D., Regents' Professor, Psychology, Neurology and Neuroscience; Director, Evelyn F. McKnight Brain Institute; Evelyn F. McKnight Chair for Learning and Memory in Aging; Director, Division of Neural Systems, Memory and Aging, University of Arizona
- Roberta Diaz Brinton, Ph.D., Professor, Pharmacology, Neurology and Psychology; Director, Center for Innovation in Brain Science
- Stephen L. Cowen, Ph.D. Assistant Professor, Psychology, Division of Neural Systems, Memory and Aging, Evelyn F. McKnight Brain Institute, University of Arizona
- Elizabeth Glisky, Ph.D., Professor, Psychology, University of Arizona
- Naomi E. Rance, M.D, Ph.D., Professor, Neurology, Cell Biology and Anatomy, and Pathology; Associate Head, Pathology, University of Arizona
- Lee Ryan, Ph.D., Professor, Psychology; Director, Cognition and Neuroimaging Labs, University of Arizona

Additional Affiliate Faculty

(Select biographical sketches included in following pages)

- Jessica Andrews-Hanna, Ph.D., Assistant Professor, Psychology, University of Arizona
- E. Fiona Bailey, Ph.D., Associate Professor, Physiology, University of Arizona
- Heather Bimonte-Nelson, Ph.D., Associate Professor, Honors Disciplinary Faculty; Behavioral Neuroscience Program Director, Arizona State University
- Ying-hui Chou, Ph.D., Assistant Professor, Psychology, University of Arizona
- Paul Coleman, Ph.D., UA Associate, Evelyn F. McKnight Brain Institute, University of Arizona; Research Professor, The Biodesign Institute, Neurodegenerative Disease Research Center, Arizona State University
- Fabian Fernandez, Ph.D., Assistant Professor, Psychology, University of Arizona
- Ralph F. Fregosi, Ph.D., Professor, Physiology, University of Arizona
- Andrew J. Fuglevand, Ph.D., Associate Professor, Physiology, University of Arizona
- Katalin M. Gothard, M.D., Ph.D., Professor, Physiology, University of Arizona
- Matt Grilli, Ph.D., Assistant Professor, Psychology, University of Arizona
- Meredith Hay, Ph.D., Professor, Physiology, University of Arizona
- Matthew J. Huentelman, Ph.D., UA Associate, Evelyn F. McKnight Brain Institute, University of Arizona; Associate Professor, Neurogenomics Division, Translational Genomics Research Institute
- Anita Koshy, M.D., Assistant Professor, Neurology, University of Arizona
- Lalitha Madhavan, MBBS, Ph.D., Assistant Professor, Neurology, University of Arizona
- Diano Marrone, Ph.D., UA Associate, Evelyn F. McKnight Brain Institute; Assistant Professor, Psychology, Wilfrid Laurier University
- Matthias R. Mehl, Ph.D., Professor, Psychology, University of Arizona
- Lynn Nadel, Ph.D., Regents' Professor, Psychology, University of Arizona
- Janko Nikolich-Zugich, M.D., Ph.D., Professor and Chairman, Immunobiology; Co-Director, Arizona Center on Aging, University of Arizona
- Mary-Frances O'Conner, Ph.D., Assistant Professor, Psychology, University of Arizona
- Mary Peterson, Ph.D., Professor, Psychology, University of Arizona
- Steve Rapcsak, M.D., Professor, Neurology, Psychology and Speech, Hearing and Language Pathology, University of Arizona; Chief, Neurology Section, VA Medical Center
- Steve Rapcsak, M.D., Professor, Neurology, Psychology and Speech, Hearing and Language Pathology, University of Arizona; Chief, Neurology Section, VA Medical Center
- Linda L. Restifo, M.D., Ph.D., Professor, Neurology, Neuroscience, Cell Biology and Anatomy, andBIO5 Institute, University of Arizona
- David A. Sbarra, Ph.D., Professor and Director of Clinical Training, Psychology, University of Arizona
- Anne C. Smith, Ph.D., Associate Research Scientist, Evelyn F. Brain Institute, University of Arizona
- Ted P. Trouard, Ph.D., Professor, Biomedical Engineering, University of Arizona
- Robert C. Wilson, Ph.D., Assistant Professor, Psychology, University of Arizona
- Pixuan 'Joe' Zhou, Ph.D., Adjunct Research Professor, Optical Sciences, Univ. of Arizona

Biographical Sketch

Geoffrey Lawrence Ahern, M.D., Ph.D.
Professor, Neurology, Psychology, and Psychiatry

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
SUNY, Purchase College	B.A.	1976	Psychology
Yale University, New Haven	M.S.	1978	Psychology
Yale University, New Haven	Ph.D.	1981	Psychology
Yale University, New Haven	M.D.	1984	Medicine
Waterbury Hospital, Waterbury	Intern	1984 – 1985	Medicine
Boston University, Boston	Resident	1985 – 1988	Neurology
Beth Israel Hospital, Boston	Fellow	1988 – 1990	Behavioral Neurology

Personal Statement

I am a professor of neurology, psychology, and psychiatry at the University of Arizona College of Medicine. I also have an appointment as professor in the Evelyn F. McKnight Brain Institute at the University of Arizona and hold the Bruce and Lorraine Cumming Endowed Chair in Alzheimer's Research. I am a board-certified neurologist with subspecialty board certification in behavioral neurology and neuropsychiatry. Over the past 25 years, I have served as principal investigator or sub-investigator in more than 45 clinical trials in Alzheimer's disease, including those from the pharmaceutical industry as well as the Alzheimer's Disease Cooperative Study (ADCS). I am the director of the University of Arizona clinical arm of the Arizona Alzheimer's Disease Core Center. For the Brain Imaging and Fluid Biomarkers Core, I will provide oversight in the acquisition of CSF and blood samples at the University of Arizona and will work with the nurse practitioners and with Drs. Alexander, Beach, and Blennow in helping to augment efforts in the coordination of the CSF and blood sample acquisition, processing, and analyses as part of the Fluid Biomarkers Workgroup for the BI-FB Core. I will work with Drs. Alexander and Caselli (Clinical Core leader) and BI-FB Core staff to help identify interested ADCC Clinical Core participants for inclusion in the neuroimaging and fluid biomarker standardization cohort. My extensive experience in performing LPs for CSF acquisition and storage for both clinical and research protocols make me well suited to be an investigator on this new core.

1. Beach TG, Adler CH, Sue SI, Serrano G, Shill HA, Walker DG, Lue LF, Roher AE, Dugger BN, Maarouf C, Birdsill AC, Intorcia A, Saxon-Labelle M, Pullen J, Scroggins A, Filon J, Scott S, Hoffman B, Garcia A, Caviness JN, Hentz JG, Driver-Dunckley E, Jacobson SA, Davis KJ, Belden CM, Long KE, Malek-Ahmadi M, Powell JJ, Gale LD, Nicholson LR, Caselli RJ, Woodruff BK, Rapcsak SZ, Ahern GL, ShiJ, Burke AD, Reiman EM, and Sabbagh MN. (2015) Arizona study of aging and neurodegenerative disorders and brain and body donation program. Neuropathology, 35:354-389.
2. Filon J, Intorcia A, Sue LI, Vazquez Arreola E, Wilson J, Davis KJ, Sabbagh MN, Belden CM, Caselli RJ, Adler CH, Woodruff BK, Rapcsak SZ, Ahern GL, Burke AD, Jacobson SA, Shill HA, Driver-Dunckley E, Chen K, Reiman EM, Beach TG, and Serrano G. (2016) Gender differences in Alzheimer's disease: Brain atrophy, histopathology burden, and cognition. Journal of Neuropathology and Experimental Neurology, 75:748-754.

Positions

1977 – 1980	Lab Director, Human Psychophysiology Laboratory, Yale University, New Haven
1985 – 1988	Teaching Fellow, Department of Neurology, Boston University School of Medicine, Boston
1988 – 1990	Instructor, Department of Neurology, Harvard Medical School, Boston
1988 – 1990	Attending Neurologist, Beth Israel Hospital, Boston
1990 – 1996	Assistant Professor, Neurology and Psychology, University of Arizona, Tucson
1990	Attending Neurologist, University Medical Center, Tucson, Arizona
1990 – 1996	Medical Director, Behavioral Neurology Unit, University of Arizona, Tucson
1990	Director, Neurobehavioral Laboratory, University of Arizona, Tucson
1990	Member, Committee on Neuroscience, University of Arizona, Tucson, Arizona
1996 – 1999	Associate Professor, Neurology and Psychology, University of Arizona, Tucson
1996	Director, Behavioral Neuroscience & Alzheimer's Clinic, University of Arizona, Tucson
1999 – 2002	Associate Professor, Neurology, Psychology, Psychiatry, University of Arizona, Tucson
2002	Professor, Neurology, Psychology, and Psychiatry, University of Arizona, Tucson
2007	Professor, Evelyn F. McKnight Brain Institute, University of Arizona, Tucson
2007	Bruce and Lorraine Cumming Endowed Chair in Alzheimer's Research

Honors and Awards

1994	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America	1994 – 1995
1996	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America, Pacific Region	1996 – 1997
1998	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America	1998 – 1999
2003	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America	2003 – 2004
2005	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America	2005 – 2006
2007	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America	2007 – 2008
2009	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America	2009 – 2010
2010	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America	2011 – 2012
2013	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America	2013
2014	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America	2014
2015	Cited in S Naifeh and GW Smith (eds.) The Best Doctors in America	2015 – 2016

Contribution to Science

Paraneoplastic syndromes are entities in which the body produces an antibody against a malignancy, which occasionally reacts against tissues and the brain, leading to a number of characteristic syndromes. During my fellowship, I came upon a patient with intractable epilepsy and severe memory difficulties. Ultimately, he was found to have testicular cancer. In collaboration with the group at Memorial Sloan-Kettering in New York, we were able to identify and characterize a new paraneoplastic antibody, anti-Ta (named after the first two initials of the patient). This antibody was ultimately found to be one of the causes of limbic encephalitis. The field has clearly grown over the past 25 years, and now the anti-Ta antibody has been characterized as coming from the family of the anti-Ma1/ Ma2 paraneoplastic antibody class.

1. Ahern GL, O'Connor M, Dalmau J, Coleman A, Posner JB, Schomer DL, Herzog AG, Kolb DA, Mesulam MM. (1994) Paraneoplastic temporal lobe epilepsy with testicular neoplasm and atypical amnesia. Neurology, 44:1270-1274.
2. O'Connor M, Sieggreen MA, Ahern GL, Schomer D, Mesulam MM. (1997) Accelerated forgetting in association with temporal lobe epilepsy and paraneoplastic encephalitis. Brain and Cognition,35:71-84.

In graduate school, I developed an interest in cerebral lateralization, particularly for emotional processes. Without going into a great deal of detail about the evidence for same, the general principal that appears to have emerged over the past three decades is that while the right hemisphere seems to be more involved in handling emotional issues in general, the left hemisphere tends to be a bit more 'positive' in terms of the emotional valence it handles and the right hemisphere tends to be more 'negative.' Over the years, I have investigated this phenomenon with such wide-ranging techniques as lateral eye movements, facial EMG, EEG spectral analysis, FDG PET scanning, and unilateral hemispheric inactivation produced in the Wada test (the latter studies are considered below under the Wada test).

1. Ahern GL and Schwartz GE. (1979) Differential lateralization for positive versus negative emotion. Neuropsychologia, 17:693-698.
2. Schwartz GE, Ahern GL, and Brown SL. (1979) Lateralized facial muscle response to positive and negative emotional stimuli. Psychophysiology, 16:561-571.
3. Ahern GL and Schwartz GE. (1985) Differential lateralization for positive versus negative emotion in the human brain: EEG spectral analysis. Neuropsychologia, 23:745-755.
4. Lane RD, Reiman EM, Ahern GL, Schwartz GE, and Davidson RJ. (1997) Neuroanatomical correlates of happiness, sadness, and disgust. American Journal of Psychiatry, 154:926-933.

The intracarotid amobarbital test, otherwise known as the Wada test (after its inventor, Juhn Wada), is a technique in which each cerebral hemisphere is transient and activated via the use of sodium amytal injected into the ipsilateral carotid artery. This test is done to determine language dominance, as well as the potential for memory dysfunction, in patients in whom unilateral temporal lobectomy is being considered for intractable epilepsy. Utilizing this technique, I was able to make a number of observations regarding how each cerebral hemisphere handles positive and negative emotion. This includes not only self-report, but the ability to perceive emotion in the faces of others.

1. Ahern GL, Schomer DL, Kleefield J, Blume H, Cosgrove GR, Weintraub S, and Mesulam MM. (1991)Right hemisphere advantage for evaluating emotional facial expressions. Cortex, 27:193-202.
2. Ahern GL, Herring AM, Tackenberg JN, Schwartz GE, Seeger JF, Labiner DM, Weinand ME, and Oommen KJ. (1994) Affective self-report during the intracarotid sodium amobarbital test. Journal of Clinical and Experimental Neuropsychology, 16:372-376.

I was also able to show that the two hemispheres are different in their ability to control heart rate and heart rate variability.

3. Ahern GL, Sollers J, Lane RD, Labiner DM, Herring AM, Weinand ME, Hutzler R, and Thayer J.(2001) Heart rate and heart rate variability changes in the intracarotid sodium amobarbital (ISA)test. Epilepsia, 42, 912-921.

Finally, using EEG spectral analysis, I was able to quantify the time course and spatial extent of hemispheric inactivation during the Wada test.

4. Ahern GL, Labiner DM, Hutzler R, Osburn C, Talwar D, Herring AM, Tackenberg JN, Weinand ME, and Oommen KJ. (1994) Quantitative analysis of the EEG in the intracarotid amobarbital test: I. Amplitude analysis. EEG & Clinical Neurophysiology, 91:21-32.

Hemispatial neglect is a well-known neurological phenomenon that is usually associated with lesions in the right hemisphere. Having trained under Dr. Marsel Mesulam, I was exposed to this phenomenon early in my career. In association with my colleagues, we published a number of reports that elucidated this phenomenon. For instance, we were able to show (in the same patient) that posterior lesions in the right hemisphere led to a greater involvement of the sensory aspects of neglect, while anterior lesions in the right hemisphere led to greater involvement in the motoric intentional aspects of neglect.

1. Daffner KR, Ahern GL, Weintraub SW, and Mesulam MM. (1990) Dissociated neglect behavior following sequential strokes in the right hemisphere. Annals of Neurology, 28:97-101.

We were also able to demonstrate that right hemispatial neglect, which is usually a transient phenomenon, might be more long lasting if there were to be bilateral involvement of attentional systems in the brain.

2. Weintraub SW, Daffner, KR, Ahern GL, Price BH, and Mesulam MM. (1996) Right hemispatial neglect and bilateral cerebral lesions. Journal of Neurology, Neurosurgery, and Psychiatry, 60:342-344.

In a later study, I was able to show that neglect was not an all-or-none phenomenon, but that it could vary in severity depending on the degree of hemispheric dysfunction. This study was performed in patients undergoing the Wada test. During maximal inactivation of the right hemisphere, left hemispatial neglect was quite severe. But as the Amytal wore off, the neglect became profound and this phenomenon correlated perfectly with other measures of right hemispheric function, including the degree of EEG slowing.

3. Ahern GL, Herring AM, Labiner DM, and Weinand ME. (1998) Quantification of hemispatial neglect during the intracarotid amytal procedure. Journal of the International Neuropsychological Society,4:1-7.

Complete list of published work in MyBibliograpy

http://www.ncbi.nlm.nih.gov/sites/myncbi/geoffrey.ahern.1/bibliography/48871570/public/?sort=date&direction=ascending

Research Support

2011 – 2018 Patient Recruitment and Outreach for Alzheimer's Disease and Related Disorders. Arizona Alzheimer's Center, State of Arizona. 3.7% effort. (overall PI: E. Reiman, MD)

2012 – 2018 Alzheimer's Disease Core Center – UAHSC Clinical Core. Protocol # P30 AG19610-01, National Institute on Aging. 10% effort. (overall PI: E. Reiman, MD)

2013 – Present A Placebo-controlled, Double-blind, Parallel-group, Bayesian Adaptive Randomization Design and Dose Regimen-finding Study to Evaluate Safety, Tolerability and Efficacy of BAN2401 in Subjects with Early Alzheimer's Disease. Protocol # BAN2401-G000-201. Eisai. 2% effort.

2013 – Present Effect of Passive Immunization on the Progression of Mild Alzheimer's Disease: Solanezumab (LY2062430) versus Placebo. Protocol # H8A-MC-LZAX. Lilly Pharmaceuticals. 2% effort.

2013 – Present A Phase III, Randomized, Placebo-Controlled, Parallel-Group, Double-Blind Clinical Trial to Study the Efficacy and Safety of MK-8931 (SCH 900931) in Subjects with Amnestic Mild Cognitive Impairment Due to Alzheimer's Disease (Prodromal AD). Protocol # 019-00. Merck Sharp & Dohme. 2% effort.

2015 – Present Randomized, Double-Blind, Placebo Controlled, Multi-center Registration Trial to Evaluate the Efficacy and Safety of TTTP488 in Patients with Mild Alzheimer's Disease Receiving Acetylcholinesterase Inhibitors and/or Memantine. Protocol # TTP488-301. Trans Tech Pharma, LLC. Total grant: $22,213.75 /patient. 2% salary support, 2% effort.

Biographical Sketch

Gene Alexander, Ph.D.
Professor, Psychology and Psychiatry

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
Pomona College, Claremont, CA	B.A.	1983	Psychology
Loyola University of Chicago, Chicago, IL	M.A.	1987	Clinical Psychology
Loyola University of Chicago, Chicago, IL	Ph.D.	1992	Clinical Psychology

Personal Statement

I am a professor in the Departments of Psychology and Psychiatry, the Evelyn F. McKnight Brain Institute, the BIO5 Institute, and the Neuroscience and Physiological Sciences Graduate Programs at the University of Arizona. I also am director of the Brain Imaging, Behavior and Aging Lab; a member of the Internal Scientific Advisory Committee for the state-supported Arizona Alzheimer's Consortium; a member of the ADCC Executive Committee, and director of the Brain Imaging and Fluid Biomarkers Core for the NIA Arizona Alzheimer's Center. Prior to coming to Arizona, I was chief of the Neuropsychology Unit in the Laboratory of Neurosciences in the Intramural Research Program at the NIA. I serve as a member of the NIA Neuroscience of Aging Study Section and am a fellow of the Association for Psychological Sciences and the American Psychological Associations Society for Clinical Neuropsychology. My research is supported by the NIA, the State of Arizona and Arizona Department of Health Services, and the McKnight Brain Research Foundation. I have 20 years of experience as a neuroimaging researcher on the effects of aging and risk factors for age-related neurodegenerative disease. I use structural and functional magnetic resonance imaging (MRI) and positron emission tomography (PET) to investigate the effects of multiple health and lifestyle factors on the cognitive and brain changes associated with healthy and pathological aging, with the goal of developing new interventions for the effects of cognitive aging.

1. Kern KC, Wright CB, Bergfield KL, Fitzhugh M, Chen K, Moeller JR, Nabizadeh N, Elkind MSV, Sacco RL, Stern Y, DeCarli C, and Alexander GE. (2017) Blood pressure control in aging predicts cerebrala trophy related to small-vessel white matter lesions. Frontiers in Aging Neuroscience, 9, 132.
2. Cohen RA and Alexander GE. (in press) Using the Telephone Interview for Cognitive Status and Telephone Montreal Cognitive Assessment for evaluating vascular cognitive impairment: Promising call or put on hold? Stroke. (Invited editorial)
3. Alexander GE. (2017) An emerging role for imaging white matter in the preclinical risk for Alzheimer disease: Linking ß-amyloid to myelin. JAMA Neurology, 74(1), 17-19. (Invited editorial)
4. Raichlen DA and Alexander GE. (2017) Adaptive Capacity: An evolutionary neuroscience model linking exercise, cognition, and brain health. Trends in Neurosciences, 40(7), 408-421.

Research and Professional Experience

1988 – 1989	Clinical Psychology Intern, Department of Psychiatry & Behavioral Science, University of Washington, Seattle
1989 – 1992	Research Fellow, Dept. of Brain Imaging, NYSPI and Columbia University, NY
1991 – 1993	Research Scientist I, Dept. of Brain Imaging, NYSPI and Columbia University, NY
1993 – 1999	Staff Fellow to Sr. Staff Fellow, Laboratory of Neurosciences, NIA, NIH, Bethesda

1993 – 1999	Chief, Neuropsychology Unit, Laboratory of Neurosciences, NIA, NIH, Bethesda
1999 – 2003	Research Assoc Professor, Dept. of Psychology, Arizona State University, Tempe
2001 – 2009	Director, Data Management and Statistics Program/Core, Arizona ADC
2003 – 2007	Professor, Psychology Dept., Arizona State University, Tempe
2007 – Present	Professor, Psychology Dept & Evelyn F McKnight Brain Institute, University of Arizona, Tucson
2007 – Present	Director, Brain Imaging, Behavior & Aging Lab, Psychology Dept., University of Arizona, Tucson
2007 – Present	Professor, Neuroscience Graduate Interdisciplinary Program, University of Arizona, Tucson
2011 – Present	Professor, Physiological Sciences Graduate Interdisciplinary Program, University of Arizona
2017 – Present	Member, BIO5 Institute, University of Arizona, Tucson
2017 – Present	Professor, Department of Psychiatry, College of Medicine Tucson, University of Arizona

Honors and Awards

1995 – Present	Ad Hoc Reviewer, more than 20 journals in Neuropsychology, Psychiatry, Neurology, and Neuroscience.
1996 – 1999	Staff Recognition Awards (annual), Laboratory of Neurosciences, IRP, NIA, NIH
2000 – Present	Reviewer, Alzheimer's Association Research Grant Program
2003 – 2007	Member, Study Section, Clinical Neuroscience and Disease, IRG, CSR, NIH
2003	Member, SEP, Women's Health Initiative Memory Study, Review Branch, NHLBI, NIH
2004	Member, Special Emphasis Panel, Alzheimer's Disease Center Grant Review, NIA, NIH
2004 – 2009	External Advisor, Aging Brain: Vasculature, Ischemia & Behavior Program Project, UCSF/Davis
2005 – 2007	Member, Specialist Review Committee, Psychology: Exp/Clinical, Fulbright Scholar Program
2006	Chair, SEP, Clinical Neuroscience & Disease, ZRG1 BDCN-E, IRG, CSR, NIH
2008	Member, SEP, Prog Project Review Group, Recovery from Illness, ZAG1 ZIJ-8 O1, NIA, NIH
2008	Member, Study Section, Brain Injury & Neurovascular Pathology, ZRB 1 BDCN-L (07), CSR, NIH
2008	Member, SEP, SPRINT Center Review, ZHL1 CCT-B C2 1, NHLBI, NIH
2008 – Present	Member, Neuroimaging Workgroup, International Conf. on Alzheimer's Disease/ISTAART
2009	Reviewer, SEP, Challenge Grant Panel #10, ZRG1 BDA-A 58 R, CSR, NIH
2009	Member, SEP, P30 Faculty Recruitment in Biomedical Research Core Centers, NIA, NIH
2009	Member, SEP, RC2 Grand Opportunity Grants in Genetics, Epigenetics & Genomics, NIA, NIH
2009	Member, SEP, Program Project Review Group, Brain Dopamine, ZAG1 ZIJ-8 J3, NIA, NIH
2009	Member, SEP, Prog. Project Review. Group, Neuroimaging and Aging, ZAG1 ZIJ-5 JF, NIA, NIH
2010	Member, Neurological Sciences & Disorders K Review Committee, NSD-K, NINDS, NIH
2010 – 2012	Member, Neuroscience of Aging Review Committee, NIA-N, NIA, NIH

2010	Member, SEP, Prog. Project Rev., Exercise, Motor Deficits, & Aging, ZAG1-ZIJ-9, NIA, NIH
2010	Member, SEP, Prog. Project Review, Dopaminergic Dysfunct. Aging, ZAG1 ZiJ-6 J3, NIA, NIH
2011	Chairperson, Member Special Emphasis Panel, ZAG1 ZIJ-7 (J1), NIA, NIH
2011 – 2014	Advisory Editor, Neurobiology of Aging, Elsevier
2011	Member, VA MHBB Merit Review Subcommittee, Veterans Administration
2011	Member, SEP, Biobehavioral Research Award Innovative New Scientists (BRAINS), ZMH1ERBL04, NIMH, NIH
2011 – Present	Reviewer, Alzheimer's Disease Pilot Grant Program, Arizona Alzheimer's Disease Center
2011 – Present	Fellow, Association for Psychological Science
2012	Member, Neurological Sciences & Disorders K Review Committee, NSD-K, NINDS, NIH
2012 – Present	Member, Cognitive Workgroup, Evelyn F. McKnight Brain Institute
2012 – Present	Member, MRI Standardization Workgroup, Evelyn F. McKnight Brain Institute
2012 – Present	Co-Director, Annual Conference on Successful Aging, University of Arizona
2013	Member, SEP, Neurodegenerative & Neurodevelopmental Disease, ZRG1BDCN-Y(02), NIA, NIH
2013	Member, SEP, Psychol. Health, Development & Aging, 10 ZRG1 BBBP-D (02), NIA, NIH
2013	Member, Alzheimer's Disease Research Centers Review, ZAG1ZIJ4J1, NIA, NIH
2013 – Present	Member, Neuroscience of Aging Review Committee, NIA-N, NIA, NIH
2014	Member and Chairperson, Biobehavioral & Behavior. Processes Review Group, ZRG1BBBPY04, CSR, NIH
2015 – Present	Guest Assoc. Editor, Neuroimaging Approaches to Cognitive Aging, Frontiers Aging Neuroscience
2015 – Present	Chair, Research Committee, Department of Psychology, University of Arizona
2016	Member, SEP, Alzheimer's Disease Center Review, ZAG1 ZIJ-1 M1, NIA, NIH
2016	Member, SEP, Prevention Trial Review, ZAG1 ZIJ-1 M2, NIA, NIH
2017 – Present	Fellow, American Psychological Association Division 40, Society for Clinical Neuropsychology

Contribution to Science

Brain Imaging and Cognitive Effects of Age-Related Dementia. My early research interests focused on understanding brain-behavior relationships in the context of Alzheimer's dementia with the use of functional and structural neuroimaging methods combined with measures of cognition and demographic characteristics. My initial work in this area, with Dr. Yaakov Stern, led to the first functional neuroimaging findings to suggest the potential for a brain-based, cognitive reserve against the effects of Alzheimer's disease. My research then expanded to include measures of cerebral metabolism with PET, further supporting the concept of cognitive reserve and the use of PET as a method to evaluate treatments to delay or diminish declines in cerebral metabolism over time in Alzheimer's dementia.

1. Stern Y, Alexander GE, Prohovnik I, and Mayeux R. (1992) Inverse relationship between educationand parietotemporal perfusion deficit in Alzheimer's disease. Ann Neurol, 32, 371-5.
2. Alexander GE, Prohovnik I, Stern Y, and Mayeux R. (1994) WAIS-R subtest profile and corticalperfusion in Alzheimer's disease. Brain and Cognition, 24, 24-43.
3. Alexander GE, Furey M, Grady CL, Pietrini P, Brady D, Mentis MJ, and Schapiro MB. (1997)Association of premorbid function with cerebral metabolism in Alzheimer disease:

Implications for the cognitive reserve hypothesis. Am J Psychiatry, 154, 165-172. (Article featured in journal editorial)

4. Alexander GE, Chen K, Pietrini P, Rapoport SI, and Reiman EM. (2002) Longitudinal PET evaluation of cerebral metabolic decline in dementia: A potential outcome measure in Alzheimer's disease treatment studies. Am J Psychiatry, 159, 738-745. (Article featured on journal cover and editorial)

Brain Imaging and Cognitive Effects of Healthy Aging. In more recent years, my research program has sought to better understand heterogeneity across the spectrum from successful to pathological aging. This work includes studies of healthy aging across the adult age range using structural and functional brain imaging methods combined with standardized and computerized measures of cognition. Additionally, I have an interest in extending my research in humans to nonhuman animal models of aging and age-related disease. The following publications provide examples of my work using both univariate and novel multivariate network analysis methods to evaluate patterns of brain structure in older adults, as well as functional brain regions and cognitive processes impacted by brain aging.

1. Alexander GE, Chen K, Merkley TL, Reiman EM, Caselli RJ, Aschenbrenner M, Santerre-Lemmon L,Lewis DJ, Pietrini P, Teipel SJ, Hampel H, Rapoport SI, and Moeller JR. (2006) Regional Network of MRI Gray Matter Volume in Healthy Aging. NeuroReport, 17, 951-6.
2. Bergfield KL, Hanson KD, Chen K, Teipel SJ, Hampel H, Rapoport SI; Moeller JR, and Alexander GE.(2010) Age-related networks of regional covariance in MRI gray matter: Reproducible multivariate patterns in healthy aging. NeuroImage, 49, 1750-9.
3. Alexander GE, Ryan L, Bowers D, Foster TC, Bizon JL, Geldmacher DS, and Glisky EL. (2012)Characterizing Cognitive Aging in Humans with Links to Animal Models. Frontiers in Aging Neuroscience, 4, 21.
4. Ryan L, Cardoza JA, Barense MD, Kawa KH, Wallentin-Flores J, Arnold WT, and Alexander GE. (2012)Age-related impairment in a complex object discrimination task that engages perirhinal cortex. Hippocampus, 22, 1978-89.

Method Development, Evaluation, and Implementation for Neuroimage Analysis Approaches. My work also includes the development, evaluation, and implementation of novel analysis methods for neuroimaging data. Early in my research, I recognized the importance of applying analysis methods that have the potential to more fully capture the rich regional information obtained within functional and structural brain images. My work in this area has focused on the application of novel multivariate network analysis methods to characterize regional patterns of covariance in brain scans to better understand the effects of brain aging and age-related disease. I have applied this approach to PET cerebral metabolism, functional MRI, and multimodal approaches that combine across imaging modalities. I have also performed the first application of this approach to structural MRI in both humans and in a nonhuman primate model of aging. The example publications below illustrate my research efforts in this area.

1. Alexander GE and Moeller JR. (1994) Application of the Scaled Subprofile Model to functional imaging in neuropsychiatric disorders: A principal component approach to modeling regional patterns of brain function in disease. Human Brain Mapping, 2, 79-94. (Article featured on journal cover)
2. Chen K, Reiman EM, Zhongdan H, Caselli RJ, Bandy D, and Alexander GE. (2009) Linking functional and structural brain images with multivariate network analyses: A novel application of the partial east square method. Neuroimage, 47, 602-10.
3. Smith JF, Chen K, Johnson SC, Morrone-Strupinsky J, Reiman EM, Nelson A, Moeller JR, and Alexander GE. (2006) Network analysis of single-subject fMRI during finger opposition task. Neuroimage, 32, 325-32.

4. Alexander GE, Chen K, Aschenbrenner M, Merkley TL, Santerre-Lemmon LE, Shamy JL, Skaggs WE, Buonocore MH, Rapp PR, and Barnes CA. (2008) Age-related regional network of magnetic resonance imaging gray matter in the rhesus macaque. Journal of Neuroscience, 28, 2710-8.

Large Multi-Institutional Collaborative Projects: Additionally, my research has included participation in several large multi-institutional collaborative research projects that have had a significant impact on the field, including supporting efforts to identify imaging methods for the evaluation of treatments, to aid diagnosis, and to enhance prevention research for Alzheimer's disease and dementia. These projects have included the Alzheimer's Disease Neuroimaging Initiative (ADNI), for which I served as a member of the MRI and PET Cores, as well as other multi-institutional projects on APOε risk and pathology confirmed dementia. Examples of my collaborative publications are illustrated below.

1. Silverman DHS, Small GW, Chang CY, Lu CS, Kung de Aburto MA, Chen W, Czernin J, Rapoport SI, Pietrini P, Alexander GE, Schapiro MB, Jagust WJ, Hoffman JM, Welsh-Bohmer KA, Alavi A, Clark CM, Salmon E, de Leon MJ, Mielke R, Cummings JL, Kowell AP, Gambhir SS, Hoh CK, and Phelps ME. (2001) Neuroimaging in evaluation of dementia: Regional brain metabolism and long-term outcome. JAMA, 286, 2120-7. (Article featured in press release)
2. Jack CR Jr, Bernstein MA, Fox NC, Thompson P, Alexander G, Harvey D, Borowski B, Britson PJ, Whitwell J, Ward C, Dale AM, Felmlee JP, Gunter JL, Hill DL, Killiany R, Schuff N, Fox-Bosetti S, Lin C, Studholme C, DeCarli CS, Krueger G, Ward HA, Metzger GJ, Scott KT, Mallozzi R, Blezek D, Levy J, Debbins JP, Fleisher AS, Albert M, Green R, Bartzokis G, Glover G, Mugler J, and Weiner MW. (2008)The Alzheimer's Disease Neuroimaging Initiative (ADNI): MRI methods. J Magnetic Resonance Imaging, 27,685-91.
3. Reiman EM, Chen K, Liu X, Bandy D, Yu M, Lee W, Ayutyanont N, Keppler J, Reeder SA, Langbaum JB, Alexander GE, Klunk WE, Mathis CA, Price JC, Aizenstein HJ, DeKosky ST, and Caselli RJ.(2009) Fibrillar amyloid-beta burden in cognitively normal people at 3 levels of genetic risk for Alzheimer's disease. Proceedings of the National Academy of Sciences USA, 106, 6820-5.
4. Leow AD, Yanovsky I, Parikshak N, Hua X, Lee S, Toga AW, Jack CR, Bernstein MA, Britson PJ, Gunter JL, Ward CP, Borowski B, Shaw LM, Trojanowski JQ, Fleisher AS, Harvey D, Kornak J, Schuff N, Alexander GE, Weiner MW, Thompson PM; for the ADNI study. (2009) Alzheimer's Disease Neuroimaging Initiative: A one-year follow up study using tensor-based morphometry correlating degenerative rates, biomarkers and cognition. Neuroimage, 45, 645-55.

Health, Lifestyle, and Genetic Risk Factors for Pathological Aging. A major focus of my current research interests includes integrating health status, lifestyle characteristics, and genetics with brain imaging and cognitive testing to investigate healthy and pathological brain aging and the risk for Alzheimer's disease. For example, my work was the first to demonstrate an interaction between age and hypertension on brain volume in aging and has contributed to our understanding of how the APOε ε4 allele impacts cognition and brain structure over the adult lifespan. I have also recently proposed a new hypothesis suggesting that demands for exercise may have interacted with APOE status to influence the evolution of the human lifespan, which was recently featured on the cover of Trends in Neurosciences

1. Strassburger TL, Lee HC, Daly E, Szczepanik J, Krasuski JS, Mentis MJ, Salerno JA, DeCarli C, Schapiro MB, and Alexander GE. (1997) Interactive effects of age and hypertension on structural brain volumes. Stroke, 28, 1410-1417. (Article featured in journal editorial & AHA press release)
2. Alexander GE, Bergfield KL, Chen K, Reiman EM, Hanson KD, Lin L, Bandy D, Caselli RJ, and Moeller JR. (2012) Gray matter network associated with genetic risk for Alzheimer's disease in young toearly middle-aged adults. Neurobiology of Aging, 33, 2723-32.

3. Caselli RJ, Reiman EM, Osborne D, Hentz JG, Baxter LC, Hernandez JL, and Alexander GE. (2004)Longitudinal changes in cognition and behavior in asymptomatic carriers of the APOE ε4 allele. Neurology, 62, 1990-5.
4. Raichlen DA and Alexander GE. (2014) Exercise, APOE genotype, and the evolution of the human lifespan. Trends in Neurosciences, 37, 247-55. (Article featured on journal cover)

Complete list of published work in MyBibliograpy

http://www.ncbi.nlm.nih.gov/sites/myncbi/gene.alexander.1/bibliography/41140485/public/?sort=date&direction=ascending [Google Scholar H-Index = 68]

Research Support

NIA RO1 AG049464 Alexander, Barnes, Coleman (MPIs) 8/1/14 – 3/31/20
Epigenetic, Neuroimaging and Behavioral Effects of Hypertension in the Aging Brain
The goal is to determine epigenetic changes induced by hypertension in brain regions important for cognition.
Role on Project: Contact PI

NIA 3P30AG019610-19S1 Alexander (Core Leader), Reiman (PI) 9/15/18 – 6/30/21
Brain Imaging and Fluid Biomarkers Core
The goal of this supplement grant is to establish a new core to support brain imaging and biomarker research as part of the Arizona Alzheimer's Disease Center.
Role on Project: Core Leader

McKnight Brain Research Foundation Alexander, Bowers, Woods (MPIs) 5/1/18 – 4/30/20
A Pilot Intervention with Near Infrared Stimulation: Revitalizing Cognition in Older Adults
The goal is to evaluate the potential of near infrared light as an intervention for healthy cognitive aging.
Role on Project: PI

McKnight Brain Research Foundation Alexander, Cohen, Levin, Wadley (MPIs) 9/1/15 – 12/31/18
McKnight Inter-Institutional Cognitive Aging Assessment Core
The goal is to provide standardized clinical and cognitive measures for multi-institutional brain aging research.
Role on Project: PI

McKnight Brain Research Foundation Alexander, Cohen, Visscher Wright(PIs) 1/1/15 – 12/31/18
McKnight Inter-Institutional Neuroimaging Core and Brain Aging Registry
The goal is to establish neuroimaging acquisition and a multisite brain aging registry to study brain aging.
Role on Project: PI

NIA R01 AG054077 Cohen, Marsiske, Woods (MPIs) 9/1/16 – 8/31/21
Augmenting Cognitive Training in Older Adults – The ACT Grant
This multisite RCT will evaluate cognitive training and transcranial direct current stimulation for brain aging.
Role on Project: PI of the UA Field Center and UA subcontract

AZ Alzheimer's Consortium (ADHS) Alexander (PI) 7/1/18 – 6/30/19
Influence of Health & Lifestyle Factors on Brain Aging and the Risk for Alzheimer's Disease

The goal is to study health and lifestyle factors that alter effects of brain aging and cognitive health.
Role on Project: PI

NIA R03 AG055020 Su (PI) 7/1/17 – 4/3019
Ultra-sensitive and Label-free Detection of Alzheimer's Disease Biomarkers
This goal is to evaluate a highly sensitive method to identify Alzheimer's biomarkers in fluid samples.
Role on Project: Co-Investigator

NIA P30 AG019610 Reiman (PI) 7/1/16 – 6/30/21
Arizona Alzheimer's Disease Core Center
This center provides core resources to support Alzheimer's disease research in the Arizona region.
Role on Project: Co-Investigator and member of the Data Management and Statistics Core

NIH 3 R01 AG031581 Reiman, Caselli (MPIs) 4/1/14 – 3/31/19
Brain Imaging, APOE & the Preclinical Course of Alzheimer's disease
The goal is to characterize the brain changes in those at risk for Alzheimer's disease with the APOE ε4 allele.
Role on Project: Co-Investigator and PI of the UA subcontract.

NIA R01 AG049465 Barnes (PI) 8/1/14 – 3/31/19
Neural System Dynamics and Gene Expression Supporting Successful Cognitive Aging
The goal is to use cognitive, neurobiological and molecular methods to test reserve in a rodent model of aging.
Role on Project: Co-Investigator

NIA 1R56 AG061888 Wilson (PI) 9/30/18 – 3/31/19
Evaluating the Neurocomputational Mechanisms of Explore-Exploit Decision Making in Older Adults
The goal is to use cognitive, neurobiological and molecular methods to test reserve in a rodent model of aging.
Role on Project: Co-Investigator

ADHS State of Arizona Koren (PI) 7/1/18 – 6/30/19
BAI Radiochemistry PET Tracer Development
The goal of this project is to increase the availability of Aß and tau PET scans for research studies in Phoenix and Tucson.
Role on Project: Co-Investigator

Biographical Sketch

Jessica Andrews-Hanna, Ph.D.
Assistant Professor, Psychology

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
Duke University, Durham, NC	B.A.	2003	Biology, Psychology
Washington University, St. Louis, MO	M.A.	2006	Neuroscience
Harvard University, Cambridge, MA	Ph.D.	2009	Psychology
University of Colorado, Boulder, CO	Postdoc	2014	Cognitive Neuroscience

Personal Statement

Despite constant sensory input from our busy environment, the human mind has the capacity to overcome external constraints in favor of a different time, place, or perspective. By imagining what was or what might be, and by reflecting on our emotions and simulating the mental states of other people, we become better adapted to predict our future mental states and navigate our social world. My research seeks insight into the psychological and neural mechanisms underlying these internally guided processes and their top-down regulation. Related to this central theme, I am also passionate about exploring these questions across the lifespan and in a variety of mental health disorders and neurodegenerative diseases, with an ultimate goal of developing interventions to help individuals harness the beneficial aspects of internally guided cognition and live happier, healthier lives.

I currently direct the Neuroscience of Emotion & Thought (NET) Laboratory at the University of Arizona, where I am also an assistant professor in the Department of Psychology and the Interdisciplinary Cognitive Science Program. I have a strong record of collaboration and research funding and have received grant support as PI or Co-I on several neuroimaging grants examining the neural underpinnings of functional and dysfunctional memory, prospection, and other forms of internally guided cognition. I employ a multimodal approach in my research, combining methods spanning task-related functional MRI, resting state functional connectivity MRI (RSFC-MRI), fMRI meta-analyses, and laboratory and naturalistic behavioral assessments. I have particular expertise in RSFC-MRI and brain network analyses, including graph theory. Using these techniques, my research has revealed important insight into the functional-anatomic organization of the brain's default mode network (DMN) and the frontoparietal control network, delineated how these large-scale brain systems develop throughout adolescence and change in normal and pathological aging, pointed to hyperconnectivity of the DMN in the first meta-analysis of RSFC-MRI in depression, and applied dynamic RSFC-MRI to clinical populations.

1. Andrews-Hanna JR, Snyder AZ, Vincent JL, Lustig C, Head D, Fox MD, Raichle ME, and Buckner RL.(2007) Evidence for large-scale network disruption in advanced aging. Neuron, 56:924-935.
2. Andrews-Hanna JR, Reidler J, Poulin R, and Buckner RL. (2010) Functional-anatomic fractionation of the default network. Neuron, 65:550-562.
3. Andrews-Hanna JR, Smallwood JS, and Spreng RN. (2014) The default network and self-generated thought: Component processes, dynamic control, and clinical relevance. Annals NY Acad Sci – Special Issue: The Year in Cognitive Neuroscience (Invited Review), 1316:29-52.
4. Andrews-Hanna JR, Saxe R, and Yarkoni T. (2014) Contributions of episodic retrieval and mentalizing to autobiographical thought: Evidence from functional neuroimaging, resting-state connectivity, and fMRI meta-analyses. Neuroimage 91:324-335

Positions

2017 – Present	Assistant Professor, Department of Psychology; Interdisciplinary Program in Cognitive Science, University of Arizona
2014 – 2016	Research Scientist/Associate, Institute of Cognitive Science, University of Colorado, Boulder
2009 – 2014	Postdoctoral Fellow, Institute of Cognitive Science, University of Colorado, Boulder

Honors

2003	Graduated with Distinction at Duke University
2004 – 2006	Washington U. in St. Louis Cognitive, Computational, and Systems Neuroscience Fellowship
2006	Washington U. in St. Louis Alzheimer's Disease Research Center Travel Fellowship
2007 – 2008	Harvard University Sosland Family Graduate Fellowship Award
2008	Thompson Reuter's Science Watch Award for Fast-Breaking Paper
2009	Harvard Psychology Department Excellence in Teaching Award
2011	NIMH Summer Institute in Cognitive Neuroscience Fellow
2011 – 2014	Ruth L. Kirschstein National Research Service Award (NRSA) Postdoctoral Fellowship
2012	Intermountain Neuroimaging Consortium Pilot Funding Award
2013	Mind & Life Summer Research Institute Fellow
2013	Neuron 25 Year Anniversary: Featured influential paper from 2010
2015	Science of Prospection Award, Templeton Foundation
2016	Neuroimage Editor's Choice Award best paper (2016)
2017	Kavli Foundation / U.S. National Academy of Science Frontiers of Science Fellow
2018	Fellow of the Psychonomics Society

Contribution to Science

Across a series of studies employing task-related fMRI and fMRI meta-analyses, resting-state functional connectivity, graph theory, and experience sampling methods, I demonstrated that the default network is organized into interacting subsystems that support mnemonic, social, and affective aspects of internally guided cognition. More specifically, my work reveals that a "medial temporal subsystem" allows us to retrieve past information and flexibly recombine this information into imagined future episodes. By contrast, meta-cognitive aspects of self-generated cognition engage the "dorsal medial subsystem," allowing us to reflect upon the mental states of ourselves and other people. These subsystems are anatomically and functionally connected with midline "hubs" – the anterior medial prefrontal cortex and posterior cingulate cortex – hypothesized to signal the affective significance and personal meaning of incoming information. Collectively, this line of work led to a novel neurocognitive model of self-generated cognition as a multi-faceted phenomenon comprising several interacting component processes.

1. Andrews-Hanna JR, Reidler J, Poulin R, and Buckner RL. (2010) Functional-anatomic fractionation of the default network. Neuron, 65:550-562.
2. Andrews-Hanna JR, Saxe R, and Yarkoni T. (2014) Contributions of episodic retrieval and mentalizing to autobiographical thought: Evidence from functional neuroimaging, resting-state connectivity, and fMRI meta-analyses. Neuroimage, 91:324-335.

3. Andrews-Hanna JR, Smallwood JS, and Spreng RN. (2014) The default network and self-generated thought: Component processes, dynamic control, and clinical relevance. Annals NY Acad Sci – Special Issue: The Year in Cognitive Neuroscience (Invited Review), 1316: 29-52.
4. Buckner RL, Andrews-Hanna JR, and Schacter DL. (2008) The brain's default network: Anatomy, function, and relevance to disease. Annals of the NY Academy of Science, Special Issue: The Year in Cognitive Neuroscience (Invited Review), 1124:1-38.

Since its delineation in the early 2000s, the brain's default network has largely been viewed as a passive, task-negative brain system with minimal contributions to goal-directed cognition. My work is widely recognized for challenging these predominant views, revealing that the default network plays a key role in several active forms of self-generated cognition spanning autobiographical and episodic memory, theory of mind, emotion, and self-referential thought. Some of my more recent work uses dynamic behavioral approaches and dynamic functional connectivity to explore how network interactions between the default network and other large-scale brain networks unfold and change over time.

1. Andrews-Hanna JR, Saxe R, and Yarkoni T. (2014) Contributions of episodic retrieval and mentalizing to autobiographical thought: Evidence from functional neuroimaging, resting-state connectivity, and fMRI meta-analyses. Neuroimage, 91:324-335.
2. Andrews-Hanna JR. (2012) The brain's default network and its adaptive role in internal mentation. The Neuroscientist, 18:251-70.
3. Zabelina DL and Andrews-Hanna JR. (2016) Dynamic network interactions supporting internally-oriented cognition. Current Opinion Neurobiology, 40:86-93.
4. Dixon M, Andrews-Hanna JR, Spreng RN, Irving ZC, Mills C, Girn M, and Christoff K. (2017)Interactions between the default network and dorsal attention network vary across default subsystems, time, and cognitive states. Neuroimage, 147:632-649.

A large body of my research involves developing methodological approaches to examine spontaneous thought, a topic that has received little experimental attention despite its ubiquitous nature and clinical relevance. My work in this domain has revealed that spontaneous thought is a frequent, heterogeneous, and often adaptive phenomenon that can be quantified through rigorous, ecologically valid experimental investigation. My 2010 paper in the Journal of Neurophysiology was the first to quantify what individuals think about during the so-called "resting state" and link these thoughts to patterns of resting state connectivity. In later work, I used hierarchical clustering to distill thought content into major dimensions that explain a considerable amount of individual variability in traits relevant to mental health. As part of a Templeton Foundation Science of Prospection Award (PI), I recently developed a smartphone application (Where's My Mind? ©2015) with the goal to create a publicly accessible international database of the causes, content, and consequences of spontaneous thought in daily life.

1. Andrews-Hanna JR, Reidler J, Huan, C, and Buckner RL. (2010) Evidence for the default network's role in spontaneous cognition. Journal of Neurophysiology, 104:322-335.
2. Andrews-Hanna JR, Kaiser R, Turner A, Reineberg A, Godinez D, and Banich MT. (2013) A penny for your thoughts: Dimensions of self-generated thought content and relationships with individual differences in emotional well-being. Frontiers in Psychology – Special Issue on Mind-Wandering,4:900.
3. Christoff K, Irving Z, Fox KC, Spreng RN, and Andrews-Hanna JR. (2016) Mind-wandering as spontaneous thought: A dynamic framework. Nature Reviews Neuroscience, 17:718-731.
4. Smallwood J and Andrews-Hanna JR. (2013) Not all minds that wander are lost: The importance of a balanced perspective on the mind-wandering state. Frontiers in Psychology – Special Issue on Mind-Wandering, 4:441.

While much of my research provides support for the adaptive functions of self-generated cognition, the experience can also be associated with significant costs, disrupting task performance and hindering psychological well-being. My work reveals that the ability to regulate the content of one's thoughts as well as the occurrence of self-generated thought based on contextual demands are two important factors that constrain the costs and benefits of self-generated cognition. Of particular interest are several recent and ongoing projects that examine dysfunctional styles of thinking in depression, anxiety, and perseverative thought more broadly. Integrating neuroimaging with behavioral assessments reveals that dysfunctional self-generated thought in depression and anxiety is accompanied by alterations in the function of, and interaction between, default and executive control networks.

1. Andrews-Hanna JR, Kaiser R, Turner A, Reineberg A, Godinez D, and Banich MT. (2013) A penny for your thoughts: Dimensions of self-generated thought content and relationships with individual differences in emotional well-being. Frontiers in Psychology – Special Issue on Mind-Wandering,4:900.
2. Kaiser RH, Andrews-Hanna JR, Wager TD, and Pizzagalli D. (2015) Large-scale network dysfunction in Major Depressive Disorder: Meta-analysis of resting-state functional connectivity. JAMA Psychiatry,72:603-11.
3. Kaiser RH, Andrews-Hanna JR, Spielberg JM, Warren SL, Sutton BP, Miller GA, Heller W, and Banich MT. (2015) Distracted and down: Neural substrates and network dynamics of affective interference in subclinical depression. Social Cognitive & Affective Neuroscience, 10:654-63.
4. Pelletier-Baldelli A, Andrews-Hanna JR, and Mittal V. (in press) Resting state connectivity dynamics in individuals at risk for psychosis. Journal of Abnormal Psychology.

Several of my completed and ongoing research projects characterize the nature of self-generated cognition, and the brain systems that support it, across the human lifespan. My work has revealed that individual differences in real-world perspective and social behavior relate to development of executive control systems in adolescents. At the other end of the lifespan, I used multi-modal imaging approaches to reveal that normal aging is associated with anatomical and functional disruptions in default and attention systems, explaining a considerable amount of variance in aspects of self-generated cognition. Ongoing work explores spontaneous thoughts across the lifespan and the effect of an aerobic exercise intervention on self-generated cognition and large-scale brain systems in aging.

1. Andrews-Hanna JR, Snyder AZ, Vincent JL, Lustig C, Head D, Fox MD, Raichle ME, and Buckner RL.(2007) Evidence for large-scale network disruption in advanced aging. Neuron, 56:924-935.
2. Andrews-Hanna JR, Mackewicz K, Claus E, Burgess GC, Ruzic L, and Banich MT. (2011) Cognitive control in adolescence: Neural underpinnings and relation to self-report behaviors. PLOS One, 6,e21958.
3. O'Callaghan C, Shine JM, Lewis SJG, Andrews-Hanna JR, and Irish M. (2015) Shaped by our thoughts: A new task to assess spontaneous cognition and its associated neural correlates in the default network. Brain and Cognition, 93:1-10.
4. Dalwani M, Tregellas JR, Andrews-Hanna JR, Sakai JT, Banich MT, and Crowley TJ. (2014) The effect of antisocial substance dependence on default mode network activity in made adolescents. Drug and Alcohol Dependence, 134:242-250.

Research Support

NIA R56 AG061888 Wilson: PI 9/30/18 – 8/31/19

Evaluating the Neurocomputational Mechanisms of Explore-Exploit Decision Making in Older Adults

Role on Project: Co-Investigator

NIA P30 AG019610 Reiman: PI 7/1/18 – 6/30/19
Uncovering Neurocognitive Links between Alzheimer's Disease and Depression in Mid-Life to Early Aging
Role on Project: Pilot Grant PI

NIA 1R01 AG043452 Bryan: PI 8/1/14 – 7/31/19
Enhancing Function in Later Life: Exercise and Functional Network Connectivity
Role on Project: Co-Investigator

NIMH 1R21 AG108848 Banich: PI 6/20/16 – 3/31/19
Clearing the Contents of Working Memory: Mechanisms and Representations
Role on Project: Co-Investigator

AZ Alzheimer's Consortium (ADHS) Andrews-Hanna: PI 7/1/17 – 6/30/18
Daily Thinking Patterns in Healthy and Pathological Aging
Role on Project: PI

LuMind Research Down Syndrome Foundation Edgin: PI 7/1/17 – 6/30/18
Brain Development, Sleep and Learning in Down Syndrome
Role on Project: Co-Investigator

Brain & Behavior Foundation Andrews-Hanna: PI 1/15/15 – 2/14/18
Young Investigator Award
Neurocognitive Mechanisms of Functional and Dysfunctional Self-generated Thought: Relevance for Depression
Role on Project: PI

Brain & Behavior Foundation Lopez-Sola: PI 1/15/15 – 2/14/18
Neural Effects of Mindfulness-based Cognitive Therapy in Post-partum Women with High Vulnerability for Depression Relapse
Role on Project: Co-Investigator

Biographical Sketch

Carol A. Barnes, Ph.D.
Regents' Professor, Psychology, Neurology, and Neuroscience

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
University of California, Riverside, CA	B.A. (Honors)	1971	Psychology
Carleton University, Ottawa, Ontario, Canada	M.A.	1972	Psychology
Carleton University, Ottawa, Ontario, Canada	Ph.D. (Cum laude)	1977	Psychology

Personal Statement

I have been interested in the brain circuits responsible for memory and how these circuits change during aging for more than four decades. I have applied behavioral and electrophysiological methods to the study of plasticity and circuit properties of the medial temporal lobe over that time, including in vivo evoked field potential recordings in chronically implanted freely behaving rats, and intracellular and extracellular recordings in vitro. I was instrumental (with McNaughton) in the development of ensemble tetrode recording methods for single units in awake young and old rats. More recently I have extended these methods to young and aged nonhuman primates, with chronic implants of hyperdrive recording devices that are capable of individually lowering multiple tetrodes into the hippocampus while monkeys behave. Another approach use to understand behavior-driven circuits is the single cell gene expression imaging method "catFISH," which was developed in her laboratory. The immediate early gene Arc is induced in a cell-specific fashion in the brain by neural activity associated with attentive, active behavior. With this method, the activity history of individual cells in a population can be determined for two different time points within the same animal (ex vivo). This method contributed to moving the field closer to the goal of behavior-driven whole brain imaging with single cell resolution. I direct the Evelyn F. McKnight Brain Institute at the University of Arizona and the Division of Neural Systems, Memory and Aging. I am actively involved in collaborative projects with scientists within the state of Arizona, across the United States and around the world. I have a track record of conducting difficult, systematic, and thorough studies with interdisciplinary teams, as well as with my own students and postdoctoral fellows – projects that have been followed through to publication (265 total, H index 98), a number of which are now classic references on brain aging and behavior.

Positions

1978	Research Associate, Dalhousie University, Dept. Psychology, Halifax, Canada
1979 – 1980	NRSA Postdoctoral Fellow, Institute of Neurophysiology, Oslo, Norway
1981	NATO Postdoctoral Fellow, Cerebral Functions Group, University College, London, England
1982 – 1985	Assistant Professor, Department of Psychology, University of Colorado, Boulder
1985 – 1989	Associate Professor, Department of Psychology, University of Colorado, Boulder
1989 – 1990	Professor, Department of Psychology, University of Colorado, Boulder
1990 – 2006	Professor, Psychology, Neurology, ARL NSMA, University of Arizona, Tucson
2006	Regents' Professor, Psychology, Neurology, University of Arizona, Tucson
2006	Director, Evelyn F. McKnight Brain Institute, University of Arizona, Tucson

2006	Evelyn F. McKnight Endowed Chair for Learning and Memory in Aging, University of Arizona, Tucson
2008	Director, Division of Neural Systems, Memory and Aging, University of Arizona, Tucson
2009 – 2016	Associate Director, BIO5 Institute, University of Arizona, Tucson
2009	Regents' Professor, Neuroscience, University of Arizona, Tucson

Honors

1969	NSF Summer Research Fellowship
1971	Phi Beta Kappa
1972 – 1974	Ontario Graduate Fellowship
1979 – 1981	NRSA Individual Postdoctoral Fellowship, NIH
1981 – 1982	NATO Fellowship in Science, NSF
1984 – 1989	Research Career Development Award, NIH
1987 – 1991	Neuroscience, Behavior and Sociology of Aging Committee A, NIA
1989 – 1994	Research Scientist Development Award, Level II, NIMH
1991 – 1997	Medical and Scientific Advisory Board, Alzheimer's Association
1994 – 1999	Research Scientist Award, NIMH
1994 – 1997	National Advisory Council on Aging, NIA
1995 – 1999	National Science Advisory Council, American Federation for Aging Research
1996 – 2000	Councilor, Society for Neuroscience
1997 – 2000	Medical and Scientific Advisory Council, Alzheimer's Association
1999 – 2004	Board of Scientific Counselors, NIMH
2000 – 2002	Secretary, Society for Neuroscience
2003 – 2006	President-Elect (2003-04), President (2004-05), Past-President (2005-06), Soc for Neuroscience
2004	MERIT Award, National Institute on Aging, NIH
2004	Elected Norwegian Royal Society of Sciences and Letters
2006	Regents' Professor, University of Arizona
2006	Evelyn F. McKnight Endowed Chair for Learning and Memory in Aging, University of Arizona
2007	Fellow, American Association for the Advancement of Science
2010	Elected: Mika Salpeter Lifetime Achievement Award, Society for Neuroscience
2011	Elected: Galileo Fellow, College of Science, University of Arizona
2013	Ralph W. Gerard Prize in Neuroscience, Society for Neuroscience
2014	American Psychological Association Award for Distinguished Scientific Contributions
2017	Quad-L Award, University of New Mexico
2018	Elected Member, National Academy of Sciences
2018	Museum of Contemporary Art Local Genius Award

Contribution to Science

Some of my early work was inspired by two fundamental discoveries in the early 1970s. The first was the discovery of the likely biological basis of memory formation in the brain in 1973 by Terje Lomo, Tim Bliss, and Tony Gardner-Medwin. They used patterned electrical stimulation to experimentally induce changes in synaptic strength in the hippocampus, enabling the study of the process the brain may use to lay down memory traces (long-term potentiation, or LTP). In that same time period, O'Keefe and Nadel were circulating a monograph, which eventually turned into a classic and

influential book (The Hippocampus as a Cognitive Map, 1978) that suggested that hippocampal function could be evaluated in animals by assessing spatial memory. These ideas made it possible to design experiments to interrogate how the brain acquires, stores, and retrieves information across the lifespan. Using awake, freely behaving rats with chronically implanted electrodes that could monitor the induction and decay of LTP over weeks, we obtained the first concrete evidence that LTP persistence and the durability of memory were related, and that a decline in its persistence was associated with poorer spatial memory in old animals. This relationship held in young rats as well – the better the animal's memory, the more durable was LTP. For these experiments, I developed a novel spatial memory task ("the Barnes maze"), which was conceived of and the methods published long before the more widely used, and conceptually similar, Morris water maze. The 1979 paper referenced below introduced the Barnes maze and provided the first demonstration that LTP and memory are associated – providing the groundwork for an explosion of research on the biophysical and molecular mechanisms of memory across the lifespan.

1. Barnes CA. (1979) Memory deficits associated with senescence: A neurophysiological and behavioral study in the rat. Journal of Comparative and Physiological Psychology, 93:74-104.
2. Barnes CA, Nadel L, and Honig WK. (1980) Spatial memory deficit in senescent rats. Canadian Journal of Psychology, 34:29-39.
3. Barnes CA and McNaughton BL. (1985) An age-comparison of the rates of acquisition and forgetting of spatial information in relation to long-term enhancement of hippocampal synapses. Behavioral Neuroscience, 99:1040-1048.
4. Barnes CA, Rao G, and Houston FP. (2000) LTP induction threshold change in old rats at the perforant path – granule cell synapse. Neurobiology of Aging, 21:613-620.

Other work that is now classic in the field of brain aging is the first detailed analysis of the biophysical characteristics of aging neural tissue in vitro. These studies provided some of the early evidence that the pattern of biophysical change in the hippocampus was not that of general deterioration, but was highly selective, and in some cases suggested adaptation of function in response to perturbation of the neural system. These studies laid the groundwork to support the contention that "aging is not a disease," but a highly selective biological process, that has a comparatively subtle impact on brain and behavior compared to pathological conditions such as Alzheimer's disease. In fact, the 1980 study referenced below was the first demonstration of biological compensation at the level of synaptic transmission in aging and suggested that these kinds of adaptive processes may play an important role in the function of the aging nervous system.

1. Barnes CA and McNaughton BL. (1980) Physiological compensation for loss of afferent synapses in rat hippocampal granule cells during senescence. Journal of Physiology (Lond), 309:473-485.
2. Barnes CA, Rao G, and McNaughton BL. (1987) Increased electrotonic coupling in aged rat hippocampus: A possible mechanism for cellular excitability changes. Journal of Comparative Neurology, 259:547-558.
3. Barnes CA, Rao G, Foster TC, and McNaughton BL. (1992) Region-specific age effects on AMPA sensitivity: Electrophysiological evidence for loss of synaptic contacts in hippocampal field CA1.Hippocampus, 2:457-468.
4. Barnes CA, Rao G, and McNaughton BL. (1996) Functional integrity of NMDA-dependent LTP induction mechanisms across the lifespan of F344 rats. Learning and Memory, 3:124-137.

Having established that plasticity mechanisms like LTP are altered at older ages, and that, with some important exceptions, most biophysical properties of aged hippocampal neurons are intact, I extended my work from an assessment of the impact of age on the function of artificially activated networks to those activated by behavior. These were the earliest studies to examine behavior-driven single cell firing characteristics in the aged hippocampus. We developed better recording methods over the years (the tetrode, the hyperdrive device) that enabled recording from many hippocampal

cells simultaneously. This made it possible to characterize how the hippocampus constructs a "cognitive map" (as proposed by O'Keefe and Nadel in 1978) of the surrounding environment. We showed that there are distinct changes in spatial representations within the hippocampus – with the older animals appearing to occasionally retrieve the wrong map (in CA1) upon repeated exposures to an environment. In addition, we have shown plasticity-related defects in the construction of these maps, changes in the replay of these maps during sleep in aged rats, as well as altered network functions of other temporal and frontal lobe structures.

1. Barnes CA, Suster MS, Shen J, and McNaughton BL. (1997) Multistability of cognitive maps in the hippocampus of old rats. Nature, 388:272-275.
2. Shen J, Barnes CA, McNaughton BL, Skaggs WE, and Weaver KL. (1997) The effect of aging on experience-dependent plasticity of hippocampal place cells. Journal of Neuroscience, 17:6769-6782.
3. Gerrard JL, Burke SN, McNaughton BL, and Barnes CA. (2008) Sequence reactivation in the hippocampus during slow wave sleep is impaired in aged rats. Journal of Neuroscience, 28:7883–7890.
4. Schimanski LA, Lipa P, and Barnes CA. (2013) Tracking the course of hippocampal representation during learning: When is the map required? Journal of Neuroscience, 33:3094-3106.

My lab has developed a behavior-driven single cell imaging method that expands on the methods developed for the conduct of high-density electrical recordings from single cells. This method uses the expression of the immediate early gene Arc that can monitor activity over hundreds of thousands of cells across the brain (the catFISH method). With this method, we have been able to identify a number of selective activity changes with age within hippocampal and other temporal lobe circuits and identify transcriptional repression mechanisms that may be responsible for the reduction in behavior-induced Arc expression. This method is now used extensively not only in applications for understanding aging circuits, but in many other areas of systems neuroscience.

1. Guzowski JF, McNaughton BL, Barnes CA, and Worley PF. (1999) Environment-specific expression of the immediate-early gene Arc in hippocampal neuronal ensembles. Nature Neuroscience,2:1120-1124.
2. Penner MR, Roth TL, Chawla MK, Hoang LT, Roth ED, Lubin FD, Sweatt DJ, Worley PF, and Barnes CA. (2011) Age-related changes in Arc transcription and DNA methylation within the hippocampus. Neurobiology of Aging, 32:2198-2210.
3. Penner MR, Parrish RR, Hoang LT, Roth TL, Lubin FD, and Barnes CA. (2016) Age-related changes inEgr1 transcription and DNA methylation within the hippocampus. Hippocampus, 26:1008-1020.
4. Thome A, Marrone DF, Ellmore TM, Chawla MK, Lipa P, Ramirez-Amaya V, Lisanby SH, McNaughton BL, and Barnes CA. (2017) Evidence for an evolutionarily conserved memory coding scheme in the mammalian hippocampus. Journal of Neuroscience, 37:2795–2801.

A final area in which my work has made a large impact is the examination of cognition and brain function in the aged nonhuman primate. We have developed methods for chronic high-density electrophysiological recording for behaving monkeys, which allows assessment of whether the basic principles of age-related brain changes in rats generalize to the primate brain. This is a critical gap to bridge, as the ultimate goal is to understand the human brain and cognitive aging. Because geriatric macaques are a precious experimental resource, studies generated from these animals will become classic in the field. In addition to the high-density recordings obtained from young and aged monkeys, we have been able to relate MRI imaging variables to cognitive test batteries productively, and more recently we have developed methods for telemetered recordings in nonhuman primates who are completely unrestrained. All of these approaches have contributed to a deeper understanding of the neural basis of behavior and how this changes over the lifespan.

1. Skaggs WE, McNaughton BL, Permenter M, Archibeque M, Vogt J, Amaral DG, and Barnes CA.(2007) EEG sharp waves and sparse ensemble unit activity in the macaque hippocampus. Journal of Neurophysiology, 98:898-910.
2. Thome A, Erickson CA, Lipa P, and Barnes CA. (2012) Differential effects of experience on tuning properties of macaque MTL neurons in a passive viewing task. Hippocampus, 22:2000-2011.
3. Engle J, Machado C, Permenter M, Vogt J, Maurer A, Bulleri A, and Barnes CA. (2016) Network patterns associated with navigation behavior are altered in aged nonhuman primates. Journal of Neuroscience, 36:12217-12227.
4. Thome A, Gray DT, Erickson CA, Lipa P, and Barnes CA. (2016) Memory impairment in aged primates is associated with region-specific network dysfunction. Molecular Psychiatry, 21:1257-1262.

Complete list of published work in MyBibliograpy

https://www.ncbi.nlm.nih.gov/myncbi/collections/bibliography/40630328/?reload=publicURL

Research Support

NIA R01 AG003376 Barnes (PI) 1/1/16 - 11/30/20

Neurobehavioral Relations in Senescent Hippocampus

The research is directed towards an understanding of the decline in spatial cognition and memory with age. Nonhuman primates are assessed behaviorally and electrophysiologically (hippocampus, perirhinal cortex), and the ensemble activity of the entorhinal and perirhinal cortical units in young and old rats are examined.

NIA R01 AG05058 Barnes (PI) 9/1/15 - 5/31/20

Cell Assemblies, Brain Adaptation and Cognitive Aging

The aims of this grant are to better understand the underlying causes of two hallmarks of cognitive aging – behavioral slowing and multi-tasking deficits. We will examine how the aging brain adapts to the changed dynamics intrinsic to both hippocampus and PFC in rats, and how these structures interact or compete during aging, as well as the cellular correlates of multi-tasking in an aging primate model, to assess how aging weakens the resilience of working memory circuits in the face of interference.

NIA R01 AG048907 Huentelman, Barnes (MPI) 9/30/14 - 5/31/19

CATT: Development and Application of a Neuronal Cell Activity-Tagging Toolbox

Our overall goal of this EUREKA award is to develop methods to label cells that were active during a defined temporal period and utilize a new approach to investigate the impact of aging on the circuit elements engaged by those behaviors as well as the transcriptional function of those behavior-driven labeled cells. The “Cell Activity-Tagging Toolbox” will provide a means to “permanently mark” the specific cells that were engaged in a defined behavioral experience. This is an extension of the catFISH methodology that can only labels cells for minutes to hours after a behavior.
Role: Principal Investigator (Multi-PI)

NIA R01 AG049465 Barnes (PI) 8/01/14 3/31/19

Neural System Dynamics & Gene Expression Supporting Successful Cognitive Aging

The major goal of this project is to understand the basis of differing cognitive trajectories that occur even over the lifespan of inbred rat strains. Methods used include cognitive assessment batteries for frontal and temporal lobe regions, 7T MRI scanning methods, transcriptional evaluation, and circuit activity pattern assessment using the Arc catFISH single cell imaging method devised in Barnes’

laboratory. All methods are applied to animals of different ages and aptitudes so that the underlying basis of differential cognitive functioning across the lifespan may be identified.

NIA R01 AG049464 Coleman, Barnes, Alexander (MPI 8/1/14 - 3/31/19
Epigenetic, Neuroimaging & Behavioral Effects of Hypertension in the Aging Brain
Major project goals are to determine what hypertension-induced epigenetic changes occur in a transgenic rat model of hypertension. Blood pressure can be slowly elevated in this rat model from middle to older ages, mimicking the course of hypertension development observed in human aging. Epigenetic changes induced by hypertension that occur in temporal and frontal lobe structures will be measured and related to behavioral assays of these regions as well as with high resolution MRI scans to assess grey and white matter integrity.
Role: Principal Investigator (Multi-PI)

NIA P30 AG019610 Reiman (PI) 8/15/16 - 6/30/21
Arizona Alzheimer's Disease Core Center
Dr. Barnes serves as Director of the Ad Hoc review program for research proposals for the Center.
Role: Co-Investigator

NIA T32 AG044402 Barnes (PI) 5/1/16 - 4/30/21
Postdoctoral Training, Neurobiology of Aging and Alzheimer's Disease
Dr. Barnes serves as Program Director, Dr. Paul Coleman and Eric Reiman as Co-Directors, and Dr. Matthew Huentelman and Health Bimonte-Nelson as Associate Directors of this statewide postdoctoral training grant focused on training postdoctoral fellows in the Arizona Alzheimer's Consortium (six participating institutions).
Role: Principal Investigator

NIA R21 AG061421 Stern (PI) 10/1/18 - 9/30/21
Collaboratory on Research for Cognitive Reserve and Resilience
Dr. Barnes role is to serve with a group of 6 Co-I's to build the infrastructure to organize workshops, databases, and facilitate award of pilot grants that will guide efforts to reach consensus on the most effective operational definitions for brain and cognitive reserve so that experiments can be directed at understanding underlying mechanism of these concepts.
Role: Co-Investigator

Biographical Sketch

Roberta Diaz-Brinton, Ph.D.
Director, Center for Innovation in Brain Science
Professor, Pharmacology and Neurology

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
University of Arizona, Tucson, AZ	B.A.	1979	Psychobiology
University of Arizona, Tucson, AZ	M.A.	1981	Neuropsychology
University of Arizona, Tucson, AZ	Ph.D.	1984	Psychobiology & Neuropharmacology
Rockefeller University, NY	Postdoc	1987	Neuropharmacology & Neuroendocrinology

Personal Statement

I am the inaugural director of the UA Center for Innovation in Brain Science at the University of Arizona Health Sciences and professor of pharmacology and neurology, College of Medicine, University of Arizona. The Center for Innovation in Brain Science is focused on mechanistically driven therapeutic development and translational research for age-associated neurodegenerative diseases (https://cibs.uahs.arizona.edu/). My research has focused broadly on the mechanisms underlying late onset Alzheimer's disease (AD) and developing therapeutics to prevent, delay, and cure the disease. Towards that goal, I lead three programs of discovery research and two programs of translational and clinical research. Our discovery research programs focus on systems biology of: 1) mechanisms underlying risk of Alzheimer's during female brain aging, 2) sex differences in mechanisms underlying Alzheimer's, and 3) regeneration and repair mechanisms to regenerate the Alzheimer's brain. Fundamental insights that have emerged from our research indicate that the aging brain is dynamic and adaptive. The dynamic adaptive nature of the aging brain has led to an increasing focus on transition states of the aging brain, their plasticity, limits, and vulnerability. We have advanced our basic science discoveries into FDA IND-enabling translational programs and two early phase clinical trials. These programs of research are supported by the National Institute on Aging (R01, P01, U01, U54) and by philanthropic foundations. The breadth and depth of our research requires effective and collaborative team science that is mission focused. Teams that I lead include basic, translational, and clinical scientists and technology transfer professionals.

Positions

2017 – Present	Professor of the Evelyn F. McKnight Brain Institute, Psychology, College of Medicine, University of Arizona, Tucson, Arizona
2016 – Present	Director, Center for Innovation in Brain Science, Professor of Pharmacology and Neurology, College of Medicine, University of Arizona, Tucson, Arizona
2001 – 2017	Professor, Department of Pharmacology and Pharmaceutical Sciences, School of Pharmacy, Professor, Department of Biomedical Engineering, Viterbi School of Engineering, Professor, Department of Neurology, Keck School of Medicine University of Southern California
2007 – 2014	Director of Preclinical Translation and Regulatory Support, USC Clinical and Translational Science Institute (USC and Children's Hospital Los Angeles)
2009 – Present	Professor of Neurology, Keck School of Medicine, Univ of Southern California

Honors

1999	Laboratory Named "The Norris Foundation Laboratory for Neuroscience Research"
2003	University of Southern California Remarkable Woman Award
2005	10 Best Minds, US News & World Report
2005	Woman of the Year, California State Senate
2006	Science Educator of the Year, Society for Neuroscience
2009	North American Menopause Society /Wyeth Pharmaceuticals SERM Research Award
2010	Presidential Citizens Medal, President Barack Obama
2014	Los Angeles Woman of the Year, LA Magazine
2015	Scientist of the Year Award, Alzheimer's Drug Discovery Foundation
2017	Disruptive Women to Watch in 2017, Disruptive Women in Health Care
2017	Recipient: NIH MERIT (Method to Extend Research in Time) Award; for outstanding record of scientific achievement as principal investigator on National Institute of Aging (NIA) research projects.
2017	Alzheimer's Drug Discovery Foundation, Melvin Goodes Prize for Excellence in Alzheimer's Drug Discovery
2017	National Academy of Inventors

Contribution to Science

The focus of my research has been to discover mechanisms leading to late-onset Alzheimer's disease and to translate those insights into therapeutics to prevent, delay, and treat the disease. Results of my systems biology research programs have resulted in fundamental discoveries of steroid action in the brain that have been translated into two independent clinical trials targeting different receptor systems and mechanisms of action. Research endeavors in my laboratory are organized under three major themes: 1) Aging female brain and endocrine mechanisms of aging that increase risk of late onset Alzheimer's disease, 2) Sex differences in mechanisms leading to late onset Alzheimer's disease, and 3)Allopregnanolone regenerative systems neurobiology and regenerative therapeutic for Alzheimer's disease.

The Aging female brain and endocrine mechanisms of aging that increase risk of late-onset Alzheimer's disease program of research is devoted to understanding the mechanisms underlying the increased lifetime risk of Alzheimer's in women. Outcomes of this pioneering research indicate that the female brain is highly dependent upon estrogen, which functions as a master regulator of the bioenergetic system of the brain. The perimenopausal transition, unique to the female, results in a bioenergetic shift in the brain from a glucose-dependent brain to a brain dependent on the alternative fuel ketone bodies. The adaptive bioenergetic shift to utilizing ketone bodies as an auxiliary fuel creates a risk for catabolizing brain lipids, myelin, to generate ketone bodies to fuel a starving brain. Based on our discovery science of estrogen action in the brain, we developed a GMP clinical grade estrogen receptor beta selective formulation that progressed into a NIA sponsored Phase 1b/2a clinical trial of Phytoserms for Menopause Symptoms and Age-Associated Memory Decline. Results of the PhytoSERM clinical trial are currently being analyzed.

1. Brinton RD, Yao J, Yin F, Mack WJ, and Cadenas E. (2015) Perimenopause as a neurological transition. Nat Rev Endocrinol, Jul;11(7):393-405. doi: 10.1038/nrendo.2015.82. Epub 2015 May 26.PMID: 26007613 PMCID in Process.
2. Yin F, Yao J, Sancheti H, Feng T, Melcangi RC, Morgan TE, Finch CE, Pike CJ, Mack WJ, Cadenas E, and Brinton RD. (2015) The perimenopausal aging transition in the female rat brain: decline in bioenergetic systems and synaptic plasticity. Neurobiol Aging, Apr 1. pii: S0197-4580(15)00198-0.doi: 10.1016/j.neurobiolaging.2015.03.013. PMCID: PMC4416218.

3. Mosconi L, Berti V, Guyara-Quinn C, McHugh P, Petrongolo G, Osorio RS, Connaughty C, Pupi A, Vallabhajosula S, Isaacson RS, de Leon MJ, Swerdlow RH, and Brinton RD. (2017) Perimenopause and emergence of an Alzheimer's bioenergetic phenotype in brain and periphery. PLoS One, Oct10;12(10): e0185926. doi: 10.1371/journal.pone.0185926. PMCID: PMC5634623.
4. Mosconi L, Berti V, Quinn C, McHugh P, Petrongolo G, Varsavsky I, Osorio RS, Pupi A, Vallabhajosula S, Isaacson RS, de Leon MJ, and Brinton RD. (2017) Sex differences in Alzheimer risk: Brain imaging of endocrine vs chronologic aging. Neurology, Sep 26;89(13):1382-1390. doi: 10.1212/WNL.0000000000004425. Epub 2017 Aug 30. PMCID: PMC5652968.

Sex differences in mechanisms leading to late onset Alzheimer's disease program investigates the underlying mechanisms for the difference between female and male risk of developing late-onset Alzheimer's disease. Outcomes of which research indicate that the female and male brain bioenergetically age quite differently in remarkable and unanticipated ways that may be beneficial to the Apoε4- male but may be deleterious to the Apoε4+male.

1. Zissimopoulos JM, Barthold D, Brinton RD, and Joyce G. (2016) Sex and race differences in the association between statin use and the incidence of Alzheimer disease. JAMA Neurol. Dec 12.PMID:27942728 PMCID 5634623.
2. Zhao L, Mao Z, Woody SK, and Brinton RD. (2016) Sex differences in metabolic aging of the brain: Insights into female susceptibility to Alzheimer's disease. Neurobiol Aging. Jun;42:69-79. Epub2016 Feb 18. PMCID 5644989
3. Wang Y, and Brinton RD. (2016) Triad of Risk for Late Onset Alzheimer's: Mitochondrial Haplotype, APOE Genotype and Chromosomal Sex. Frontiers in Aging Neuroscience Oct 4;8:232.PMCID:PMC5047907.
4. Riedel BC, Thompson PM, and Brinton RD. (2016) Age, APOE and sex: Triad of Risk of Alzheimer's disease. J Steroid Biochem Mol Biol. Jun;160:134-47. PMC 4905558.

The Allopregnanolone regenerative systems neurobiology and regenerative therapeutic for Alzheimer's disease programs of research are devoted to elucidating the regenerative mechanisms of the brain and harnessing those mechanisms to both promote endogenous mechanisms of regeneration while simultaneously targeting mechanisms underlying Alzheimer's disease. Outcomes of this pioneering research indicate that the neurosteroid allopregnanolone significantly increases endogenous neural stem cell generation, which restores learning and memory functions to age-associated normal in both males and females. Further allopregnanolone reduces the burden of disease by promoting mitochondrial function and beta amyloid clearance. Based on our discovery science of allopregnanolone regenerative mechanisms, we advanced allopregnanolone through IND-enabling research (PK,PD and toxicology), and acquired an FDA IND to conduct a NIA sponsored Phase 1b clinical trial of allopregnanolone in persons with mild cognitive impairment or early Alzheimer's disease. The NIA-sponsored clinical trial Allopregnanolone for Mild Cognitive Impairment Due to Alzheimer's Disease or Mild AD is currently ongoing.

1. Brinton RD. (2013) Neurosteroids as regenerative agents in brain: Therapeutic implications. Nature Endocrine Reviews. Feb 26. PMID:2343883 PMCID in process.
2. Singh C, Liu L, Wang JM, Irwin RW, Yao J, Chen S, Henry S, Thompson RF, and Brinton RD. (2011)Allopregnanolone restores hippocampal-dependent learning and memory and neural progenitor survival in aging 3xTgAD and nonTg mice. Neurobiol Aging. 2012 Aug;33(8):1493-506. Epub Jul 30.PMC3232295.
3. Chen S, Wang JM, Irwin RW, Yao J, Liu L, and Brinton RD. (2011) Allopregnanolone promotes regeneration and reduces ß-amyloid burden in a preclinical model of Alzheimer's disease. PLoS One. 2011;6(8):e24293. Epub Aug 30. PMC3168882.
4. Wang JM, Singh C, Liu L, Irwin RW, Chen S, Chung EJ, Thompson RF, and Brinton RD. (2010)Allopregnanolone reverses neurogenic and cognitive deficits in mouse model of

Alzheimer's disease. Proc Natl Acad Sci U S A. 2010 Apr 6;107(14):6498-503. Epub Mar 15 - PMC2851948.

Complete list of published work in MyBibliograpy

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Research Support

NIA R01 AG057931 Brinton (PI) 9/1/18 - 8/31/23

Sex Differences in the Molecular Determinants of Alzheimer's Disease Risk: Prodromal Endophenotype

The mission for the Sex Differences in the Molecular Determinants of Alzheimer's Disease Risk: Prodromal Endophenotype project is to determine the complex interaction between chromosomal sex and the major risk factors for late onset Alzheimer's (LOAD): age, APOE*4 genotype and maternal history of AD. As LOAD accounts for the greatest incidence and prevalence of the disease, determining molecular mechanisms relevant to LOAD has the potential for greatest impact. Further, targeting early stage transitions of risk have the greatest potential for therapeutic efficacy. Thus, research proposed herein focuses on the prodromal / preclinical stage of LOAD and the sex differences that underlie early risks of LOAD progression. Elucidation of sex differences in the mechanisms driving prodromal LOAD will lead to identification of therapeutic targets to change the trajectory of the disease to prevent, delay and potentially reverse course of developing LOAD. Role: PI

NIA T32 AG061897 Brinton (PI) 9/1/18 - 8/31/23

Translational Research in AD and related Dementias (TRADD)

The University of Arizona (UA) Training Program to Advance Translational Research on Alzheimer's Disease and AD Related Dementias is designed to address knowledge and experience gaps in AD therapeutic discovery and preclinical translational development. To meet this challenge, the UA Translational Research in AD and related Dementias (TRADD) training program is designed as a problem based translational learning experience for predoctoral PhD and MD/PhD fellows. In alignment with the 2012, 2015 and 2018 NIH Alzheimer's Disease Research summits and the National Alzheimer's Project Act, the goal of the TRADD training program is to fill critical gaps that exist for AD translational research in academic graduate programs. To achieve this goal, the University of Arizona TRADD program will: 1) recruit trainees across multiple scientific disciplines; 2) employ problem-based learning approaches to solve challenges in AD therapeutic development with emerging tools ***and techniques; and 3) equip TRADD trainees with career development and leadership skills necessary to conduct team science and manage multidisciplinary teams in the 21st century. Role: PI***

NIA R37-AG053589 Brinton (PI) 3/15/17 - 2/28/22

Aging and Estrogenic Control of The Bioenergetic System In Brain

The proposed program of research is designed to first test estrogenic control of the bioenergetic system in the female brain requires: 1) both nuclear and mitochondrial genomes; 2) integration of gene expression across both genomic compartments and 3) activation of rapid signaling cascades to provide real time feedback on bioenergetic performance. Second, that loss of estrogen in the aging female brain leads to a systematic dis- integration of estrogenic control of nuclear and mitochondrial genomes followed by decline in bioenergetic sensing mechanisms.

*Recipient NIH MERIT (Method to Extend Research in Time) Award, recognizing outstanding scientific contributions and allowing for up to 5 years non-competitive extension.

Role: PI

NIA P01 AG026572 Brinton (PI) 7/1/05 - 5/31/21

Perimenopause in Brain Aging and Alzheimer's Disease

The Perimenopause in Brain Aging and Alzheimer's Disease Program Project will determine how the brain changes during the perimenopausal transition and how these changes can lead to development of early risk factors for developing Alzheimer's disease. The goal of these studies is the early identification of those at greatest risk for developing AD and the window of opportunity for interventions to prevent Alzheimer's disease in those at greatest lifetime risk, postmenopausal women.

Role: Program PI; PL Administrative Core A, Project 1 and Project 4

NIA U01 AG047222 Brinton (PI) 6/15/18- 6/30/19

Allopregnanolone a Regenerative Therapy for Alzheimer's: FDA-Required Toxicology

This project addresses the urgent need to develop therapeutics to prevent, delay and treat Alzheimer's disease (AD). A promising regenerative medicine, Allo, is being developed. Allo activates the brain's own regenerative ability while also reducing the pathology of AD. Studies proposed here are required by the FDA to ensure that Allo is safe to use for extended period of time to generate new neurons, restore cognitive function, reduce AD pathology and to regenerate the connective tracts of the brain.

Role: PI

Alzheimer's Association Brinton (PI) 5/1/17 - 4/30/20

Perimenopause In ApoE4 Brain: Accelerated Myelin Catabolism for Fuel

Discovery of at-AD-risk phenotypes in women and the underlying mechanisms could potentially lead to early identification of those at greatest risk of developing AD and interventions to prevent the disease. Having established that the perimenopause is a neurological bioenergetic transition state that shifts the brain from utilizing glucose as its primary fuel to utilizing ketone bodies as an auxiliary fuel and that metabolic compromise is associated with compromised cognitive function in postmenopausal women [3], we advance a program wide three hit hypothesis for women positive for ApoE4: Females positive for ApoE4 gene experience three strikes that result in accelerated bioenergetic aging in brain and concomitant generation of three hallmarks of Alzheimer's disease in brain, hypometabolism, beta amyloid deposition and white matter (WM) degeneration. Strike one for ApoE4 positive females, is the genetic risk conferred by the ApoE4 genotype. Strike two is chronological aging. Strike three is the bioenergetic transformation of the perimenopause. Interestingly, all three of these strikes are independently associated with WM degeneration and we hypothesize that in combination they will lead to an accelerated AD-like WM degeneration phenotype.

NIA R01 AG059093 Kaddurah-Daouk (PI) 8/1/18 - 6/30/23

Metabolic Networks and Pathways Predictive of Sex Differences in AD Risk and Responsiveness to Treatment

In this study, we use global metabolomics approach to delineate biochemical differences in men and women across the trajectory of disease. We aim to define biochemical pathways and networks for greater vulnerability of disease in women and men that would enable discovery of more effective therapies for each of the sexes.

Role: Subaward PI

Biographical Sketch

Ying-hui Chou, Ph.D.
Assistant Professor, Psychology

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
National Taiwan University, Taipei	B.S.	1994	Occupational Therapy
Boston University, Boston, MA	M.S.	2001	Occupational Therapy
Boston University, Boston, MA	Sc.D.	2005	Movement & Rehabilitation Sci
Brigham and Women's Hospital Boston, MA	Postdoctoral	2005	Brain Imaging
Duke University Medical Center, Durham, NC	Postdoctoral	2012	Gerontology and Brain Imaging
Duke University Medical Center, Durham, NC	Other training	2012	Transcranial Magnetic Stimulation
Beth Israel Deaconess Medical Center/Harvard Medical School, Boston, MA	Other training	2013	Transcranial Magnetic Stimulation
Duke University Medical Center, Durham, NC	Postdoctoral	2013	Brain Imaging
Beth Israel Deaconess Medical Center/Harvard Medical School, Boston, MA	Other training	2015	Transcranial Direct Current Stimulation

Personal Statement

I received postdoctoral training in brain imaging and cognitive science at Surgical Planning Lab of Brigham and Women's Hospital/Harvard Medical School, Duke Brain Imaging and Analysis Center, and Duke Aging Center. In addition, I have been trained to operate non-invasive brain stimulation protocols (e.g., TMS and transcranial direct current stimulation) at the Berenson-Allen Center for Noninvasive Brain Stimulation of Harvard Medical School and Duke Psychiatry. I am currently an assistant professor of psychology at the University of Arizona (since August 2016). My laboratory focuses on applications of noninvasive brain stimulation and advanced brain imaging techniques to the development of image-guided noninvasive brain stimulation protocols for clinical populations and studying causal relations among brain networks. Over the years I have developed strong expertise in brain imaging, noninvasive brain stimulation, and cognitive science. I have produced 24 peer-reviewed journal articles and one book chapter.

1. Chou YH, Sundman M, Whitson HE, Gaur P, Chu ML, Weingarten CP, Madden DJ, Wang L, Kirste I, Joliot M, Diaz MT, Li YJ, Song AW, and Chen NK. (2017) Maintenance and Representation of Mind Wandering during Resting-State fMRI. Sci Rep. Jan 12, 7:40722. PMCID: PMC5227708.
2. Chou YH, You H, Wang H, Zhao YP, Hou B, Chen NK, and Feng F. (2015) Effect of repetitive transcranial magnetic stimulation on fMRI resting-state connectivity in Multiple System Atrophy. Brain Connect. Apr 22, 5(7): 451-9. PMCID: PMC4575511.
3. Chou YH, Chen NK, and Madden DJ. (2013) Functional brain connectivity and cognition: Effects of adult age and task demands. Neurobiol Aging. Aug, 34(8): 1925-34. PMCID: PMC3674832.
4. Chou YH, Hickey PT, Sundman M, Song AW, and Chen NK. (2015) Effects of Repetitive Transcranial Magnetic Stimulation on Motor Symptoms in Parkinson Disease: A Systematic Review and Meta-Analysis. JAMA Neurol. Apr 1, 72(4): 432-40. PMCID: PMC4425190.

Positions

1994 – 1995	Occupational Therapist, Department of Psychiatry, Taipei Veterans General Hospital, Taiwan
1995 – 1997	Occupational Therapist, Department of Physical Medicine and Rehabilitation, National Taiwan University Hospital, Taiwan
2001 – 2003	Research Assistant, Center for Neurological Rehabilitation, Boston University, Boston, MA
2001 – 2003	Teaching Assistant of (1) Neurological Systems and (2) Scientific Inquiry, Department of Physical Therapy, Boston University, Boston, MA
2004 – 2005	Postdoctoral Fellow of Radiology, Brigham and Women's Hospital/Harvard Medical School, Boston, MA
2005 – 2008	Chair and Assistant Professor, Department of Occupational Therapy, Fu-Jen Catholic University, Taiwan
2008 – 2011	Maternity Leave
2011 – 2013	Postdoctoral Fellow, Center for Aging and Human Development and Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC
2013 – 2016	Medical Instructor, Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC
2016	Assistant Professor of Psychology, University of Arizona, Tucson, AZ
2016	Director, Brain Imaging and TMS Laboratory, University of Arizona
2017	Research Associate, Arizona Center on Aging
2017	Scholar, CDC Arizona Healthy Brain Research Center

Honors

1999	The Study Abroad Scholarship, Ministry of Education, Taiwan
2000	The Carolyn Kohn Memorial Scholarship, American Occupational Therapy Foundation, USA
2005	The Educational Stipend Award, International Society for Magnetic Resonance in Medicine, USA
2006	The E.K. Zavoisky Stipend, International Society for Magnetic Resonance in Medicine, USA
2007	The Fu-Jen University Excellence in Teaching Award, Fu-Jen Catholic University, Taiwan

Contribution to Science

Repetitive transcranial magnetic stimulation for neurodegenerative disorders. Repetitive transcranial magnetic stimulation (rTMS) is a non-invasive brain stimulation technique that has been closely examined as a possible treatment for Parkinson's disease (PD). However, results evaluating the effectiveness of rTMS in PD are mixed, mostly due to low statistical power or variety in individual rTMS protocols. Recently, we published a meta-analysis of 20 clinical trials in 470 patients with PDa. Pooled evidence suggests a significant medium effect size favoring active rTMS over sham rTMS for reducing motor symptoms. Findings of our meta-analysis highlight the need for multimodal studies that combine the use of rTMS and different neuroimaging techniques when developing an rTMS treatment protocol. As a first step to combine the rTMS and brain imaging techniques, we measured both motor symptoms and brain functional connectivity before and after a 10-session, 5 Hz, rTMS intervention targeting the primary motor cortex in patients with multiple system atrophy. Our results showed significant rTMS-related changes in motor symptoms and functional connectivity. Specifically, 1) significant improvement of motor symptoms was observed in the active-r TMS group, but not in the sham-r TMS group; and 2) several functional links involving the default mode,

cerebellar, and limbic networks exhibited positive changes in functional connectivity in the active-rTMS group. Moreover, the positive changes in functional connectivity were associated with improvement in motor symptoms for the active-rTMS group. The present findings suggest that rTMS may improve motor symptoms by modulating functional links connecting to the default mode, cerebellar, and limbic networks, inferring a future therapeutic candidate for patients with multiple system atrophy.

1. Chou YH, Hickey PT, Sundman M, Song AW, and Chen NK. (2015) Effects of repetitive transcranial magnetic stimulation on motor symptoms in Parkinson's disease: A systematic review and meta-analysis. JAMA Neurol. Apr 1;72(4): 432-40. PMCID: PMC4425190.
2. Chou YH, You H, Wang H, Zhao YP, Hou B, Chen NK, and Feng F. (2015) Effect of repetitive transcranial magnetic stimulation on fMRI resting-state connectivity in multiple system atrophy .Brain Connect. Apr 22;5(7): 451-9. PMCID: PMC4575511.
3. Chou YH. (2018) Effects of repetitive transcranial magnetic stimulation on cognitive function in mild cognitive impairment: A systematic review and meta-analysis. Poster presentation at the2018 Alzheimer's Association International Conference, Chicago, IL.
4. Chou YH, Rapcsak S, Chen N-K, Sundman M, Lim K, Ugonna C, Lindley M, Fuglevand A, Mohler J, and Huang Y-Z. (2018) Cortical Excitability in Alzheimer's Disease and Mild Cognitive Impairment: A Systematic Review and Meta-analysis of Transcranial Magnetic Stimulation Studies. Presented at the Arizona Alzheimer's Consortium 2018 Annual Scientific Conference, Phoenix, AZ.

Resting-state fMRI and its applications to cognitive science and clinical populations. Resting-state functional connectivity measured by fMRI has played an essential role in understanding brain functional networks and their relations to cognitive function and diseases. Measures of resting-state functional connectivity refer to temporal correlations of fMRI signals between spatially distinct brain regions when participants are not performing a perceptual or behavioral task. In a longitudinal study, we acquired resting-state fMRI data of healthy participants nine times during one year. Our findings indicate that the functional connectivity measures exhibit outstanding long-term reproducibility and are potentially suitable as biomarkers for monitoring disease progression and treatment effects in clinical trials and individual patients. In a series of studies, we documented age- and disease-related alterations in resting-state functional connectivity, their correlations with cognitive function and symptom severity, and treatment effects using functional connectivity as an outcome measure. This body of work has demonstrated the usefulness of resting-state functional connectivity for understanding cognitive function and for clinical applications.

1. Chou YH, Panych LP, Dickey CC, Petrella JR, and Chen NK. (2012) Investigation of long-term reproducibility of intrinsic connectivity network mapping: A resting-state fMRI study. Am J Neuroradiol. May;33(5): 833-8. PMCID: PMC3584561.
2. Chou YH, Chen NK, and Madden DJ. (2013) Functional brain connectivity and cognition: Effects of adult age and task demands. Neurobiol Aging. Aug;34(8): 1925-34 PMCID: PMC3674832.
3. Whitson HE, Chou YH, Potter GG, Diaz MT, Chen NK, Lad EM, Johnson MA, Cousins SW, ZhuangJ, and Madden DJ. (2015) Phonemic fluency and brain connectivity in age-related macular degeneration: A pilot study. Brain Connect, Apr;5(2): 126-35. PMCID: PMC4361291.
4. Wang L, Chou YH, Potter GG, and Steffens DC. (2015) Altered synchronization among neural networks in geriatric depression. BioMed Research International, January 11. NIHMSID:NIHMS690881.

Virtual reality and rehabilitation. I was trained as a movement and rehabilitation scientist during my graduate studies investigating gait patterns and how a virtual reality environment would modulate locomotion in healthy older adults and patients with Parkinson's disease. We have successfully combined the virtual reality apparatus and three-dimensional motion analysis system to investigate perceptual-motor interaction. These studies demonstrate the usefulness of virtual reality in

modulating locomotion and will facilitate the development of systematic approaches for effective preventive and therapeutic intervention for gait dysfunction in older adults and patients with Parkinson's disease. Virtual reality is compatible with many brain-imaging techniques and has allowed researchers to evaluate typical and atypical brain function when users are immersed in a virtual reality environment. We published a book chapter in 2012 summarizing research findings that combine both virtual reality and brain imaging technologies. This chapter has been downloaded more than 2,000 times from the publisher's website.

1. Chou YH, Wagenaar RC, Saltzman E, Giphart JE, Young D, et al. (2009) Effects of optic flow speed and lateral flow asymmetry on locomotion in younger and older adults: a virtual reality study. J Gerontol B Psychol Sci Soc Sci. Mar;64(2):222-31. PMCID: PMC2655160.
2. Giphart JE, Chou YH, Kim DH, Bortnyk CT, Wagenaar RC. (2007) Effects of virtual reality immersion and walking speed on coordination of arm and leg movements. Presence: Teleoperators and Virtual Environments. 16(4): 399-413.
3. Young DE, Wagenaar RC, Lin CC, Chou YH, Davidsdottir S, et al. (2010) Visuospatial perception and navigation in Parkinson's disease. Vision Res. Nov 23;50(23):2495-504. PMCID: PMC3008343.
4. Chou YH, Weingarten C, Madden DJ, Song AW, Chen N. Virtual Reality. Eichenberg C, editor. Rijeka ,Croatia: Intech – Open Access Publisher; 2012. Applications of virtual reality technology in brain imaging studies; p.203-228.

Complete list of published work in MyBibliograpy

http://www.ncbi.nlm.nih.gov/myncbi/browse/collection/40106197/?sort=date&direction=descending

Research Support

NIA R56 AG061888 Wilson (PI) 9/30/18 - 8/31/23
Evaluating the Neurocomputational Mechanisms of Explore Exploit Decision Making in Older Adults
Role on Project: Co-Investigator

NIA P30 AG019610 Reiman(PI); Chou (Pilot PI) 7/01/17 - 06/30/19
Use of TMS and fMRI Measures to Assess the Risk of Conversion of MCI to Dementia
In this pilot project, we propose probing cortical excitability and plasticity in individuals with MCI in order to assess the diagnostic potential of TMS-evoked responses.
Role on Project: Pilot Project PI

Arizona Alzheimer's Consortium, DHS Chen (PI) 7/1/18 – 6/30/19
High-resolution MR Imaging Technologies for Mapping Neuronal Connectivity Network to Subfields of Hippocampus and Amygdala: Application to Studies of Alzheimer's Disease
Role on Project: Project PI

Cancer Center, University of Arizona Kou (PI) 7/1/18 - 6/30/19
Use of TMS and fMRI Measures to Assess the Risk of Conversion of MCI to Dementia
Feasibility Study for the Treatment of Post-Chemotherapy Cognitive Impairment with Transcranial Magnetic Stimulation
Role on Project: Co-Investigator

BIO5 Institute, University of Arizona Chou (PI) 7/1/18 - 6/30/19
Developing a Non-Invasive Magnetic Brain Stimulation Protocol for Mild Cognitive Impairment
Role on Project: PI

Biographical Sketch

Stephen Cowen, Ph.D.
Assistant Professor, Psychology

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
University of Wisconsin, Madison, Wisconsin	B.B.A	1992	Management and Marketing
University of Arizona, Tucson, Arizona	Ph.D.	2007	Psychology and Neuroscience
The Neurosciences Institute, San Diego, CA	Postdoc	2008	Neuroscience

Personal Statement

A fundamental and unresolved question in neuroscience is how the activities of tens of billions of interconnected neurons become coordinated during learning, decision making, and sleep. Resolving this question is important as dysregulated neural coordination contributes to disorders such as Parkinson's disease (PD), epilepsy, Down syndrome, and schizophrenia, and may also contribute to cognitive deficits associated with normal aging. My research seeks to understand the mechanisms by which the timing of the activities of ensembles of neurons and dopamine release is coordinated during learning and sleep. Towards this end, my laboratory has developed novel instrumentation that allows, for the first time, the simultaneous measurement of the activities of large groups of neurons and fast changes in dopamine release. This instrument integrates high-density, single-unit/local-field recording technologies to measure neural activity in rodents during decision making, navigation, and sleep with fast-scan cyclic voltammetry for the measurement of dopamine release. My laboratory is using this tool to investigate the role that dopamine plays in regulating neuronal coordination in behaving and resting animals, and we are working towards testing this device in animal models of PD and normal aging. Our ongoing and funded work on PD involves the investigation of sleep-associated oscillatory activity in PD. This work is supported by a grant from the Michael J. Fox Foundation. Specifically, we are exploring how cortico-striatal coordination is altered during sleep in a genetic form of PD (the LRRK2 G2019S mutation). We are testing the hypothesis that sleep spindles, corticothalamic oscillations associated with slow wave sleep and memory consolidation, are enhanced in this particular mutation.

My lab also investigates the roles that high-frequency brain oscillations play in learning, memory, and disease. For example, we have found that normal aging is associated with a significant decrease in the frequency of oscillations in the hippocampus that are associated with memory formation. With regard to disease, my laboratory is investigating how ketamine and ketamine-induced high-frequency activity in the striatum reduces dyskinesias in PD. Data collected in my laboratory now suggest that ketamine simultaneously enhances cortico-striatal coherence at high frequencies (~135 Hz) and reduces coherence at theta and beta frequencies (~8-30 Hz) – frequency ranges associated with Parkinsonian motor symptoms.

To assist other researchers studying these topics, my students and I have designed, built, and freely distributed custom microelectrode microdrives, data acquisition software, data-analysis software, inertial measurement systems, and automated mazes designed for the assessment decision making in rodents.

1. Ye T, Bartlett MJ, Schmit MB, Sherman SJ, Falk T, and Cowen SL. (2018) Ten-Hour Exposure to Low-Dose Ketamine Enhances Corticostriatal Cross-Frequency Coupling and Hippocampal Broad-BandGamma Oscillations. Front. Neural Circuits, 12, 61. doi: 10.3389/fncir.2018.00061

2. Cowen SL, Gray DT, Wiegand, J-PL, Schimanski, LA, and Barnes CA. (2018) Age-associated changes in waking hippocampal sharp-wave ripples Hippocampus. doi: 10.1002/hipo.23005. [Epub ahead of print].
3. Cowen SL, Phelps, CE, Navratilova E, McKinzie DL, Okun A, Husain, BS, Gleason SD, Witkin JM, and Porreca FC. (2018) Chronic pain impairs cognitive flexibility and engages novel learning strategies in rats. Pain, 157:1403-1412. doi: 10.1097/j.pain.0000000000001226. (Editor's Choice article)
4. Hill DF, Parent KL, Atcherley CW, Cowen SL and Heien ML. (2018) Differential release of dopamine in the nucleus accumbens evoked by low-versus high-frequency medial prefrontal cortex stimulation. Brain Stimulation, 11:426-434.
5. Parent KL, Hill DF, Crown LM, Wiegand J-P, Gies KF, Miller MA, Atcherley CW, Heien ML, and Cowen SL. (2017) Platform to enable combined measurement of dopamine and neural activity. AnalChem:acs.analchem.6b03642.
6. Okun A, McKinzie DL, Witkin JM, Remeniuk B, Husein O, Gleason SD, et al. (2016) Hedonic and motivational responses to food reward are unchanged in rats with neuropathic pain. Pain. doi:10.1097/j.pain.0000000000000695.
7. Wiegand J-PL, Gray DT, Schimanski LA, Lipa P, Barnes CA, and Cowen SL. (2016) Age is associated with reduced sharp-wave ripple frequency and altered patterns of neuronal variability. J Neurosci36:5650–5660.
8. Cowen SL and Nitz DA. (2014) Repeating firing fields of CA1 neurons shift forward in response to increasing angular velocity. J Neurosci, Jan 1;34(1):232-41. PubMed PMID: 24381284.
9. Cowen SL, Davis GA, and Nitz DA. (2012) Anterior cingulate neurons in the rat map anticipated effort and reward to their associated action sequences. J Neurophysiol, May;107(9):2393-407.PubMed PMID: 22323629.
10. Cowen SL and McNaughton BL. (2007) Selective delay activity in the medial prefrontal cortex of the rat: contribution of sensorimotor information and contingency, J Neurophysiol. Jul;98(1):303-16.PubMed PMID: 17507507.

Positions

2007 – 2008	Postdoctoral Fellow	The Neurosciences Institute, San Diego, CA
2008 – 2010	Research Fellow	The Neurosciences Institute, San Diego, CA
2010 – 2012	Associate Fellow	The Neurosciences Institute, San Diego, CA
2012 – Present	Assistant Professor	Department of Psychology, Graduate Interdisciplinary Program in Neuroscience, Graduate Interdisciplinary Program in Cognitive Science, Graduate Interdisciplinary Program in Physiology. University of Arizona

Honors

1998-1999	Recipient of National Science Foundation training grant
2010	Blasker-Rose-Miah Technology Development grant, San Diego Foundation

Contribution to Science

Aging is associated with altered single-unit coordination and local-field oscillatory activity. The hippocampus is critical for the formation of episodic memories, and this capacity is reduced over the course of normal aging. Sharp-wave ripple events are high-frequency (~150 Hz) oscillations generated in the hippocampus, and these events have been implicated in the stabilization of long-term memories. Our analysis of these oscillations and of correlated single-unit activity in rats identified key changes that occur through the course of aging. Specifically, results from our analysis indicate that aging is accompanied by a decline in the oscillation frequency and rate of occurrence of these oscillations and that individual neurons fire less reliably within each ripple event. Together, these changes may contribute to age-associated memory decline.

1. Wiegand J-PL, Gray DT, Schimanski LA, Lipa P, Barnes CA, and Cowen SL. (2016) Age is associated with reduced sharp-wave ripple frequency and altered patterns of neuronal variability. J Neurosci.,36:5650–5660.
2. Cowen SL, Gray DT, Wiegand J-PL, Schimanski, LA, and Barnes CA. (2018) Age-associated changes in waking hippocampal sharp-wave ripples. Hippocampus, https://doi.org/10.1002/hipo.23005.[Epub ahead of print]

Anterior-cingulate neurons are involved in post-decision action maintenance and value prediction. The previously-described observation that motor activity plays a role in modulating "delay cell" activity in the prefrontal cortex motivated a search for theories of frontal function that incorporate representations of body movement. One theory proposes that the anterior cingulate cortex, a subregion of the medial prefrontal cortex, plays a critical role in the evaluation of the cost of physical effort. Evidence from rodents and primates suggests that neurons in the anterior cingulate cortex integrate information about expected effort to guide cost-benefit decision making. To identify the physiological correlates of this evaluative process, I used arrays of single-unit electrodes to record ensemble activity in the anterior cingulate cortex as animals made effort- and reward-guided evaluations. Unexpectedly, results indicated that neurons responding to the anticipated effort responded at least 100 milliseconds after animals made their decision, suggesting that these neurons do not contribute to deliberation, but, instead, may be involved in sustaining goal-directed behaviors after decisions are made. Our observations led me to the proposal that the anterior cingulate cortex facilitates "perseverance" by regulating both glutamatergic and dopaminergic transmission in the motor cortex and dorsal striatum.

1. Cowen SL, Davis GA, and Nitz DA. (2012) Anterior cingulate neurons in the rat map anticipated effort and reward to their associated action sequences. J Neurophysiol., 107:2393–2407.
2. Miller MA, Thomé A, and Cowen SL. (2013) Intersection of effort and risk: ethological and neurobiological perspectives. Front Neurosci., 7:208.
3. Cowen SL, Phelps, CE, Navratilova E, McKinzie DL, Okun A, Husain, BS, Gleason SD, Witkin JM, and Porreca FC. (2018) Chronic pain impairs cognitive flexibility and engages novel learning strategies in rats. Pain, 157:1403-1412. doi: 10.1097/j.pain.0000000000001226.

Expanding the traditional view of the hippocampal representation of space. The discovery of the hippocampal place cell (O'Keefe and Dostrovsky, 1971) provided convincing physiological evidence that the hippocampus creates a cognitive map of the environment. With time, it was found that the response properties of these place cells were more nuanced than expected. For example, "place cells" were found to be sensitive to both location and trajectory and that these neurons coupled their activity to specific phases of the hippocampal theta (7 Hz) oscillation. My research contributed to the expansion of the traditional view of the place cell by challenging the view that spatial coding in the hippocampus is an exclusive property of principal cells. Together with Drew Maurer and Bruce McNaughton, we determined that inhibitory interneurons convey precise information about space, and that this information is only identifiable if the phase of the theta rhythm at which interneurons fire is accounted for. We used this phase-based definition of the place field to improve upon existing measures of place-field sizes, an approach which became useful in quantifying how the spatial scale of the cognitive map changes in different regions of the hippocampus.

The second way my research extended the understanding of hippocampal function resulted from my collaboration with Dr. Douglas Nitz and our investigation of repeating place fields – a recently discovered phenomenon whereby multiple fields appear when animals visit locations with similar behavioral or visual features (Derdikman et al., 2009). Dr. Nitz and I observed that these repeating fields shift forward in space as animals run on spiral-shaped tracks. Further experiments revealed that this shift was most likely due to a buildup of inertial navigation error, suggesting that animals were actually using an inertial/vestibular strategy as opposed to a visual cue based navigation

strategy – even in brightly-lit rooms. This is an interesting contribution, as one assumption in the field is that inertial navigational strategies are only employed when visual cues are unavailable.

1. Cowen SL and Nitz DA. (2014) Repeating Firing Fields of CA1 Neurons Shift Forward in Response to Increasing Angular Velocity. J Neurosci., 34:232–241.
2. Maurer AP, Cowen SL, Burke SN, Barnes CA and McNaughton BL. (2006a) Organization of hippocampal cell assemblies based on theta phase precession. Hippocampus, 16:785–794.
3. Maurer AP, Cowen SL, Burke SN, Barnes CA and McNaughton BL. (2006b) Phase precession in hippocampal interneurons showing strong functional coupling to individual pyramidal cells. J Neurosci., 26:13485–13492.

Development of technologies for the neuroscience community. From the onset of my scientific career, I have worked to develop software and hardware to assist the neuroscience community. Below is a list of some of these contributions and ongoing projects:

- Ultrasound measurement of electrical brain activity. I am a collaborator on Brain Initiative R24(Lead PI: Russel Witte, UA) to develop a non-invasive ultrasound system for the measurement of electrical activity in the brain. The system capitalizes on the acoustoelectric effect, and my role is to validate the system's effectiveness by comparing in vivo measurements obtained from the ultrasound system with measurements obtained from traditional electrophysiology.
- Simultaneous dopamine and single-unit/local-field measurement. Awarded a 2014 NSF BRAINEAGER grant to develop technologies for the simultaneous recording of the activities of ensembles of neurons and real-time measurement of dopamine release. Since receiving support, we have produced working versions of this device and successfully tested the device in anesthetized and awake and behaving rats (methods paper under review). The next stage of development will be to improve the hardware and software to improve robustness and ease of use.
    1. Parent KL, Hill DF, Crown LM, Wiegand J-P, Gies KF, Miller MA, Atcherley CW, Heien ML, and Cowen SL. (2017) Platform to Enable Combined Measurement of Dopamine and Neural Activity. Anal Chem:acs.analchem.6b03642.
    2. Hill DF, Parent KL, Atcherley CW, Cowen SL, and Heien ML. (2019) Differential release of dopamine in the nucleus accumbens evoked by low-versus high-frequency medial prefrontal cortex stimulation. Brain Stimulation, 11:426-434.
- To better characterize fine body movements in animals as they perform decision-making behaviors, I developed a novel 9-axis head-mounted inertial measurement system. Prototypes of this system are being developed for three laboratories for the investigation of brain-body interactions in the hippocampus, parietal cortex, and prefrontal cortex.
- Designed and built numerous automated maze systems for the training and testing of decision-making and memory-driven behaviors. The design and required software is freely available. I helped set up these systems in the laboratories of three collaborators and they continue to be used.
- Produced an interactive graphical system for real-time and off-line spike sorting (Waveform Cutter, Cowen 2002). This tool became an integral part of MClust (David Redish, U. Michigan), one of the most popular open-source spike-sorting systems.

Complete list of published work in MyBibliograpy

https://www.ncbi.nlm.nih.gov/sites/myncbi/1Lk1z2JuTON/bibliography/46504043/public/?sort=date&direction=ascending.

Research Support

LuMind Foundation PI: Elgin 1/1/17 - present
Brain Development, Sleep & Learning in Down Syndrome
Objective: Identify neural signatures of sleep dysfunction in Down-syndrome subjects (EEG).
Role on Project: Co-Investigator

Michael J. Fox PI: Cowen 8/1/17 - 7/31/19
Identification of Network and Oscillatory Signatures Of The LRRK2 Mutation
Objective: Identify neural biomarkers that distinguish the LRRK2 genetic form of Parkinson's disease from healthy controls and idiopathic Parkinson's disease.
Role on Project: Principal Investigator

NINDS R01 NS084026 PI: Gurkoff 6/1/14 - 9/1/18
Restoring Functional Connectivity Following TBI
Objective: Assist investigation of functional connectivity changes associative traumatic brain injury and following deep-brain stimulation therapy. Support for travel to assist with inter-region LFP surgical procedures and recording.
Role on Project: Co-Investigator

NIMH R24 MH109060 PI: Witte 11/1/15 - 8/31/18
High Resolution Electrical Brain Mapping by Real-time and Portable 4D Acoustoelectric Imaging
Objective: Develop new technologies for in vivo acoustoelectric imaging of neural activity.
Role on Project: Co-Investigator

NIMH R44 MH114776 PI: Hedlin 8/1/17 - 1/31/18
High Resolution Electrical Brain Mapping by Real-time and Portable 4D Acoustoelectric Imaging
Objective: Develop new technologies for simultaneously stimulating and recording the activities of groups of individual neurons in behaving animals.
Role on Project: Co-Investigator

Biographical Sketch

Arne Ekstrom., Ph.D.
Associate Professor, Psychology,

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
Brandeis University, Waltham, MA	B.A.	1996	Psychology, Biology
University of Arizona, Tucson, AZ	M.S.	2001	Neuroscience
Brandeis University, Waltham, MA	Ph.D.	2004	Neuroscience

Personal Statement

The primary focus of my research is to better understand the neural basis of human memory, with a particular focus on spatial navigation. I employ several different methodologies to better understand spatial memory, including immersive virtual reality, intracranial EEG, fMRI, and scalp EEG. Studies in my lab focus on how neural signals code space vs. time, how we represent different scales of space, how navigation and episodic memory are represented differently in the brain, and how the different recording modalities used tie together or provide complementary information about underlying brain processes.

Positions

1996 – 1997	Research Assistant	Department of Psychology, Harvard University, Cambridge
2004 – 2009	Postdoctoral Fellow	Division of Neurosurgery and Center for Cognitive Neuroscience, Semel Institute of Neuroscience and Human Behavior, University of California, Los Angeles
2009 – 2014	Assistant Professor	Department of Psychology and Center for Neuroscience, University of California, Davis
2014 – 2018	Associate Professor	Department of Psychology and Center for Neuroscience, University of California, Davis
2018 – Present	Associate Professor	Department of Psychology and Evelyn F. McKnight Brain Institute, University of Arizona, Tucson

Honors

1996	B.A., Brandeis University, magna cum laude, High Honors in Neuroscience
1998 – 2000	Flinn Biomathematics Fellow, University of Arizona
2006 – 2009	NIH/NINDS Postdoctoral NRSA fellowship
2008	The Brain Research Institute Distinguished Postdoctoral Fellow in Neuroscience
2011	Hellman Young Investigator Award
2011 – 2012	Alfred P. Sloan Fellow
2012	Kavli Fellow – National Academy of Sciences Kavli Frontiers of Science
2015	Chancellor's Fellow

Contribution to Science

Multivariate approaches to the fMRI of human episodic memory and navigation. In the work cited below, we demonstrate mechanisms by which hippocampal subfields store and retrieve spatiotemporal memories, helping to resolve how the human hippocampal subfields contribute to episodic memory. Using high-resolution imaging of the hippocampus along with multivariate pattern

analysis, we demonstrate how patterns of activations within hippocampal subfields might be important to memory for details of events. Together, this work has advanced our understanding of how the human hippocampal subfields code spatial and temporal context as part of a more general role in episodic memory.

1. Copara MS, Hassan A, Kyle C, Libby L, Ranganath C, and Ekstrom AD. (2014) Complementary roles of human hippocampal subregions during retrieval of spatiotemporal context. Journal of Neuroscience, 34:6834-6842.
2. Stokes JD, Kyle C, and Ekstrom AD. (2015) Complementary roles of human hippocampal subfields in differentiation and integration of spatial context. Journal of Cognitive Neuroscience, 27:546-559.
3. Kyle CT, Stokes JD, Lieberman J, Hassan AS, and Ekstrom AD. (2016) Successful retrieval of competing spatial environments in humans involves hippocampal pattern separation mechanisms. ELife, 27, e10499.

The brain as a network: Graph theory reveals medial temporal lobe and neocortical interactions during successful memory retrieval. Multiple brain regions are important to spatiotemporal memory yet how these interact at a "systems" level in the brain is not clear. In Watrous et al. 2013 Nature Neuroscience, using multi-lobular recordings from patients undergoing clinical monitoring, we reported that the medial temporal lobe showed elevated levels of low-frequency coherence with neocortical nodes during correct retrieval of recently encoded events. In Schedlbauer et al. 2013 Scientific Reports, We demonstrated a similar finding using fMRI in healthy human participants (specifically, that connectivity was higher across multiple nodes, specifically to the hippocampus, during correct memory retrieval). In two additional papers we outline and test models in which neural specific interactions at specific hubs are critical to both encoding and retrieval of navigation and episodic memories. These findings advance our understanding of how networks of brain areas contribute to human navigation and episodic memory both empirically and theoretically.

1. Watrous AJ, Tandon N, Connor C, Pieters T, and Ekstrom AD. (2013) Frequency-specific increases in network connectivity underlie successful spatiotemporal memory retrieval. Nature Neuroscience,16:349-56. PMID: 23354333.
2. Schedlbauer A, Copara MS, Watrous AJ, and Ekstrom AD. (2014) Multiple interacting brain areas underlie successful spatiotemporal memory retrieval in humans. Scientific Reports, 4:6431.
3. Ekstrom AD, Huffman D, and Starrett MJ. (2017) Interacting networks of brain regions underlie human spatial navigation: A review and novel synthesis of the literature. Journal of Neurophysiology, 118:3328-3344.

Behavioral and neural correlates of human spatial navigation. In the work cited below, we employ patients with focal lesions, fMRI, and behavioral methods to better understand the neural basis of human spatial navigation. Prior to this work, the exact contribution of the human hippocampus versus extra-hippocampal cortical areas to encoding and retrieval spatial locations was unclear. Based on our findings, we propose that allocentric spatial memory (memory for object locations referenced to external cues in the environment rather than the self) depends primarily on extra-hippocampal network contributions, with the hippocampus primarily contributing to the precision of such spatial memories. Together, these findings argue for the importance of hippocampal and extra-hippocampal cortical areas to spatial navigation and provide novel paradigms for understanding human spatial navigation.

1. Kolarik BS, Baer T, Shahlaie K, Yonelinas AP, and Ekstrom AD. (2018) Close but no cigar: Spatial precision deficits following medial temporal lobe lesions provide novel insight into theoretical models of navigation and memory. Hippocampus, 28:31-41.

2. Kolarik BS, Shahlaie K, Hassan B, Borders AA, Kaufman K, Gurkoff G, Yonelinas AP, and Ekstrom AD. (2016) Impairments in precision, rather than spatial strategy, characterize performance on the virtual Morris Water Maze: A case study. Neuropsychologia, 80:90-101.
3. Zhang H and Ekstrom AD. (2013) Human neural systems underlying rigid and flexible forms of allocentric spatial representation. Human Brain mapping, 34(5):1070-87.
4. Arnold AE, Iaria G, and Ekstrom AD. (2016) Mental simulation of routes during navigation involves adaptive temporal compression. Cognition, 157:14-23.

Direct recordings from epilepsy patients undergoing seizure monitoring reveal the cellular and oscillatory basis of human spatial navigation. The work summarized below addresses the critical issue of how and in what manner cellular and oscillatory coding mechanisms in the rodent are conserved in humans. In Ekstrom et al. 2003, we establish the presence of both place and view responsive neurons in the hippocampus and parahippocampal cortex, respectively, using direct recordings in patients undergoing surgical monitoring. By demonstrating both place and view coding in the human medial temporal lobe, we helped resolve decades of debate on whether place coding or view coding mechanisms were present in the primate temporal lobes. This paper has been cited more than 1,000 times and forms the foundation of other studies that investigated cellular responses in humans during navigation. Watrous et al. (2011, 2013) establish the presence of low-frequency oscillations during movement and spatial navigation in the human hippocampus. Vass et al. (2016) establish that low frequency oscillations in the human hippocampus code spatial distance by removing sensory and vestibular cues during virtual teleportation. Together, these findings advance our understanding of the extent to which rodent cellular coding mechanisms are both similar and different in the human hippocampus.

1. Ekstrom AD, Kahana MJ, Caplan JB, Fields TA, Isham EA, Newman E, and Fried I. (2003) Cellular networks underlying human spatial navigation. Nature, 425(6954): 184-188. PMID: 12968182.
2. Vass LK, Copara MS, Seyal M. Shahlaie, K, Tomaszewski-Farias S, Shen P, and Ekstrom AD. (2016)Oscillations go the distance: Low frequency human hippocampal oscillations code spatial distance in the absence of sensory cues during teleportation. Neuron, 89:1-7.
3. Bohbot VD, Copara MS, Gotman J, and Ekstrom AD. (2017). Low-frequency oscillations in the human hippocampus during real-world and virtual navigation. Nature Communications, 8:14415.

High-resolution imaging of the human hippocampus and the neural basis of the human hippocampal BOLD signal. Another focus of the lab has been developing ways to better image the human hippocampus using fMRI and to relate these hippocampal BOLD-specific changes to underlying neural activity. Our work has developed novel BOLD sequences for imaging the human hippocampus in-plane with 1.5 mm x 1.5 voxels, which provides functional resolution sufficient to image changes in the neural activity at specific subfields (Ekstrom et al. 2009 Neuroimage). Together, these findings advance current methods in the field for imaging and recording from the human hippocampus.

1. Ekstrom AD. (2010) How and when the fMRI BOLD signal relates to underlying neural activity: The danger in dissociation. Brain Research Reviews, 62(2):233-44. PMID: 20026191.
2. Ekstrom AD, Bazih AJ, Suthana NA, Al-Hakim R, Ogura K, Zeineh M, and Bookheimer SY. (2009)Advances in high-resolution imaging and computational unfolding of the human hippocampus. Neuroimage, 47, 42-49. PMID: 19303448.
3. Ekstrom AD, Suthana NA, Millet D, Fried I, and Bookheimer SY. (2009) Correlation Between BOLD fMRI and Theta-band Local Field Potentials in the Human Hippocampal Area. Journal of Neurophysiology, 101, 2668-2678. PMID: 19244353.
4. Ekstrom AD, Suthana NA, Behnke E, Salamon N, Bookheimer SY, and Fried I. (2008) High-resolution depth electrode localization and imaging in patients with pharmacologically intractable epilepsy. Technical Note. Journal of Neurosurgery, 108, 812-5. PMID: 18377264.

Research Support

NINDS R01 NS076856 PI: Ekstrom 7/1/12 – 6/30/22

Representation of Spatiotemporal Information in Human Episodic Memory and Navigation

The human hippocampus is critical for both episodic memory and navigation, as indicated by the devastating consequences of neural diseases such as stroke and ischemia. This proposal seeks to leverage functional magnetic resonance imaging and intracranial electrode recordings in patients to address these gaps in knowledge, with potential outcomes providing a more complete framework for understanding how the hippocampal circuitry underlies memory and navigation and how cortical circuits might partially compensate for lost function following hippocampal damage.

Role on Project: PI

NSF BCS-1630296 PI: Ekstrom 9/1/16 – 8/31/20

The Neural Basis of Human Spatial Navigation in Large-scale Virtual Spaces with Vestibular Input

A major gap in our knowledge about human spatial navigation regards the importance of vestibular and other proprioceptive cues (termed "body-based" cues). We propose to cross this barrier in our knowledge by developing a novel set-up in which participants freely ambulate on a 2-D treadmill with a head-mounted display, allowing for full range of motion during navigation. The expected outcomes from this project are a better understanding of how we represent large-scale spaces during free ambulation and the neural basis of direction and distance codes during enriched vs. impoverished body-based cues.

Role on Project: PI

NIA R01 AG003376 PI: Barnes 10/1/15 – 9/30/20

Neurobehavioral Relations in Senescent Hippocampus

The objective of this research program is to understand the basis of memory impairments that result from normal aging in rhesus macaques.

Role on Project: Co-investigator

NINDS R01 NS08402 PI: Gurkoff 2/1/14– 1/30/19

Restoring Connectivity Following Traumatic Brain Injury

The goal of this grant is to assess how traumatic brain injury alters oscillations, particularly phase coherence across distal neural networks, during performance of cognitive tasks and to determine whether deep brain stimulation can be utilized to improve coherence and restore function. Role on Project: Co-investigator

NIMH R01 MH113855 PI: Geng 6/1/18 – 5/31/23

Quantifying the Attentional Template

Problems of attentional control are a core deficit in many mental health disorders, most notably the attention deficit disorders. The proposed work investigates why the quality of attentional control varies between people and situations.

Role on Project: Consultant

Biographical Sketch

Fabian Fernandez, Ph.D.
Assistant Professor, Psychology and Neurology

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
University of Florida, Gainesville, FL	B.Sc.	2002	IDS, Neurobiology
Stanford University, Palo Alto, CA	Ph.D.	2008	Neuroscience
University of Colorado, Denver, CO	Postdoctoral	2009	Neuropharmacology
Johns Hopkins University, Baltimore, MD	Postdoctoral	2015	Translational Neurosci

Personal Statement

I see many parallels between running a laboratory and operating a technology startup. My vision is to use the lab as a vehicle to identify promising basic research that—if strategically rounded out with a little more investment—could have a disproportionate impact on the way diseases of the nervous system are conceptualized and treated. This perspective informs my current work on circadian rhythms and aging, as well as a previous project I led concerning the design of a treatment for intellectual disability in people with Down syndrome (please see Fernandez et al., Nature Neuroscience, 2007, Jamie Edgin & Fabian Fernandez, New York Times, "The Truth about Down Syndrome," and item 1 in Publications and Career Contributions).

Based in part on professor Art Winfree's conjectures on circadian singularity and other research suggesting disrupted rhythms in aging, I have recently used a photic manipulation to take away circadian function and "cognition" from a healthy animal (i.e., the Siberian hamster; Fernandez et al., Science, 2014). The central question that frames my laboratory's day-to-day activities at the University of Arizona is whether we can design a photic intervention to do the opposite: can we design short-lived light pulses with specific color temperatures, intensities, or frequency schedules that will restore disrupted rhythms and cognition back to normal in older individuals with existing memory/circadian problems? And corollary to this central question: can we do it while the person is sleeping—i.e., at a time when the circadian pacemaker, ironically enough, is most responsive to light stimulation from the retina?

To accomplish this long-term goal, my lab is in the process of developing a technology that emits a precise printed array of LED point lights with predetermined wavelength characteristics and intensity fluctuations that could be optimal for kick-starting rhythms. This device will deliver light from a long-wear contact lens in integrated bursts at times of night when the circadian system is primed to adapt in response to photic input. A natural bedfellow to these efforts is ongoing to: 1) code-break the language by which light can be used as a repetitive stimulus to shift the operation of the brain's circadian clock and rehabilitate it when it has weakened, and 2) identify individual differences in circadian profile that will increase the risk of memory impairment as a person ages. At the intersection of these data, we hope to uncover important principles for how to use naturally occurring facets of dawn- or dusk-like twilight to strengthen the pacemaker specifically in those forecast to experience circadian-linked memory troubles with normal aging (or those whose troubles might accelerate progression of Alzheimer's disease).

In my training and previous experimental work, I have demonstrated a resolve to tackle tough problems and to find elegant solutions that might find their way into everyday life. It is this tenacity that I bring to my current and future work in circadian science.

Positions

1999 – 2002	University Scholars undergraduate research fellow with Dr. Darragh P. Devine, University of Florida, Gainesville
2002 – 2008	PhD research in neuroscience with Dr. Craig C. Garner, Stanford University, Palo Alto, CA
2008 – 2009	Fondation Jérôme-Lejeune fellow with Dr. Alberto C.S. Costa, University of Colorado, Denver
2009 – 2012	Senior Scientist and Consultant, Intellimet LLC.
2012 – 2015	Research Associate with Dr. Roger H. Reeves, Johns Hopkins University, Baltimore, MD
2015	Assistant Professor, Department of Psychology and Neurology, Bio5 Fellow, University of Arizona, Tucson

Honors

2000	Peter J. Sones Endowed Scholarship, University of Florida, Gainesville
2001	Charles Vincent McLaughlin Endowed Scholarship, Univ of Florida, Gainesville
2001	Phi Beta Kappa Honor Society
2002	BSc, summa cum laude, self-tailored IDS program
2003 – 2006	NSF Predoctoral Fellowship (GRFP #2003014684)
2007 – 2008	Ruth L. Kirschstein NRSA Research Service Award (NINDS, 1F31NS056571)
2008 – 2009	La Fondation Jérôme-Lejeune Postdoctoral Fellowship
2014	U.S. Patent, 8,729,067, Pharmacological Treatment of Cognitive Impairment
2015	Fellow Award, BIO5 Institute, University of Arizona, Tucson
2016	Bisgrove Scholar Award, Science Foundation Arizona (SFAz)

Contribution to Science

My early publications were concerned with therapeutics research in animal models of intellectual disability. While at Stanford University, I spearheaded efforts to “cure” memory problems in Ts65Dn mice, animals with a genetic background similar to individuals with Down syndrome (DS). For decades, it was assumed that nothing could be done to improve cognitive function in the DS population. The condition results from the over-expression of ~200 categorically diverse genes that steer development of the brain in a completely different direction from that of the typical one. By 2004, it became clear, however, that the Ts65Dn DS model showed one central difference in brain signaling that could contribute to the animal’s difficulties with learning and memory: an increase in the signaling of a neurotransmitter called GABA. I established that higher-than-normal GABA was a key therapeutic target—drugs that reduced this transmitter in the brain also restored the ability of these mice to remember novel objects and navigate mazes.

These findings, published in Nature Neuroscience, were commented on in Lancet and the Journal of the American Medical Association and reported in the international press (UK Telegraph, Reuters, LA Times, Scientific American, Bloomberg, etc). They have been replicated by several laboratories around the world and are currently the basis for clinical trials by Roche and Balance Therapeutics to evaluate the ability of GABA antagonists to raise IQ in children and young adults with DS.

The last decade has seen disruptive innovation in DS research and a rethinking of treatment approaches for intellectual disability. This would not have been possible without a purpose-driven program of study and a naïve willingness to transform a new idea into value for a medically underserved area of society. Having devised a treatment approach that might be relevant for the developmental disabilities experienced by people with DS early on, I turned my attention to the fact that these individuals experience another phase of cognitive decline as they age. This process is an accelerated form of normal aging and, in some with DS, is thought to bear resemblance to

Alzheimer's disease. A consensus in industry and academia suggests the memory problems accompanying normal aging and those typifying progression of dementia are coordinated by multiple factors. Over the past decade, I have explored how one of these factors—circadian arrhythmia—interferes with memory function in older animal models of DS and have focused my lab's efforts to mapping arrhythmia's effects with relevance to the older general population.

1. Fernandez F, Morishita W, Zuniga E, Nguyen J, Blank M, Malenka RC, and Garner CC. (2007)Pharmacotherapy for cognitive impairment in a mouse model of Down syndrome. Nature Neuroscience, 10: 411-413.
2. Fernandez F and Garner CC. (2007) Object recognition memory is conserved in Ts1Cje, a mouse model of Down syndrome. Neuroscience Letters, 421: 137-141.
3. Fernandez F and Garner CC. Over-inhibition: a model for developmental intellectual disability. Trends in Neurosciences, 30: 497-503, 2007.
4. Fernandez F and Garner CC. (2008) Episodic-like memory in Ts65Dn, a mouse model of Down syndrome. Behavioural Brain Research, 188: 233-237.
5. Fernandez F, Trinidad JC, Blank M, Feng DD, Burlingame AL, and Garner CC. (2009) Normal protein composition of synapses in Ts65Dn mice, a mouse model of Down syndrome. Journal of Neurochemistry, 110: 157-169.
6. Ruby NF*, Fernandez F, Zhang P, Klima J, Heller HC, and Garner CC. (2010) Circadian locomotor rhythms are normal in Ts65Dn "Down Syndrome" mice and unaffected by Pentylenetetrazole. Journal of Biological Rhythms, 25: 63-66.
7. Fernandez F, Torres V, and Zamorano P.* (2010) An evolutionarily conserved mechanism for presynaptic trapping. Cellular and Molecular Life Sciences, 67: 1751-1754.
8. Zampieri BL, Fernandez F*, Pearson JN, Stasko MR, and Costa ACS. (2014) Ultrasonic vocalizations during male-female interaction in the mouse model of Down syndrome Ts65Dn. Physiology &Behavior, 128: 119-125.
9. Fernandez F and Reeves RH. (2015) Assessing cognitive improvement in people with Down syndrome: Important considerations for drug efficacy trials. Handbook of Experimental Pharmacology, 228: 335-380.
10. Fernandez F and Edgin JO. (2016) Pharmacotherapy in Down syndrome: Which way forward? Lancet Neurology, 15: 776-777.
11. Clark CAC, Fernandez F, et al. (2017) The medial temporal memory system in Down syndrome: Translating animal models of hippocampal compromise. Hippocampus, 27: 683-691.
12. Fernandez F, Nyhuis CC, Anand P, et al. (2017) Young children with Down syndrome show normal circadian development, but poor sleep efficiency: A cross-sectional study across the first 60months of life. Sleep Medicine, 33: 134-144.

Since 2005, my colleague, Dr. Norman Ruby, and I have explored how circadian arrhythmia impairs memory function using a novel animal model, the Siberian hamster (Phodopus sungorus) (PNAS 2008; PLoS 2013; Science, 2014). Circadian misalignment due to shift work or jet-lag is well-known to impair memory in humans. However, circadian arrhythmia in rodents induced by clock gene knockouts or surgical lesion of the suprachiasmatic nucleus (SCN), the brain's clock, is reported to have very little effect on memory. Dr. Ruby and I reasoned that this long-held disconnect occurred because the SCN remains developmentally and structurally intact in humans but not in these rodent models. What if the impairments brought on by circadian dysfunction resulted, not from the loss of a "good-functional" SCN (i.e., degeneration), but from the gain of a "bad-defective" SCN that was now sending error signals to memory systems in the medial temporal lobe? What if the proper phenotypic expression of arrhythmia in the brain – and its effects on behavior – require preservation of circuitry from "malfunctioning" SCN areas to their downstream targets? What if key aspects of this expression are lost upon severing SCN connections? We addressed these issues in the Siberian hamster, a species that can be rendered circadian arrhythmic by a simple, one-time photic treatment that does

not interfere with SCN structure or development/genetics. We found that hamsters with persistent light-induced arrhythmia actually have severe deficits in spatial and object recognition memory that can be rescued by subsequent ablation of the SCN. These data suggest that chronic arrhythmia per se does not cause memory impairments in animals – or presumably humans – as has been historically believed. Rather, in line with our hypothesis, an intact, but dysrhythmic SCN is necessary to realize these deficits (Fernandez et al., Science, 2014).

1. Ruby NF, Hwang CE, Wessells C, Fernandez F, Zhang P, Sapolsky R, and Heller HC. (2008)Hippocampal-dependent learning requires a functional circadian system. Proceedings of the National Academy of Sciences, 105: 15593-15598.
2. Fernandez F, Lu D, Ha P, Costacurta P, Chavez R, Heller HC, and Ruby NF. (2014) Dysrhythmia in the suprachiasmatic nucleus inhibits memory processing. Science, 346: 854-857.
3. Lewis SA, Negelspach DC, Kaladchibachi S, Cowen SL, and Fernandez F.* (2017) Spontaneous alternation: A potential gateway to spatial working memory in Drosophila. Neurobiology of Learning and Memory, 142: 230-235. *Corresponding Author
4. Ruby NF, Fisher N, Patton DF, Paul MJ, Fernandez *, and Heller HC.* (2017) Scheduled feeding restores memory and modulates c-Fos expression in the suprachiasmatic nucleus and septohippocampal complex. Scientific Reports, 7: 6755.
5. Kaladchibachi S and Fernandez F. (2018) Precision light for the treatment of psychiatric disorders. Neural Plasticity, 5868570, 1-16.
6. Kaladchibachi S, Negelspach DC, and Fernandez F.* (2018) Circadian phase-shifting by light: Beyond photons. Neurobiology of Sleep and Circadian Rhythms, 5: 8-14. *Corresponding Author
7. Negelspach DC, Kaladchibachi S, and Fernandez F. (2018) The circadian activity rhythm is reset by nanowatt pulses of ultraviolet light. Proceedings of the Royal Society of London B: Biological Sciences, 285, 1884.

Research Support

Science Foundation Arizona PI: Fernandez 8/1/16 – 7/31/18
2016 Bisgrove Scholar Program
ole on Project: Project PI

Biographical Sketch

Elizabeth L. Glisky., Ph.D.
Professor, Psychology

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
University of Toronto	B.A.	1962	Psychology
University of Toronto	Ph.D.	1983	Psychology
University of Toronto	Post-doc	1987	Psychology

Personal Statement

The goal of my research has been to gain an understanding of the cognitive and neural mechanisms of memory and executive function, how they change with normal aging and brain damage, and how to reduce the impact of memory disorders in everyday life. My early research focused on designing rehabilitation methods for people with severe memory disorders to help them learn new information relevant in their daily lives. For the past 20 years, I have been exploring individual differences in memory and executive function in normal aging, and how they predict performance in a variety of cognitive tasks and in the real world. To this end, we developed and normed composite measures of memory and executive function in normally aging older adults, which we have tracked longitudinally for several years, and which have yielded a rich dataset with the potential to reveal the variables most critical for successful aging. We have shown that these composite neurocognitive measures predict performance in a variety of memory and cognitive tasks, including source memory and prospective memory, in both older adults and patients. During the past 10 years, my students and I have continued to explore ways to improve memory in a variety of special populations and have shown mnemonic benefits of self-referential processing and self-imagination in older people and in young people with memory deficits. Most recently, we have become interested in the potential for social engagement to provide cognitive benefits for older people through the use of internet communication tools such as Facebook and through intergenerational interactions. We observed benefits in some aspects of executive function but not others, and are continuing work focused on the benefits of intergenerational communication for both young and older adults. We have also found a relation between executive function and hearing loss in older adults. To gain a deeper understanding of the specifics of executive function in these studies, we have constructed an executive function battery for older adults to allow us to explore specific sub-components of executive function that may work together or independently in different cognitive tasks.

1. McFarland C and Glisky E. (2011) Implementation intentions and prospective memory among older adults: An investigation of the role of frontal lobe function. Aging, Neuropsychology, and Cognition, 18, 633-652.
2. Grilli, MD and Glisky EL. (2013) Imagining a better memory: Self-imagination in memory-impaired patients. Clinical Psychological Science, 1, 93-99.
3. Myhre JW, Mehl MR, and Glisky EL. (2016) Cognitive benefits of online social networking in healthy older adults. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. doi:10.1093/geronb/gbw025.
4. Grilli MD, Woolverton CB, Crawford MS, and Glisky EL. (2017) Self-reference and emotional memory effects in older adults at increased genetic risk of Alzheimer's disease. Aging ,Neuropsychology, and Cognition. doi: 10.1080/13825585.2016.1275508.

Positions

1987 – 1989	Visiting Assistant Professor, Department of Psychology, University of Arizona
1989 – 1995	Assistant Professor, Department of Psychology, University of Arizona
1995 – 1999	Associate Professor, Department of Psychology, University of Arizona
1999	Professor, Department of Psychology, University of Arizona
2000 – 2002	Head, Interdisciplinary Program in Gerontology, University of Arizona
2004 – 2008	Associate Head and Director of Graduate Studies, Dept. of Psychology, University of Arizona
2006	Professor, Evelyn F. McKnight Brain Institute
2008 – 2009	Acting Head, Department of Psychology, University of Arizona
2010 – 2015	Head, Department of Psychology, University of Arizona

Honors and Awards

1980 – 1981	Natural Sciences and Engineering Research Council Postgraduate Scholarship
1981 – 1982	University of Toronto Open Fellowship
1982 – 1983	Ontario Government Scholarship
1983 – 1986	University of Toronto Postdoctoral Award to Research Fellow
1989 – 1990	University of Arizona, Provost's Teaching Award
2003	Social and Behavioral Sciences Research Professorship
2006	Fellow of the Association for Psychological Science
2011	Elizabeth Hurlock Beckman Award for Educational Leadership and Translational Work in Cognitive Rehabilitation

Contribution to Science

In 1986, I published the first of several papers showing that severely amnesic patients could learn considerable amounts of new information. Prior to that time, there were no reports of any significant new learning capabilities in amnesic patients. The method that I developed was called the method of vanishing cues, and it was based on new empirical findings and theories by my colleague Dan Schacter, showing that people with amnesia, although severely impaired in explicit memory, could nevertheless demonstrate preserved implicit memory. My contribution was to take those findings of intact implicit memory and translate them into real-world clinical outcomes for memory-impaired individuals. In several publications, we showed that these patients, using the method of vanishing cues, could learn new vocabulary, computer programming, and even a complex set of procedures for a new job. We concluded that the method was successful because it tapped into intact implicit memory allowing people to learn new things even though they had no explicit memory. The method was later explored and extended by many others in the field of neuropsychological rehabilitation and is still used clinically today.

1. Glisky EL, Schacter DL, and Tulving E. (1986) Learning and retention of computer related vocabulary in memory impaired patients: Method of vanishing cues. Journal of Clinical and Experimental Neuropsychology, 8, 292 312.
2. Glisky EL and Schacter DL. (1987) Acquisition of domain specific knowledge in organic amnesia: Training for computer related work. Neuropsychologia, 25, 893 906.
3. Glisky EL. (1992) Acquisition and transfer of declarative and procedural knowledge by memory-impaired patients: A computer data-entry task. Neuropsychologia, 30, 899-910.
4. Glisky EL. (1995) Acquisition and transfer of word processing skill by an amnesic patient. Neuropsychological Rehabilitation, 5(4), 299-318.

In the early 90s, studies of source memory began to appear in the literature, with findings that source memory deficits were found in memory-impaired patients only if they had damage to frontal

brain regions. In addition, some studies noted that older people performed more poorly on source memory tasks, and debate ensued about the relative contributions of frontal (FL) and medial temporal (MTL) brain regions to source memory. I became interested in the possibility that individual differences in older adults, many of whom were experiencing declining memory function, might inform this question. I decided to use neuro-psychological tests designed to measure memory function, dependent on the MTLs, and executive function, dependent on the MTLs, to look at individual differences in older adults. I normed a battery of tests on 227 older adults yielding two composite measures: one that tapped fundamental memory functions dependent on the MTLs and one that measured executive function, depending on the FLs. These composite measures were then used to predict performance on item and source memory tasks respectively, and later on other kinds of memory tasks, including prospective memory. The idea was picked up by several other researchers to explore brain-behavior relations in older adults, and the use of neuropsychological tests in older adults has now become quite commonplace.

1. Glisky EL, Polster MR, and Routhieaux BC. (1995) Double dissociation between item and source memory. Neuropsychology, 9, 229-235.
2. Glisky EL, Rubin SR, and Davidson PSR. (2001) Source memory in older adults: An encoding or retrieval problem? Journal of Experimental Psychology: Learning, Memory, and Cognition, 27,1131-1146.
3. Glisky EL and Kong LL. (2008) Do young and older adults rely on different processes in source memory tasks? A neuropsychological study. Journal of Experimental Psychology: Learning, Memory, and Cognition, 34, 809-822.
4. Drag LL, Bieliauskas L, Kaszniak AW, Bohnen NI, and Glisky EL. (2009) Source memory and frontal functioning in Parkinson's disease. Journal of the International Neuropsychological Society, 15,399-406.

Prospective memory–remembering to do things in the future–came into the mainstream literature in the mid-90s as interest began to shift somewhat to real-world memory problems. Little research or theory existed at that time concerning how memory for future intentions differed from the more classically studied memory for past experiences, or whether it might depend on different brain regions. In 1996, I was asked to write a chapter for a book on Prospective Memory, the first of its kind, on the neuropsychology of prospective memory. The chapter was largely speculative, since little laboratory research had been done on prospective memory at all. In that chapter, I proposed that executive functions associated with frontal regions of the brain were probably implicated because of the self-initiation that was required to remember a future intention and the potential need for planning, functions that are associated with executive control. This was the beginning of a series of experiments both in my lab and in others looking at the differential contributions of memory and executive function to prospective memory and retrospective memory. Although prospective memory is still an area that attracts only a small number of researchers, the added insights from neuropsychology have made a significant contribution to theory development and to understanding the underlying mechanisms of prospective memory.

1. Glisky EL. (1996) Prospective memory and the frontal lobes. In M. Brandimonte, G. Einstein & M. McDaniel (Eds.), Prospective memory: Theory and applications (pp. 249-266). Northvale, NJ: Lawrence Erlbaum Associates.
2. McDaniel MA, Glisky EL, Rubin SR, Guynn MJ, and Routhieaux BC. (1999) Prospective memory: A neuropsychological study. Neuropsychology, 13, 103-110.
3. McFarland CP and Glisky EL. (2009) Frontal lobe involvement in a task of time-based prospective memory. Neuropsychologia, 47, 1660-1669.
4. McFarland C and Glisky E. (2012) Implementation intentions and imagery: Individual and combined effects on prospective memory among young adults. Memory & Cognition, 40, 62-69.

In 1977, Rogers, Kuiper, and Kirker published a paper showing that processing information in relation to the self-enhanced memory more than semantic processing – what has been called the self-reference effect. Rogers et al. interpreted this finding as evidence of special mnemonic properties of the self, while others suggested it just involved deeper processing. This debate continues. What has added to the evidence concerning the potential benefits of self-reference is more recent research in aging. Although there was one study in the 1980s, it was not until the mid-2000s where research in self-referential processing in aging again surfaced, and we were at the forefront of this renewed interest. We completed our first study in 2005 and published our first paper on aging and self-reference in 2009. One other paper preceded us in 2007. What we showed was that older adults (over the age of 75) showed a decreased benefit of semantic processing on memory but showed the same added benefit for self-referential processing as did younger adults, suggesting again that the self had special mnemonic properties. Since then, several other studies have appeared in the literature looking at the self-reference effect in older adults. In our lab, we decided to try to enhance the effect even further, combining self-referential processing with imagery – what we have called self-imagination. In a series of experiments, we have demonstrated even greater benefits in memory for self-imagination in both patient and aging populations.

1. Glisky EL and Marquine MJ. (2009) Semantic and self-referential processing of positive and negative trait adjectives in older adults. Memory, 17, 144-157.
2. Grilli MD and Glisky EL. (2010) Self-imagining enhances recognition memory in memory-impaired individual with neurological damage. Neuropsychology, 24, 698-710.
3. Grilli MD and Glisky EL. (2011) The self-imagination effect: Benefits of a self-referential encoding strategy on cued recall in memory-impaired individuals with neurological damage. Journal of the International Neuropsychological Society, 17, 929-933.
4. Grilli MD and Glisky EL. (2013) Imagining a better memory: Self-imagination in memory-impaired patients. Clinical Psychological Science, 1, 93-99. doi: 10.1177/2167702612456464.

Research Support

Arizona Alzheimer's Consortium, DHS PI: Glisky 7/1/18 -6/30/19

Memory and executive function in normally-aging older adults: Completion, analyses, and publication of two projects

The goals are to document changes over time in episodic memory and executive function in normally aging older adults aged 65+; identify specific demographic, health, genetic, and neurocognitive variables that are associated with differential change; and validate an executive function test battery for older adults incorporating specific sub-components of executive function.

Role on Project: PI

McKnight Brain Research Foundation PI: Alexander 7/1/15 -6/30/18

Inter-Institutional cognitive aging assessment core

My responsibilities are to work with a team at the University of Arizona to develop a core assessment battery for older adults over the age of 85 to be shared across 4 sites.

Role on Project: co-investigator

Advanced Bionics Corporation PI: Jacobs 2015 - 2018

Cochlear implants and cognitive impairment

Goals are to look at effects of cochlear implants on cognitive function and social engagement in adults over the age of 72.

Role on Project: co-investigator

Arizona Alzheimer's Consortium, DHS PI: Glisky 7/1/17 -6/30/18

Interventions to improve memory and executive function in older adults in real-world settings

Role on Project: PI

Biographical Sketch

Matthew D. Grilli, Ph.D.
Assistant Professor Psychology

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
University of California, Irvine, CA	B.A.	2007	Psychology
University of Arizona, Tucson, AZ	M.A.	2009	Psychology
Brandeis University, Waltham, MA	Ph.D.	2013	Clinical Psychology
VA Boston Healthcare System, Boston, MA	Postdoc	2015	Clinical Neuropsychology

Personal Statement

I am an assistant professor in the Departments of Psychology and Neurology at the University of Arizona and director of neuropsychology training for the Clinical Psychology Doctoral Program. I am also a licensed psychologist. My research is broadly focused on the clinical and cognitive neuroscience of autobiographical memory, which is memory for real-world events. I use a combination of cognitive, neuropsychological, neuroimaging (magnetic resonance imaging), and genetic methods. For the past five years, I have studied healthy adults and individuals with brain lesions to gain insight into the cognitive and neural bases of autobiographical memory. Since starting my position at the University of Arizona in 2015, I have added a new line of research focused on autobiographical memory and aging, both normal and abnormal trajectories. This has become a major line of research being conducted in my laboratory. As part of this new line of research, I have gained skills in genetic and neuroimaging methods. I also have worked on developing new behavioral tasks of autobiographical memory that might have translational potential.

Positions

2012 – 2013	Psychology Intern, Boston Consortium in Clinical Psychology, Boston, MA
2012 – 2014	Teaching Fellow in Psychiatry, Boston University School of Medicine, Boston, MA
2012 – 2015	Clinical Fellow in Psychology, Harvard Medical School, Boston, MA
2014 – 2015	Assistant Professor, Boston University School of Medicine, Boston, MA (Promoted while completing postdoctoral fellowship)
2015 – Present	Assistant Professor, University of Arizona, Tucson, AZ
2015 – Present	Director of Neuropsychology Track for the Clinical Psychology PhD Program
2015 – Present	Director of the Neuropsychology Clinic, Evelyn F. McKnight Brain Institute
2015 – Present	Affiliate, Graduate Interdisciplinary Program – Cognitive Sciences

Honors

2007	Summa Cum Laude, University of California, Irvine
2007	Undergraduate Investigator Spotlight, University of California, Irvine
2007	Order of Merit Scholar-Athlete of the Year, University of California, Irvine
2007	Undergraduate Research Fellowship, University of California, Irvine
2008	Community Outreach Fellowship, University of Arizona, Tucson

Contribution to Science

Introduced the episodic autobiographical memory hypothesis of preclinical AD cognitive detection. Alzheimer's disease (AD) typically eludes clinical detection for years, if not decades. The identification of subtle cognitive decline associated with preclinical AD would not only advance understanding of the disease but would also provide clinical targets to assess preventative and early intervention treatments. My colleagues and I recently proposed that disrupted retrieval of detailed episodic autobiographical memories may be a sensitive indicator of subtle cognitive decline, because this type of memory taxes a core neural network affected by preclinical AD neuropathology. To begin to address this idea, we assessed the episodic specificity of autobiographical memories retrieved by cognitively normal middle-aged and older individuals who are carriers of the apolipoprotein E ε4 allele – a population at increased risk for subtle cognitive decline related to neuropathological risk factors for AD. We compared the ε4 carriers to non-carriers of ε4 similar in age, education, and gender. In support of the episodic autobiographical memory hypothesis, we found that the ε4 carriers generated autobiographical memories that were reduced in episodic details relative to non-carriers. Also consistent with the notion that this type of memory is particularly sensitive to preclinical subtle cognitive decline, we found that ε4 carriers did not perform worse than the non-carriers on a comprehensive battery of neuropsychological tests. These findings support the notion that disrupted episodic autobiographical memory may be a marker of preclinical AD. In regard to my role, I was the lead researcher and first author for this recent publication, and I was the PI of several small grants that supported this work.

1. Grilli MD, Wank AA, Bercel JJ, and Ryan L. (2018) Evidence for Reduced Autobiographical Memory Episodic Specificity in Cognitively Normal Middle-Aged and Older Individuals at Increased Risk for Alzheimer's Disease Dementia. Journal of the International Neuropsychological Society ,doi: 10.1017/S1355617718000577.

Developed a novel cognitive neuroscience model of how personal semantics are stored and retrieved. Much of one's autobiographical memory is composed of personal semantics, which is knowledge about the self that contextualizes experiences and adds meaning to the life story. Despite the importance of personal semantics to one's sense of self, how such knowledge is organized and retrieved remains underspecified. I have attempted to close this gap in knowledge by studying personal semantics in individuals with lesions to core regions of the autobiographical memory neural network. I have proposed that personal semantics can be viewed as consisting of subtypes of content that place distinct computational demands on regions in the autobiographical memory network. Personal semantics can be bound to events, in which case they are supported by bilateral medial temporal lobe structures. They also can be associated with personally known people, places, and objects and critically depend on the left anterior ventrolateral temporal lobe. Or, they can represent categorical knowledge about the self, such as personality traits or social roles, in which case they are supported by neural regions that are implicated in basic level categorical knowledge or schema-like knowledge, including the medial prefrontal cortex. This cognitive neuroscience model reflects the most comprehensive attempt to explain the neural bases of personal semantics. Clinically, this model highlights the need for research on disorders of memory in the context of isolated lesions and dementias, because different patterns of autobiographical memory impairment could emerge depending on the localization of lesions and neurodegeneration. In regard to my role, I was the lead researcher and first author (or co-first author) of the publications that have come from my work on this topic, including key theoretical pieces.

1. Grilli MD and Verfaellie M. (2014) Personal semantic memory: insights from neuropsychological research on amnesia. Neuropsychologia, 61:56-64.
2. Grilli MD and Verfaellie M. (2016) Experience-near but not experience-far autobiographical facts depend on the medial temporal lobe for retrieval: Evidence from amnesia. Neuropsychologia,81:180-185.

3. Grilli MD, Bercel JJ, Wank AA, and Rapcsak SZ. (in press) The contribution of the left anterior ventrolateral temporal lobe to the retrieval of personal semantics. Neuropsychologia.
4. Marquine M, Grilli MD, Rapcsak SZ, Kaszniak AW, Ryan L, Walther K, and Glisky EL. (2016)Impaired personal trait knowledge, but spared other-person trait knowledge, in an individual with bilateral damage to the medial prefrontal cortex. Neuropsychologia, 89:245-53.

Advanced understanding of how autobiographical memory is necessary for maintaining the self-concept. Autobiographical memory, which is the repository of experiences and facts that are unique to each person, has long been thought to ground one's conceptualization of the self, which consists of higher-order knowledge structures about personal identity (i.e., traits and roles). My research has supported this idea. First, in a neuropsychological study, I demonstrated that MTL amnesics rely entirely on abstract personal semantic memories to ground their traits and roles, which comes at a cost: they cannot retrieve as many self-defining traits as healthy controls do. This indicates that episodic autobiographical memories serve a necessary role in grounding the self-concept. Second, I showed that the relative importance of episodic autobiographical memory and personal semantic memory depends on the stability of one's traits and roles. Specifically, I found that whereas healthy adults primarily rely on episodic and episodic-like autobiographical memories to ground recently formed traits and roles, they tend to ground remotely formed traits and roles with abstract personal semantic memories more than other autobiographical contents. These studies provide important insight into the self-supporting function of autobiographical memory. In regard to my role, I was the lead researcher and first (or sole) author of both publications on this topic.

1. Grilli MD and Verfaellie M. (2015) Supporting the self-concept with memory: insight from amnesia. Social Cognition and Affective Neuroscience, 10:1684-1692.
2. Grilli MD. (2017) The association of personal semantic memory to identity representations: insight into higher-order networks of autobiographical contents. Memory, 25:1435-1443.

Developed a novel cognitive strategy for improving memory. Although much of my research has focused on advancing cognitive neuroscience models, I always consider how insights from basic research can inform new interventions for memory disorders. My first line of research merged two largely separate literatures on self-referential processing and imagination to establish a new cognitive strategy for improving episodic memory in individuals with acquired brain injury, which I referred to as self-imagination. In a series of studies, I have demonstrated that self-imagination is a highly effective cognitive intervention for individuals with traumatic brain injury, capable of enhancing recognition, cued recall, free recall, and prospective memory across various delays and over and above a variety of cognitive strategies. In regard to my role, I was the lead researcher and first author of the first four publications on this line of work.

1. Grilli MD and Glisky EL. (2010) Self-imagining enhances recognition memory in memory-impaired individuals with neurological damage. Neuropsychology, 24:698-710.
2. Grilli MD and Glisky EL. (2011) The self-imagination effect: benefits of a self-referential encoding strategy on cued recall in memory-impaired individuals with neurological damage. Journal of the International Neuropsychology Society, 17:929-933.
3. Grilli MD and McFarland CP. (2011) Imagine that: Self-imagination improves prospective memory in memory-impaired individuals with neurological damage. Neuropsychology Rehabilitation, 21:847-59.
4. Grilli MD and Glisky EL. (2013) Imagining a better memory: Self-imagination in memory-impaired patients. Clinical Psychological Science, 1:93-99.

Complete list of published work in MyBibliograpy

https://www.ncbi.nlm.nih.gov/sites/myncbi/matthew.grilli.1/bibliography/48613144/public/?sort=date&direction=ascending

Research Support

Arizona Alzheimer's Consortium, DHS Grilli (PI) 7/1/18 -6/30/19

The Status of Personal Semantic Memory Among Cognitively Healthy Older Adults and Individuals with Mild Cognitive Impairment.

The specific aims of this project are: 1) to identify patterns of spared versus impaired personal semantic memory (PSM) among cognitively normal older adults relative to young adults, as well as in comparison to individuals with mild cognitive impairment (MCI), and 2) to reveal that PSM status is related to neural markers of the integrity of the medial temporal and ventrolateral temporal lobes, as measured with MRI methods.

NIA P30 AG019610 Reiman(PI); Andrews-Hanna (Pilot PI) 7/1/17 - 6/30/19

Uncovering Neurocognitive Links between Alzheimer's Disease and Depression in Mid-Life to Early Aging

The specific aims of this project are: 1) to compare symptoms of depression and characteristics of internally oriented thought across middle-aged adults with and without a first-degree family history of late-onset AD, and 2) to develop novel, dynamic neurocognitive markers of depressive symptoms in cognitively healthy middle aged to early older-aged adults.

Role on Project: co-investigator

McKnight Brain Research Foundation Wilson (PI) 4/6/18 – 9/1/20

Uncovering Risk Profiles of Deception and Mitigating Susceptibility to Scamming

The specific aims of this project are to: 1) develop a prototype of MERLIN, an automated warning tool to support decision-making online; 2) develop the in-lab Scam Identification Task (SIT), a new behavioral task to effectively "scam people in the lab" and allow validation of the efficacy of MERLIN under controlled conditions; and 3) quantify the cognitive, physical, and socio-affective correlates of scam susceptibility to tailor MERLIN to age-specific user profiles.

Role on Project: co-investigator

Arizona Alzheimer's Consortium, DHS Grilli (PI) 7/1/17 -6/30/18

Forgetting One's Past: Episodic Autobiographical Memory in ε4 Carriers

The goal of this project is to reveal cognitive and neural mechanisms that contribute to disrupted memory in individuals at risk of Alzheimer's disease.

Role on Project: PI

Arizona Alzheimer's Consortium, DHS Ryan (PI) 7/1/17 -6/30/18

Perirhinal Cortical Structure and Function in Older Adults and Its Role in Memory

The goal of this project is to elucidate the neural bases of impaired object recognition in aging and determine its relation to pattern separation and associative memory.

Role on Project: co-investigator

Univ Arizona Faculty Seed Grant Grilli (PI) 7/1/16 -6/30/18

Detecting the Earliest Signs of Alzheimer's Disease: A New Cognitive Neuroscience Approach

The goal of this project is to apply structural and functional MRI methods to understand the neural bases of disrupted autobiographical memory among older adults.

Role on Project: PI

CoS Dean's Innovation/Education Fund Grilli (PI) 8/30/16 -6/10/18

Detecting the Earliest Signs of Alzheimer's Disease

The goal of this project is to develop cognitive measurements for preclinical Alzheimer's disease.

Role on Project: PI

Biographical Sketch

Matthias R. Mehl, Ph.D.
Professor, Psychology

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
University of Erlangen, Germany	B.A./M.A.	1998	Psychology
University of Texas, Austin, TX	Ph.D.	2004	Psychology

Personal Statement

I am a social, personality, and health psychologist with broad interest and expertise in the conceptualization and measurement of how social processes affect health. Methodologically, I use subjective and objective ambulatory assessment methods to study social processes and have helped to pioneer novel methods of ecologically valid data collection. One of these methods involves the collection and coding of ambient sounds via a recording device called the Electronically Activated Recorder (EAR). As the developer of the EAR method, a naturalistic observation sampling method, I have extensive experience in the administration of the EAR, the coding of the sound files, and the management and analysis of the EAR data. Further, I have extensively published about and given workshops on the method. I joined the faculty of the Psychology Department of the University of Arizona in 2004 and I am now a tenured full professor. I am also an adjunct faculty in Family Studies and Human Development and the Department of Communication and an affiliated investigator at the Arizona Cancer Center and the Evelyn F. McKnight Brain Institute. My prior collaborative EAR research has been funded by, among other sources, the American Cancer Society and the NIH (National Institute of Mental Health, National Cancer Institute, National Center for Complementary and Integrative Health, National Institute for Child Health and Human Development).

Positions

1998 – 1999	Visiting Scholar, Department of Psychology, University of Texas at Austin
1999 – 2000	Research Assistant, Institute for Physiological Psychology, University of Düsseldorf
2004 – 2010	Assistant Professor, Department of Psychology, University of Arizona
2010 – 2016	Associate Professor, Department of Psychology, University of Arizona
2007 – Present	Adjunct Faculty, Department of Communication, University of Arizona
2007 – Present	Associate Investigator, Arizona Cancer Center, University of Arizona
2010 – Present	Affiliate Faculty, Department of Communication, University of Arizona
2011 – Present	Affiliate Faculty, Evelyn F. McKnight Brain Institute, University of Arizona
2016 – Present	Professor, Department of Psychology, University of Arizona
2017 – Present	Affiliate Faculty, Division of Family Studies and Human Development, University of Arizona

Honors

1996 – 1998	Undergraduate Fellowship, German National Academic Foundation
1998 – 1999	Postgraduate Fellowship for Studying Abroad, German National Academic Foundation
2003 – 2004	University Continuing Fellowship, University of Texas at Austin
2011	Rising Star Award, Association for Psychological Science

2015	Fellow, Society for Personality and Social Psychology
2015	Fellow, Association for Psychological Science
2018	Fellow, Collegium Helveticum & Digital Society Initiative, University of Zürich
2019	Miegunyah Distinguished Visiting Fellow, University of Melbourne (one month)

Contribution to Science

Development of a Methodology for Naturalistic Observation of Daily Social Behavior and Interactions. Despite the fact that psychology is the study of human behavior, naturalistic observation of social behavior has a remarkably thin history in the field. I have (co-)developed and psychometrically validated the Electronically Activated Recorder as an ecological momentary assessment method for tracking people's naturally occurring (acoustic) social lives. Technically, the EAR is a digital audio recorder that intermittently records snippets of ambient sounds while participants go about their normal lives. Conceptually, it is a naturalistic observation method that produces an acoustic log of a person's day as it unfolds. With the EAR, researchers can study how subtle yet objective aspects of people's daily behaviors and interactions are related to core psychological processes. The EAR app is freely available on iTunes and the Google Playstore and is currently being used in research studies by more than two dozen investigator groups on three continents.

1. Mehl MR, Pennebaker JW, Crow MD, Dabbs J, and Price JH. (2001) The Electronically Activated Recorder (EAR): A device for sampling naturalistic daily activities and conversations. Behavior Research Methods, Instruments, and Computers, 33:517–523.
2. Mehl MR and Conner TS. (Eds.) (2012) Handbook of research methods for studying daily life. Guilford Press: New York, NY.
3. Mehl MR, Robbins ML, and Deters GF. (2012) Naturalistic observation of health-relevant social processes: The Electronically Activated Recorder (EAR) methodology in psychosomatics. Psychosomatic Medicine, 74:410-417.
4. Mehl MR. (2017) The Electronically Activated Recorder or EAR: A method for the naturalistic observation of daily social behavior. Current Directions in Psychological Science, 26:184-190.

Natural Word Use as Linguistic Marker of Psychological Processes. Despite the fact that verbal behavior is by far the most frequent human behavior (apart from sleep), verbal data sources, until recently, have been surprisingly neglected. We have found that computerized text analysis programs, despite their relative conceptual simplicity, can provide highly valuable information about patterns of word use. People's natural (written or spoken) word use shows clear associations with their personalities, social status, well-being and even mental and physical health. In my research, I have studied word use mostly in the context of personality and coping-related couple and family interactions.

1. Pennebaker JW, Mehl MR, and Niederhoffer K. (2003) Psychological aspects of natural language use: Our words, our selves. Annual Review of Psychology, 54:547–577.
2. Mehl MR, Vazire S, Ramírez-Esparza N, Slatcher RB, and Pennebaker JW. (2007) Are women really more talkative than men? Science, 317:82.
3. Carey AL, Brucks M, Küfner ACP, Holtzman N, Deters F, Back MD, Donnellan B, Pennebaker JW, and Mehl MR. (2015) Narcissism and the use of personal pronouns revisited. Journal of Personality and Social Psychology, 109, e1-e15. doi: 10.1037/pspp0000029.
4. Mehl MR, Raison CL, Pace TWW, Arevalo JMG, and Cole SW. (2017) Natural language indicators of differential gene regulation in the human immune system. Proceedings of the National Academy of Sciences, 114:12554-12559.

The Role of Everyday Social Interactions in Coping and Health. Critical life events can cause serious disruptions to people's social lives. In my research, I explore the role that people's daily social lives play in coping with and adjustment to personal and collective upheavals. Because self-reports are particularly susceptible to bias when material of high personal relevance and emotional intensity is assessed—the very material in which coping researchers are interested—I have pursued this question primarily from a behavioral observation perspective. This choice of method has led to a theoretical focus on the role that people's mundane, ordinary, everyday conversations play for coping and health (in contrast to direct coping conversations about the focal illness or critical life event).

1. Mehl MR and Pennebaker JW. (2003) The social dynamics of a cultural upheaval: Social interactions surrounding September 11, 2001. Psychological Science, 14:579–585.
2. Robbins ML, Focella ES, Kasle S, Weihs KL, Lopez AM, and Mehl MR. (2011) Naturalistically observed swearing, emotional support and depressive symptoms in women coping with illness. Health Psychology, 30:789-792.
3. Robbins ML, Mehl MR, Holleran SE, and Kasle S. (2011) Naturalistically observed sighing and depression in rheumatoid arthritis patients: A preliminary study. Health Psychology, 30:129-133.
4. Robbins ML, López AM, Weihs KL, and Mehl MR. (2014) Cancer conversations in context: Naturalistic observation of couples coping with breast cancer. Journal of Family Psychology,28:380-390.

Behavioral Manifestations of Personality in Everyday Life. Personality is an important predictor of personal and relational life outcomes. However, for a long time, the field of personality was largely built on questionnaire responses and was lacking an empirical grounding in observable social behavior which, conceptually, is the variable that should "carry" or mediate personality's effects on life outcomes. My research in this area has been aimed at identifying such behavioral manifestations of personality and other individual differences in daily life. Importantly, to really understand how personality can affect life outcomes through variability in daily behavior, shared method variance should be minimized and therefore daily behavior be assessed through direct observation rather than indirect (self-)reporting. Over the last years, we have made critical contributions to this field by identifying clear, observable behavioral markers of the Big Five personality domain, subclinical depression, and psychological well-being.

1. Mehl MR and Pennebaker JW. (2003) The sounds of social life: A psychometric analysis of students' daily social environments and natural conversations. Journal of Personality and Social Psychology,84:857-870.
2. Mehl MR. (2006) The lay assessment of sub-clinical depression in daily life. Psychological Assessment, 18, 340-345.
3. Mehl MR, Gosling SD, and Pennebaker JW. (2006) Personality in its natural habitat: Manifestations and implicit folk theories of personality in daily life. Journal of Personality and Social Psychology,90:862-877.
4. Mehl MR, Vazire S, Holleran SE, and Clark CS. (2010) Eavesdropping on happiness: Well-being is related to having less small talk and more substantive conversations. Psychological Science, 21:539-541.

Complete list of published work in MyBibliograpy

https://www.ncbi.nlm.nih.gov/sites/myncbi/1TS90_ozwnkQD/bibliography/54270729/public/?sort=date&direction=ascending

Research Support

NIMH RO1 MD008940 Stone: PI 9/25/14 – 5/31/19
Reducing Implicit Verbal and Nonverbal Bias toward Hispanic Patients
The goal of this project is to test (a) how doctor's implicit bias is related to how they talk to Hispanic patients, and (b) how an intervention aimed at reducing implicit bias changes the way doctors talk to Hispanic patients.
Role on Project: Co-Investigator

NIMH RO1 MH105379 Nugent: PI 3/1/15 – 2/28/20
Biomarkers, Social, and Affective Predictors of Suicidal Thoughts and Behaviors in Adolescents
The goal of this project is to examine adolescent in vivo emotion reactivity as related to social context in the real world during the high-risk post-discharge period.
Role on Project: Co-Investigator

NIMH RO1 MH108641 Nugent: PI 7/1/16 – 6/30/21
Understanding the Interplay of Social Context and Physiology on Psychological Outcomes in Trauma-Exposed Adolescents
The goal of this project is to examine real-world emotion and social context as risk and protective factors for adjustment in trauma-exposed adolescents.
Role on Project: Co-Investigator

Biographical Sketch

Mary-Frances O'Connor, Ph.D.
Associate Professor, Psychology

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
Northwestern University, Evanston, IL	B.A.	1996	Psychology
University of Arizona, Tucson, AZ	Ph.D.	2004	Clinical Psychology
University of California, Los Angeles, CA	Postdoc	2007	Psychoneuroimmmunology

Personal Statement

I am an associate professor of clinical psychology and psychiatry at the University of Arizona. My research focuses on the physiological correlates of emotion, in particular the wide range of physical and emotional responses during bereavement. I investigate the failure to adapt following the death of a loved one, termed Complicated Grief, included as an area of research in the DSM-5. To that end, I have studied the neurobiological, immune, and autonomic parameters that vary between individual grief responses. Specifically, I have publications utilizing functional neuroimaging, immune and endocrine analysis of saliva and blood, and psychophysiological assessment of heart rate variability. I recently served on the council for the American Psychosomatic Society (APS), where I inaugurated the annual Health and Behavior International Collaborative Award for trainees (graduate students, residents, post-doctoral fellows) to attend international laboratories and gain technical skills not available at their home institution.

Positions

2007 – 2011	Assistant Professor, Cousins Center for Psychoneuroimmunology, Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, UCLA
2012 – 2017	Assistant Professor, Department of Psychology, University of Arizona, Tucson
2013 – Present	Affiliated Faculty, Evelyn F. McKnight Brain Institute, University of Arizona, Tucson
2017 – Present	Associate Professor, Department of Psychology, University of Arizona, Tucson

Honors

2005	NIH Loan Repayment Program Award
2006	UCLA Semel Institute for Neuroscience Research Fellow
2008	NIA and OBSSR invitation to "Opportunities for Advancing Behavioral and Social Science Research on Aging" Workshop
2009	UCLA School of Medicine John H. Walsh Young Investigator Research Prize Nominee
2010	NSF/University of Arizona ADVANCE Junior Scientist Award
2011	RAND Summer Institute Workshop on Aging Invitee
2011	Advanced Research Institute in Geriatric Mental Health Scholar
2012	International Research Development Travel Grant from University of Arizona
2014	Undergraduate Biology Research Program Outstanding Mentor Award
2014	International Research Development Travel Grant from University of Arizona

Contribution to Science

Neuroimaging correlates of grief. Scientific contributions from my research investigate the way the brain processes the changing reality after the death of a loved one. Notably, my research was the first to use neuroimaging to investigate typical grief and has now been cited nearly 200 times. Later work demonstrated that those with Complicated Grief show differential activation from those with Non-Complicated Grief, highlighting the uniqueness of the disorder. This latter article, from 2008, has been cited nearly 150 times. My work investigates the relationship between both brain and peripheral physiology, because of the impact of grief (recursively) on these systems. From my K award, I have recently published on the cognitive-affective dysregulation of Complicated Grief during the emotional Stroop task.

1. Arizmendi BJ, Kaszniak AW, and O'Connor M-F. (2015) Disrupted prefrontal activity during emotion regulation in Complicated Grief: An fMRI investigation. NeuroImage, 124:968-976.
2. O'Connor M-F, Wellisch DK, and Irwin M. (2009) When grief heats up: Proinflammatory cytokines predict regional brain activation. NeuroImage, 47:891-896.
3. O'Connor M-F, Wellisch DK, Stanton AL, Eisenberger NI, Irwin MR, and Lieberman MD. (2008)Craving love? Complicated grief activates brain's reward center. NeuroImage, 42:969-972.
4. Gündel H, O'Connor M-F, Littrell L, Fort C, and Lane R. (2003) Functional neuroanatomy of grief :An fMRI study. American Journal of Psychiatry, 160:1946-1953.

Bereavement: Immune system and stress physiology. Additional work from my laboratory has investigated the biomarkers of adaptation during grief, primarily in the stress response systems (sympathetic nervous system and hypothalamic pituitary adrenal axis) and the immune system. Supporting the hypothesis that Complicated Grief is the clinical outcome of concern in bereavement, I have demonstrated the flattened diurnal slope of cortisol in Complicated compared to Non-Complicated Grief groups. In addition, my work has shown that those with both a high-producing variation in the IL-6 -174 gene and a bereavement event (a Gene x Environment interaction) have the highest levels of circulating inflammation.

1. Schultze-Florey CR, Martínez-Maza O, Magpantay L, Breen EC, Irwin MR, Gündel H, and O'Connor M-F. (2012) When grief makes you sick: Bereavement induced systemic inflammation is a question of genotype. Brain, Behavior, and Immunity, 26:1066-1071.
2. O'Connor M-F, Schultze-Florey CR, Irwin MR, and Cole SW. (2014) Divergent gene expression responses to Complicated Grief and Non-complicated Grief. Brain, Behavior and Immunity, 37:78–83.
3. O'Connor M-F, Shear MK, Fox R, Skritskaya N, Campbell B, Ghesquiere A, and Glickman K. (2013)Catecholamine predictors of complicated grief treatment outcomes. International Journal of Psychophysiology, 88:349-352.
4. O'Connor M-F, Wellisch DK, Stanton AL, Olmstead R, and Irwin MR. (2012) Diurnal cortisol in Complicated and Non-Complicated Grief: Slope differences across the day. Psychoneuroendocrinology, 37:725-728.

Psychological outcomes in bereavement. A third area of my work includes the study of psychological outcomes in patient families after the death of a loved one. Specifically, I have contributed to understanding the psychological reaction to interpersonal loss, how adaptation happens in typical grief, and what factors lead to poor adaptation. These psychological factors include cognitive functioning, yearning and repetitive thought, and quality of life.

1. O'Connor M-F and Arizmendi B. (2014) Neuropsychological correlates of complicated grief in older spousally bereaved adults. Journals of Gerontology: Psychological Sciences, 69B:12-18.

2. Bourassa KJ, Knowles L, Sbarra DA, and O'Connor M. (2016) Absent, but not gone: Interdependence in couples' quality of life persists after a partner's death. Psychological Science,27:270-281.
3. Kaplan DM, Palitsky R, Carey AL, Crane TE, Havens CM, Medrano MR, Reznik SJ, Sbarra DA, and O'Connor MF. (2018) Maladaptive repetitive thought as a transdiagnostic phenomenon and treatment target: An integrative review. Journal of Clinical Psychology, 74:1126–1136.
4. Robinaugh DJ, Mauro C, Bui E, Stone L, Shah R, Wang Y, Skritskaya NA, Reynolds CF, Zisook S, O'Connor M-F, Shear K, and Simon NM. (2016) Yearning and its measurement in complicated grief. Journal of Loss and Trauma, 21:410-420.

Development of criteria for disordered grief. As part of a group of leaders in the fields of psychology and psychiatry, I contributed to the argument that under specific extreme conditions, poor adaptation should be considered a disorder. This argument persuaded the committee developing the DSM 5, and Persistent Complex Bereavement Disorder was included as a disorder for further research. This article has been cited almost 600 times.

1. Shear MK, Duan N, Reynolds C, Simon N, Zisook S, Lebowitz B, Sung S, Guesquierre A, Gorscak B, Clayton P, Ito M, Nakajima S, Konishi T, Brent D, Melhem N, Meert K, Schiff M, Neimeyer R, O'Connor M-F, First M, Sareen J, Bolton J, Skritskaya N, and Mancini A. (2011) Complicated Grief and related bereavement issues for DSM-5. Depression and Anxiety, 28:103–117.

Complete list of published work in MyBibliograpy

https://www.ncbi.nlm.nih.gov/sites/myncbi/mary-frances.o'connor.1/bibliography/40699290/public/?sort=date&direction=descending

Research Support

Society for Scientific Study of Religion Palitsky (PI) 7/1/18 – 9/1/19
Untangling the Health Influence of Religion in Bereavement: The Role of Affect
Role on Project: co-investigator

Biographical Sketch

Naomi Rance, M.D., Ph.D.
Professor, Pathology

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
University of Maryland, College Park	B.S.	1973	Psychology
University of Maryland, Baltimore	Ph.D.	1981	Physiology
University of Maryland, Baltimore	M.D.	1983	Medicine
The Johns Hopkins Hospital	Fellowship	1989	Neuropathology
The Johns Hopkins Hospital	Residency	1983 – 1987	Pathology

Personal Statement

For more than 25 years, our overall goal has been to characterize and understand the physiological significance of the changes that occur in the hypothalamus secondary to menopause. We observed hypertrophy and increased gene expression in a subpopulation of estrogen receptor expressing neurons in the hypothalamic infundibular nucleus of postmenopausal women. These neurons are called KNDy neurons, based on the co-expression of kisspeptin, neurokinin B (NKB), and dynorphin. For many years, our goal was to understand the role of NKB in reproductive regulation. The significance of these studies became widely recognized with the observation that mutations in either the gene encoding NKB or its receptor (NK3R) result in hypogonadotropic hypogonadism. In the last 10 years, we have focused on studying the role of KNDy neurons in the estrogen modulation of body temperature. The results of these studies allowed us to propose that KNDy neurons play a role in the generation of hot flushes via NK3R signaling in the hypothalamic median preoptic nucleus. Recent clinical trials in have shown that NK3R antagonists effectively reduce the number and severity of hot flushes, thus providing strong support for our hypothesis.

1. Rance NE. (2009) Menopause and the human hypothalamus: Role of kisspeptin/neurokinin B neurons in the regulation of estrogen negative feedback. Peptides, 30:111-22.
2. Rance NE, Krajewski SK, Smith MA, Cholanian M, and Dacks PA. (2010) Neurokinin B and the hypothalamic regulation of reproduction. Brain Research, special issue entitled “New Insights into the Neurobiology of Reproduction and Puberty,” 1364:116-128.
3. Mittelman-Smith MA, Williams H, Krajewski-Hall, McMullen NT, and Rance NE. (2012) Role for kisspeptin/neurokinin B/dynorphin (KNDy) neurons in cutaneous vasodilatation and the estrogen modulation of body temperature. Proceedings of the National Academy of Science, USA,109:19846-19841, PMCID: PMC3511761.
4. Rance NE, Dacks PA, Mittelman-Smith MA, Krajewski SK, Romanovsky AA. (2013) Modulation of body temperature and LH secretion by hypothalamic KNDy (kisspeptin, neurokinin Band dynorphin) neurons: A novel hypothesis on the mechanism of hot flushes. Frontiers in Neuroendocrinology, 34, 211-27, PMID: 23872331.

Positions

1976 – 1981	Predoctoral Fellow, Department of Physiology, University of Maryland
1983 – 1986	Resident, Anatomic Pathology, The Johns Hopkins Hospital
1986 – 1987	Chief Resident, Anatomic Pathology, The Johns Hopkins Hospital
1987 – 1989	Clinical and Research Fellow, Neuropathology Laboratory, The Johns Hopkins Hospital

1989 – 1995	Assistant Professor, Department of Pathology, University of Arizona College of Medicine
1989	Chief, Division of Neuropathology, University Medical Center, Tucson, Arizona
1989	Neuropathology Consultant, Forensic Science Center, Pima County, Arizona
1995 – 2000	Associate Professor, Department of Pathology, University of Arizona College of Medicine, Tucson
1996	Associate Head, Department of Pathology, University of Arizona College of Medicine, Tucson
2000	Professor, Department of Pathology, University of Arizona College of Medicine, Tucson

Honors

1973	Phi Beta Kappa
1983	Rudolph Virchow Prize for Research in Pathology, University of Maryland
1995	John Davis Outstanding Residency Teaching Award, Dept. of Pathology, University of Arizona
1997	Vernon and Virginia Furrow Award for Excellence in Graduate Medical Education, University of Arizona College of Medicine
1999	Basic Science Educator of the Year, University of Arizona College of Medicine
2000	Basic Science Educator of the Year, University of Arizona College of Medicine
2001	Basic Science Educator of the Year, University of Arizona College of Medicine
2002	Basic Science Educator of the Year Lifetime Award, University of Arizona College of Medicine
2007	Vernon and Virginia Furrow Award for Excellence in Innovation in Teaching, University of Arizona College of Medicine
2015	Founder's Day Speaker, University of Arizona College of Medicine

Contribution to Science

We have characterized changes in the morphology and neuropeptide gene expression that occur in the human hypothalamus secondary to the ovarian failure of menopause. Studies in animal models showed that the changes in neurokinin B and kisspeptin gene expression in postmenopausal women are secondary to withdrawal of ovarian estrogen and not due to age per se.

1. Rance NE and Young WS III. (1991) Hypertrophy and increased gene expression of neurons containing neurokinin B and substance P messenger RNAs in the hypothalami of postmenopausal women. Endocrinology, 128:2239-2247.
2. Rance NE and Bruce TR. (1994) Neurokinin B gene expression is increased in the arcuate nucleus of ovariectomized rats. Neuroendocrinology, 60:337-345.
3. Abel TW, Voytko ML, and Rance NE. (1999) Effects of hormone replacement therapy on neuropeptide gene expression in a primate model of menopause. Journal of Clinical Endocrinology and Metabolism, 84:2111-2118.
4. Rometo AM, Sally J, Krajewski SJ, Voytko ML, and Rance NE. (2007) Hypertrophy and increased kisspeptin gene expression in the hypothalamic infundibular nucleus of postmenopausal women and ovariectomized monkeys. Journal of Clinical Endocrinology and Metabolism, 92:2744-2750.

Based on the dramatic changes in NKB gene expression in postmenopausal women, we hypothesized that NKB neurons participate in the estrogen modulation of LH secretion. This hypothesis is supported by pharmacological and anatomic studies. Using an NK3R agonist conjugated to saporin to ablate KNDy neurons, we show that KNDy neurons are essential for the functioning of the reproductive axis.

1. Sandoval-Guzmán T and Rance NE. (2004) Central injection of senktide, an NK3 receptor agonist, or neuropeptide Y inhibits LH secretion and induces different patterns of Fos expression in the rat hypothalamus. Brain Research, 1026:307-312.
2. Krajewski SJ, Anderson Miranda J, Iles-Shi L, Chen, Kyung J, Urbanski HF, and Rance NE. (2005)Morphological evidence that neurokinin B neurons modulate GnRH secretion via NK3 receptors in the rat median eminence. Journal of Comparative Neurology, 489:372-386.
3. Mittelman-Smith MA, Williams H, Krajewski-Hall SJ, Lai J, Ciofi P, McMullen NT, and Rance NE. (2012) Arcuate kisspeptin/neurokinin B/dynorphin (KNDy) neurons mediate the estrogen suppression of gonadotropin secretion and body weight. Endocrinology, 153:2800-2012. PMCID:PMC3359616.
4. Mittelman-Smith MA, Krajewski-Hall, McMullen NT, and Rance NE. (2016) Ablation of KNDy neurons results in hypogonadotropic hypogonadism and amplifies the steroid-induced LH surge in female rats. Endocrinology, 157:2015-2027.

Neuroanatomic studies were conducted using dual labeled immunohistochemistry, anatomic tract-tracing and biocytin injections in tissue slices of EGFP-labeled transgenic mice. We described a bilateral network of KNDy neurons within the arcuate nucleus in which these neurons communicate with each other via NK3R and project to GnRH terminals in the median eminence. Connections between arcuate KNDy neurons provides an anatomic framework to explain how KNDy neurons could be coordinated to provide sex-steroid modulation of pulsatile GnRH secretion. Projections to other brain regions suggest that KNDy neurons influence a wide variety of physiologic functions including thermoregulation.

1. Krajewski SJ, Anderson, Miranda J, Iles-Shi L, Chen, Kyung J, Urbanski HF, and Rance NE. (2005)Morphological evidence that neurokinin B neurons modulate GnRH secretion via NK3 receptors in the rat median eminence. Journal of Comparative Neurology, 489:372-386.
2. Krajewski SJ, Burke MC, Anderson MJ, McMullen NT, and Rance NE. (2010) Forebrain projections of arcuate neurokinin B neurons demonstrated by anterograde tract-tracing and monosodium glutamate lesions in the rat. Neuroscience, 166:1187-1193. PMCID: PMC2823949.
3. Burke MC, Letts (Dacks) PA, Krajewski SJ, and Rance NE. (2006) Coexpression of dynorphin and neurokinin B immunoreactivity in the rat hypothalamus: Morphologic evidence of interrelated function within the arcuate nucleus. Journal of Comparative Neurology, 498, 712-726.
4. Cholanian M, Krajewski-Hall SJ, Levine RB, McMullen NT, and Rance N. (2015) Chronic oestradiol reduces the dendritic spine density of KNDy (kisspeptin/neurokinin B/dynorphin) neurons in the arcuate nucleus of ovariectomised Tac2-enhanced green fluorescent protein transgenic mice. Journal of Neuroendocrinology 27:253-263.

To determine if KNDy neurons could play a role in thermoregulation, a series of studies was performed using a rat model. Anatomical studies showed projections of KNDy neurons to the median preoptic nucleus (MnPO), an important component of the CNS pathway that regulates heat dissipation effectors. Moreover, MnPO neurons express the neurokinin 3 receptor (NK3R), the primary receptor for NKB. Further studies using a rat model strongly supported the hypothesis that KNDy neurons could influence cutaneous vasodilation (flushing) via projections to NK3R-expressing neurons in the MnPO.

1. Dacks PA, Krajewski SK, and Rance NE. (2011) Activation of neurokinin 3 receptors in the median preoptic nucleus decreases body temperature in the rat. Endocrinology, 152:4894-4905. PMCID:PMC3230049.
2. Mittelman-Smith MA, Williams H, Krajewski-Hall, McMullen NT, and Rance NE. (2012) Role for Kisspeptin/Neurokinin B/Dynorphin (KNDy) Neurons in Cutaneous Vasodilatation and the Estrogen Modulation of Body Temperature. Proceedings of the National Academy of Science, USA,109:19846-19841, PMCID: PMC3511761.

3. Rance NE, Dacks PA, Mittelman-Smith MA, Krajewski SK, Romanovsky AA. (2013) Modulation of body temperature and LH secretion by hypothalamic KNDy (kisspeptin, neurokinin Band dynorphin) neurons: A novel hypothesis on the mechanism of hot flushes. Frontiers in Neuroendocrinology, 34, 211-27, PMID: 23872331.
4. Mittelman-Smith MA, Williams H, Krajewski-Hall, McMullen NT, and Rance NE. (2015) Neurokinin 3receptor-expressing neurons in the median preoptic nucleus modulate heat-dissipation effectors in the female rat. Endocrinology, 156:2552-2562.

Research Support

NIA RO1 AG047887 Rance (PI) 8/15/14 – 4/30/19

Role of Preoptic NK3R Neurons in the Estrogen Modulation of Body Temperature

This grant explores how preoptic neurons that express the neurokinin 3 receptor participate in the neural circuits regulating body temperature. Our goal is to provide information related to mechanism of menopausal flushes. $1.5 million total award.

Role on Project: PI

Biographical Sketch

Lee Ryan, Ph.D.
Professor, Psychology, Neurology and Neuroscience Program

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
University of Toronto, Canada	B.Mus.	1979	Music
University of Toronto, Canada	M.A.	1981	Music
University of Toronto, Canada	B.S.	1988	Psychology/Neuroscience
University of British Colombia, Vancouver, Canada	Ph.D.	1992	Clinical/Cognitive Psych
University of California, San Diego, CA	Postdoc	1993 - 1995	Neuropsychology

Personal Statement

I am a professor and the head of the Department of Psychology in the School of Mind, Brain, and Behavior at the University of Arizona, and the associate director of the Evelyn F. McKnight Brain Institute. Since 1998, I have directed the Cognition and Neuroimaging Laboratory, which provides technical and analysis support for cognitive neuroscience researchers from across the campus utilizing MRI methods. My research focuses on memory, age-related memory decline, and the neural basis of memory. I have published more than 60 scholarly articles utilizing various MRI methods, including functional MRI, ASL perfusion, voxel-based morphometry, and high-resolution diffusion tensor imaging. My research on the neural basis of memory has focused on understanding the hippocampal processes mediating autobiographical and semantic memory, how memory changes across the adult lifespan, how those changes relate to brain structure and function, and the early prediction of Alzheimer's disease. Recent studies using morphometric analyses and diffusion imaging have investigated factors that influence individual differences in age-related cognitive function, including genetic markers, obesity, hypertension, and anti-inflammatory drug use. As a clinical neuropsychologist, I work with individuals and families who are coping with chronic and progressive diseases that affect cognitive functioning, including multiple sclerosis, Parkinson's disease, and Alzheimer's disease. I teach undergraduate and graduate level courses in memory, neuropsychology, neuroanatomy, cognitive neuroscience, and MRI methods and have been very active in mentoring programs at the University of Arizona.

1. Memel M and Ryan L. (2017) Visual integration enhances associative memory equally for young and older adults without reducing hippocampal encoding activation. Neuropsychologia, 100, 195-206.
2. Ryan L, Walther K, Bendlin BB, Lue L-F, Walker DG, and Glisky EL. (2011) Age-related differences in white matter integrity measured by diffusion tensor imaging and cognitive function are related to APOE status. NeuroImage, 54(2), 1565-77.
3. Alexander GE, Ryan L, Bowers D, Foster TC, Bizon JL, Geldmacher DS, and Glisky EL. (2012) Characterizing cognitive aging in humans with links to animal models. Frontiers in Aging Neuroscience, 4:21.
4. Ryan L, Cardoza JA, Barense MD, Kawa KH, Wallentin-Flores J, Arnold WT, and Alexander GE. (2012) Age-related impairment in a complex object discrimination task that engages perirhinal cortex. Hippocampus, 22(10), 1978-89.

Positions and Honors

1988 – 1992	National Science & Engineering Research Council of Canada Graduate Fellowships
1993 – 1995	National Science & Engineering Research Council of Canada Postdoctoral Fellowships
1992 – 1993	Clinical internship in Neuropsychology, VAMC, La Jolla, and UCSD, San Diego
1993 – 1996	Research Scientist, Department of Psychiatry, University of California, San Diego
1996 – 2003	Assistant Professor, Department of Psychology, University of Arizona, Tucson
1998	Participant in Summer Institute on Aging Research, National Institute on Aging
1998 – Present	Director, Cognition & Neuroimaging Laboratories, University of Arizona, Tucson
2000 – Present	Member, Memory Disorders Research Society
2003 – 2014	Associate Professor and Associate Head, Department of Psychology, University of Arizona, Tucson
2013 – Present	Associate Director, Evelyn F. McKnight Brain Institute
2014 – Present	Professor, Department of Psychology, University of Arizona, Tucson
2015 – Present	Head, Department of Psychology, University of Arizona, Tucson

Contribution to Science

Recently, my colleagues and I published a theoretical article that combines evidence from human cognitive neuroscience and animal models to build an integrative model of age-related memory changes. The model describes the impact of aging on neural circuitry across subregions of the medial temporal lobe, and how these changes are responsible for the specific types of memory impairments associated with normal aging. In addition, the model makes strong predictions regarding the neuropathological changes associated with normal aging versus those that may provide early pre-clinical markers of Alzheimer's disease.

1. Burke SN, Gaynor LS, Barnes CA, Bauer RM, Bizon JL, Roberson ED, and Ryan L. (2018). Shared Functions of Perirhinal and Parahippocampal Cortices: Implications for Cognitive Aging. Trends Neurosci. 41(6):349-359. PMCID: PMC5970964

Using fMRI, I demonstrated that the hippocampus remains active during autobiographical memory retrieval, even when the memories are more than 20 years old. This finding, consistent with Multiple Trace Theory, has had a significant impact on the field's understanding of the role of medial temporal lobe structures in consolidation, storage, and retrieval of old memories. The finding helps to clarify the types of memory impairment associated with medial temporal lobe damage in patients with stroke or other pathology.

1. Campbell J, Nadel L, Duke D, and Ryan L. (2011) Remembering all that and then some: Recollection of autobiographical memories after a 1-year delay. Memory 19(4), 406-15.
2. Nadel L, Winocur G, Ryan L, and Moscovitch M. (2007) Systems consolidation and hippocampus: Two views. Debates in Neuroscience, 4, 55-66.
3. Nadel L, Ryan L, Hayes S, Gilboa A, and Moscovitch M. (2003) The role of the hippocampal complex in episodic long-term memory. In T Ono, G Matsumoto, R Lllinas, A Berthoz, R Norgren, H Nishijo, and R Tamura (Eds.) Limbic and Association Cortical Systems - Basic, Clinical and Computational Aspects, 7-12 October 2002. Excerpta Medica International Congress Series (ICS), Amsterdam, Elsevier Science.
4. Ryan L, Nadel L, Keil K, Putnam K, Schnyer D, Trouard T, and Moscovitch M. (2001) Hippocampal complex and retrieval of recent and very remote autobiographical memories: Evidence from functional magnetic resonance imaging in neurologically intact people. Hippocampus, 11: 707-714.

Using fMRI, I demonstrated that the hippocampus is important for the retrieval of both episodic and semantic memory, contrary to previous views of the hippocampus as a structure that is primarily or even solely involved in episodic retrieval. These studies have highlighted the interactive nature of these two systems.

1. Ryan L, Lin CY, Ketcham K, and Nadel L. (2010) The role of medial temporal lobe in retrieving spatial and nonspatial relations from episodic and semantic memory. Hippocampus, 20(1),11-8.
2. Greenberg DL, Keane MM, Ryan L, and Verfaillie M. (2009) Impaired category fluency in medial temporal lobe amnesia: The role of episodic memory. Journal of Neuroscience, 29(35), 10900-10908. PMCID: PMC2761020.
3. Ryan L, Hoscheidt S, and Nadel L. (2008) Time, space, and episodic memory. In E Dere, A Easton, J Huston, and L Nadel (Eds.). Handbook of Episodic Memory Research.
4. Ryan L, Cox C, Hayes S, and Nadel L. (2008) Hippocampal activation during episodic and semantic memory retrieval: Category production and category cued recall. Neuropsychologia, 46, 2109-2121.

My laboratory has shown that cardiovascular health risk factors, including obesity, hypertension, and inflammation, have a negative impact on both the structure and function of the aging brain. These brain changes are associated with increased age-related memory and executive function impairments. These studies are important because they suggest that healthy lifestyles that prevent the occurrence of cardiovascular disease may maintain brain health as well.

1. Ryan L and Walther K. (2014) White matter integrity in older females is altered by increased bodyfat. Obesity (Silver Spring), 22(9):2039-46.
2. Ryan L, Walther K, Bendlin BB, Lue L-F, Walker DG, and Glisky EL. (2011) Age-related differences in white matter integrity measured by diffusion tensor imaging and cognitive function are related to APOE status. NeuroImage, 54(2), 1565-77.
3. Walther K, Bendlin BB, Glisky EL, Trouard TP, Lisse JR, Posever JO, and Ryan L. (2011) Anti-inflammatory drugs reduce age-related decreases in brain volume in cognitively normal older adults. Neurobiology of Aging, 32(3), 497-505.
4. Walther K, Birdsill AC, Glisky EL, and Ryan L. (2010) Structural brain differences and cognitive functioning related to body mass index in older females. Human Brain Mapping, 31(7), 1052-64.

Complete list of published work in MyBibliograpy

https://www.ncbi.nlm.nih.gov/sites/myncbi/lee.ryan.1/bibliography/44215085/public/?sort=date&direction=descending

Research Support

NHLBI U01 HL131014 Sweitzer, Hay, Ran, Arai (MRI) 3/1/17 – 2/28/21

Evaluation of the Safety and Efficacy of Angiotensin 1-7 to Enhance Cognitive Function in Participants Undergoing Coronary Artery Bypass Graft (CABG) Surgery

This project is designed to evaluate the safety and efficacy of Ang-(1-7) to enhance cognitive function in participants undergoing CABG surgery. Further, by teaming with the unique capabilities of the NIH Clinical Center, these studies will measure, for the first time, post-CABG surgery brain inflammation and microglia activation as measured by PET imaging of [11C]PBR28 and test the hypothesis that Ang-(1-7) will result in a decrease in brain inflammation and microglia activation in CABG patients. When completed, this clinical study will have advanced development of a new therapy with potential to treat cognitive impairment in CABG patients.

Role on Project: PI (MPI)

Arizona Alzheimer's Consortium, ADHS Ryan (PI) 7/1/18 – 6/30/19

A Novel Model of Medial Temporal Lobe Functions: Implications for Aging and Memory

This grant studies medial temporal lobe functions in a group of older adults using functional MRI.
Role on Project: PI

Arizona Alzheimer's Consortium, ADHS Ryan (PI) 7/1/17– 6/30/18

Perirhinal Cortical Structure and Function in Older Adults and Its Role in Memory

This grant studied hippocampal and perirhinal function and how it relates to genetic risk for Alzheimer's disease in a group of older adults using functional MRI.
Role on Project: PI

Biographical Sketch

Robert C. Wilson, Ph.D.
Assistant Professor, Psychology and Cognitive Science

Education/Training

Institution & Location	Degree	Year(S)	Field Of Study
University of Cambridge	B.A.	2002	Natural Sciences
University of Cambridge	M.Sci.	2002	Chemistry
University of Pennsylvania	M.S.E.	2003	Bioengineering
University of Pennsylvania	Ph.D.	2009	Bioengineering
Princeton University	Postdoc	2014	Psychology and Neuroscience

Personal Statement

I am an expert in reinforcement learning, decision making, and computational modeling. I have modeled learning and decision making at a variety of levels – from low level neural networks to high level Bayesian inference – and have extensive experience linking theoretical models to experimental data. I have expertise in developing explore-exploit experiments (Wilson et al, JEP: General 2014), building cognitive models of complex tasks (Wilson RC and Niv Y, 2012), linking models to behavioral and neural data (Wilson et al. Neuron 2014), and the effects of TMS on explore-exploit behavior (Zajkowski W, Kossut M, and Wilson RC, in revision).

1. Wilson RC, Geana A, White JM, Ludvig EA, and Cohen JD. (2014) Humans use directed and random exploration to solve the explore-exploit dilemma. JEP: General, 143 (6) 2074-2081.
2. Wilson RC and Niv Y. (2012) Inferring relevance in a changing world. Front Hum Neurosci, 5:189.
3. Wilson RC, Takahashi YK, Schoenbaum G, and Niv Y. (2014) Orbitofrontal cortex as a cognitive map of task space. Neuron, 81(2) 267-279.
4. Zajkowski W, Kossut M, and Wilson RC. (In revision) A causal role for right frontopolar cortex in directed, but not random, exploration. eLife.

Positions

2003 – 2009	Graduate Student, Department of Bioengineering, University of Pennsylvania
2009 – 2014	Postdoctoral Research Associate, Princeton Neuroscience Institute
2015 – Present	Assistant Professor of Psychology and Cognitive Science, University of Arizona

Contribution to Science

How humans and animals solve the explore-exploit dilemma. Many decisions in life involve a tradeoff between exploring new options for information and exploiting known options for reliable reward. For example, when dining at a favorite restaurant, do you explore the new ravioli that is sure to be informative, or exploit the known pizza that is sure to be good? Beyond eating out, the explore-exploit dilemma occurs at all levels of decision making, from picking a TV show to watch or a person to marry, and there are real advantages to solving it well. Yet despite its importance, solving the dilemma optimally is intractable in all but the simplest settings, and so the question arises as to how we balance exploration and exploitation in practice. In recent work I have shown that humans use two distinct strategies for solving the explore-exploit dilemma: a directed strategy in which information seeking drives exploration by choice, and a random strategy in which behavioral variability drives exploration by chance. In addition, initial studies from my lab and my collaborators suggest that these two strategies rely on dissociable neural networks, with directed exploration

dependent of frontal pole, correlating with blink rate and developing over the course of adolescence, while random exploration appears to be tied to norepinephrine. The identification of the two strategies, in addition to experiments with which to quantify them, is already having a significant impact on the field. Versions of my task are currently being run in at least nine different labs around the world to study exploration in mental illness, across development, in animals and in response to drugs.

1. Wilson RC, Geana A, White JM, Ludvig EA, and Cohen JD. (2014) Humans use directed and random exploration to solve the explore-exploit dilemma. JEP: General, 143 (6), 2074-2081.
2. Somerville LH, Sasse SF, Garrad MC, Drysdale AT, Abi Akar N, Insel C, and Wilson RC. (accepted)Charting the Expansion of Strategic Exploratory Behavior During Adolescence. JEP: General.
3. Krueger PK, Wilson RC, and Cohen JD. (2017) Strategies for exploration in the domain of losses. Judgment and Decision Making, 12(2), 104.
4. Zajkowski W, Kossut M, and Wilson RC. (2017) A causal role for right frontopolar cortex in directed, but not random, exploration. eLife, 6.

Learning in the presence of abrupt change. Whether getting a new job or a new president, life is full of “change points” that cause the rules of the game to shift abruptly. Learning and making predictions in such circumstances can be challenging because change points can render much of the past irrelevant. In this work, I developed a series of computational models to look at how humans and animals learn in the face of such environmental change points. These models ranged in scale from low-level neural network models to high-level cognitive models. All of these models made detailed experimental predictions, some of which have been tested and borne out in experiments by my collaborators.

1. Wilson RC and Finkel LH. (2009) A neural implementation of the Kalman filter. Advances in Neural Information Processing Systems, 22, 2062-2070.
2. Wilson RC, Nassar, MR, and Gold JI. (2010) Bayesian online learning of the hazard rate in change-point problems. Neural Computation, 22(9), 2452-2476.
3. Wilson RC and Niv Y. (2012) Inferring relevance in a changing world. Front Hum Neurosci, 5:189.
4. Wilson RC, Nassar MR, and Gold JI. (2013) A Delta-rule approximation to Bayesian inference in change-point problems. PLoS Comp Biol, 9(7), e1003150.

The role of orbitofrontal cortex in learning and decision making. Orbitofrontal cortex (OFC) has long been known to play an important role in learning and decision making. However, the exact nature of that role has remained elusive. I have recently proposed a new unifying theory of OFC function in which the OFC provides an abstraction of currently available information in the form of a labeling of the current task state. This “cognitive map” of “task space” in OFC is then used as a scaffold for learning and decision making throughout the brain. The theory accounts for many of the puzzling findings related to OFC such as its role in a number of behavioral tasks, as well as more recent findings showing the effect of OFC lesions on the firing of dopaminergic neurons in ventral tegmental area (VTA). This work has been well received by the field and has been cited more than 100 times in just over two years.

1. Takahashi YK, Roesch MR, Wilson RC, Toreson K, O’Donnell P, Niv Y, and Schoenbaum G. (2011)Expectancy-related firing of midbrain dopamine neurons depends on orbitofrontal cortex. Nature Neuroscience, 14, 1590-1597.
2 Wilson RC, Takahashi YK, Schoenbaum G, and Niv Y. (2014) Orbitofrontal cortex as a cognitive map of task space. Neuron, 81 (2) 267-279.

Research Support

NIA R56 AG06188 Wilson (PI) 9/30/18 – 8/31/19
Evaluating the Neurocomputational Mechanisms of Explore-Exploit Decision Making in Older Adults
This grant uses behavioral, neuroimaging, and neurostimulation experiments to investigate explore-exploit behavior in younger and older adults.
Role on Project: PI

McKnight Brain Research Foundation Wilson (UA PI; multi-PI) 7/1/17 – 6/30/19
Evaluating the Neurocomputational Mechanisms of Explore-Exploit Decision Making in Older Adults
This grant uses behavioral, neuroimaging, and neurostimulation experiments to investigate explore-exploit behavior in younger and older adults.
Role on Project: Multi-PI: Wilson, Grilli, Levin, Ebner, Oliveira, Getz)

NIA P30 AG019610 Reiman (PI); (Wilson Pilot Project PI) 7/1/17 – 6/30/19
The Neural Substrates of Explore-Exploit Decisions in Old Age
The purpose of this pilot study is to understand the neural systems underlying explore-exploit decisions and how these systems change in old age and with cognitive decline.
Role on Project: PI

University of Arizona, Faculty Seed Grant Wilson (PI) 7/1/17 – 6/30/18
The Neural Substates of Exploration and Exploitation.
The purpose of the study is to understand the neural systems underlying explore-exploit decisions using fMRI.
Role on Project: PI

UA Dean's Innovation and Education Fund Wilson (PI) 7/1/17 – 6/30/18
The High-Throughput Psychophysiology Lab - A Cognitive Neuroscience Resource for Research, Education and Outreach
The purpose of the study is to build a high-throughput psychophysiology lab using consumer-grade EEG, eye tracking, and heart rate monitoring equipment to run psychophysiology experiments on a large scale.
Role on Project: PI

UA - Improving Health TRIF Bernard (PI) 7/1/17 – 6/30/18
Building Capacity for Inferring Facial Communication from Video Data
The purpose of this work is to develop technology to enable automatic facial feature detection from video for use in psychology and neuroscience research.
Role on Project: co-investigator

Trainees

Postdoctoral

Monica Chawla, Ph.D. (Barnes)
Area of Interest: Immediate early gene expression in aging in the rat

Alexander Danvers, Ph.D. (Mehl)
Area of Interest: Mobile-phone and wearable sensor-based assessment of social and emotional processes in daily life; dynamic systems modeling of emotion dynamics

Yu (Karen) Du, Ph.D. (Ekstrom)
Area of Interest: Virtual reality, scalp EEG, and fMRI

Martha Forloines. Ph.D. (Ekstrom)
Area of interest: Spatial navigation impairments in aging

Derek Huffman, Ph.D. (Ekstrom)
Area of Interest: Decoding body-based neural codes underlying human spatial navigation using fMRI

Sevag Kaladchibachi, Ph.D. (Fernandez)
Area of Interest: Age-related changes in circadian responses to light

Waitsang Keung, Ph.D. (Wilson)
Area of Interest: Age-related changes in exploration and exploitation

Koeun Lim, Ph.D. (Chou)
Area of Interest: Development of image-guided rTMS protocols.

Allison Tackman, Ph.D. (Mehl)
Area of Interest: Personality development over the lifespan; ambulatory assessment of daily social behavior and interactions

Erin Maresh, Ph.D. (Andrews-Hanna)
Area of Interest: Neural underpinnings and health relevance of social cognition

Predoctoral

Mónica Acevedo-Molina (Grilli)
Area of Interest: Self-referential cognition and emotional changes associated with normal aging and Alzheimer's disease

Eric Andrews (Andrews-Hanna)
Area of Interest: Brain network underpinnings of emotion and cognition, and relevance to aging and mental health

Eliza Bacon (Brinton)
Area of Interest: Epigenetic regulation of endocrine aging: Transitions of the perimenopausal and menopausal brain (Ph.D. received 2018)

Pradyumna Bharadwaj (Alexander)
Area of Interest: Applications of multimodal brain imaging in the study of cognitive aging

Yu-Chin Chen (Chou)
Area of Interest: Repetitive TMS treatment for people with MCI

Sarah Cook (Wilson)
Area of Interest: The effect of top-down processing on perceptual decision making

Andrea Coppola (Andrews-Hanna, Sbarra)
Area of Interest: Intersection between healthy relationships and healthy minds

Lindsey Crown (Cowen)
Area of Interest: Neural basis of Parkinson's disease and Neural synchrony involved in memory functions

Hannah Dollish (Fernandez)
Area of Interest: Effects of frequent long-haul travel on circadian system aging and health

Maunil (Neal) Desai (Brinton)
Area of Interest: Cognitive benefits of Allopregnanolone in ApoE 4 to limit progression of Alzheimer's disease

Daniel Gray (Barnes)
Area of Interest: Circuits involved in working memory and their decline with age in a non-human primate model of aging (Ph.D. received fall 2018)

Mary Katherine Franchetti (Alexander)
Area of Interest: Effects of physical activity and sleep on cognitive and brain aging

Dan Hill (Cowen)
Area of Interest: How the frontal cortex alters dopamine release in aging

Mingzhu Hou (Glisky)
Area of Interest: Source memory and aging (Ph.D. received summer 2018)

Deanna Kaplan (Mehl and O'Connor)
Area of Interest: Naturalistic study of how everyday behaviors and social interactions impact health and well-being.

Lindsey Knowles (O'Conner)
Area of Interest: The relationship between profound life stress (bereavement, advanced cancer) and mental and physical health, specifically in the areas of autonomic arousal and immune dysregulation

Bryan Kromenacker (Wilson)
Area of Interest: The interaction between mental effort and mental representations

Ashley Lawrence (Ryan)
Area of Interest: Cardiovascular risk factors and glucose metabolism and the impact on aging

Adam Lester (Barnes)
Area of Interest: Spatial computations made by the entorhinal cortex and how this changes in aging rats (Ph.D. received fall 2018)

Mingli Liang (Ekstrom)
Area of Interest: Human spatial navigation and wireless scalp EEG

Stephanie Matijevic (Ryan)
Area of Interest: Brain imaging and cognitive changes in normal older adults

Mairead McConnell (O'Conner)
Area of Interest: The impact of emotion on physical health, mediated through brain mechanisms, and clinical interventions improving emotional expression

Molly Memel (Ryan)
Area of Interest: The underlying mechanisms of memory impairment in older adults

Aarti Mishra (Brinton)
Area of Interest: Mechanistic role of ApoE4 and inflammation in the development of at-risk aging phenotype in females and its implication on Alzheimer's disease

Jack-Morgan Mizell (Wilson)
Area of Interest: Age-related changes in exploration and exploitation

Suzanne Moseley
Area of Interest: Effects of hearing loss on cognitive function in aging (Ph.D. received summer 2018)

David Negelspach (Fernandez)
Area of Interest: Scaling circadian responses to millisecond administration of FED light

Justin Palmer (Ryan)
Area of Interest: Cognitive and neurobiological changes with normal and abnormal aging trajectories

Roman Palitsky (O'Conner)
Area of Interest: Cultural and religious contributions to emotion regulation and cardiovascular health

Quentin Raffaelli (Andrews-Hanna)
Area of Interest: Cognitive neuroscience of memory, creativity, and spontaneous thought

Ruth Robbins (Glisky)
Area of Interest: Social networking and cognition in socially isolated older adults (Ph.D. received summer 2018)

Hashem Sadegiyeh (Wilson)
Area of Interest: Cognitive correlates of exploration and exploitation

Amber Schedlbauer (Ekstrom)
Area of interest: Episodic memory and network approaches to the brain (Ph.D. received spring 2018)

Saren Seeley (O'Conner)
Area of Interest: Relationships between cognition and emotion, and neural and psychophysiological mechanisms through which these factors give rise to distress and impairment

Samantha Smith (Alexander)
Area of Interest: Actigraphy and cognition in normal and pathological aging

Hyun Song (Alexander)
Area of Interest: Neural mechanisms of individual differences in cognitive aging

Christine Solinsky (Brinton)
Area of Interest: Development of iPSC-based biomarker strategy to identify neuroregenerative responders to Allopregnanolone (Ph.D. received 2018)

Sahana Srivathsa (Barnes)
Area of Interest: Age-related changes of signals involved in spatial memory and decision making

Michael Starrett (Ekstrom)
Area of interest: Human spatial navigation and scales of space

Eva-Maria Stelzer (O'Conner)
Area of Interest: The cultural (collectivist vs. individualist) effects of major life stressors, such as bereavement, on mental and physical health

Ariana Stickel (Ryan)
Area of Interest: Brain imaging, genetics, and cognitive changes in normal older adults

Jared Stokes (Ekstrom)
Area of Interest: Human spatial navigation, high-resolution imaging, and pattern completion/separation (Ph.D. received summer 2018)

Mark Sundman (Chou)
Area of Interest: Development of image-guided rTMS protocols

Alma Tejeda (Mehl)
Area of Interest: Psychological aspects of natural language use; linguistic markers of aging

Emily Van Etten (Alexander)
Area of Interest: Effects of healthy aging on memory and brain structure

Siyu Wang (Wilson)
Area of Interest: The neural correlates of exploration and exploitation

Yvette (Yiwei) Wang (Brinton)
Area of Interest: Estrogen regulation of mitochondrial genome and implication of mitochondrial genetic variances in therapeutics for Alzheimer's disease

Aubrey Wank (Grilli)
Area of Interest: Brain and autobiographical memory changes associated with normal aging and Alzheimer's disease (Master's degree received 2018)

Jean Paul Wiegand (Cowen)
Area of Interest: Oscillatory activity related to memory formation in aging (Ph.D. received spring 2018)

Da'Mere Wilson (O'Conner)
Area of Interest: The role of discrimination, grief, and other stressors on the development of cardiovascular disease within the African American and Latinx community

Cindy Woolverton (Glisky)
Area of Interest: Effects of intergenerational interactions in young and older adults

Tony Ye (Cowen)
Area of Interest: Effect of Parkinson's disease and ketamine on oscillatory activity in the aging brain (Ph.D. received summer 2018)

Clinical / translational programs

Drs. Meredith Hay and Lee Ryan (both EMBI affiliate faculty) are conducting a study to evaluate the safety and efficacy of angiotensin 1-7 to enhance cognitive function in participants undergoing coronary artery bypass graft surgery. Many older individuals undergo this surgical procedure and report negative effects on their cognition as a result. The hypothesis is that this drug will result in a decrease in brain inflammation and microglia activation in these individuals, which was predicted on the basis of preclinical animal experiments conducted at the UA. If the hypothesis is supported in this trial, the researchers will apply to conduct further tests.

Dr. Roberta Brinton (EMBI affiliate faculty) is conducting a study to evaluate allopregnanolone as a therapeutic agent to treat age-associated memory deficits. She is conducting a translational therapeutic development project, required for an Investigational New Drug application to the FDA, to determine the efficacy of allopregnanolone as a neurogenic regenerative and disease modifying agent, first for Alzheimer's disease, and then potentially for normal aging brain health.

Dr. Gene Alexander (EMBI affiliate faculty), together with Cohen (McKnight, UF), Marsiske (McKnight, UF), and Woods (McKnight, UF), are participating in a multi-site evaluation of cognitive training along with transcranial direct current stimulation for its impact on cognitive aging. Dr. Alexander also is engaged in a project, along with Raichlen (UA), on the effects of an aerobic training system for enhancing cognitive performance in healthy older adults.

Dr. Geoff Ahern (EMBI affiliate faculty) is engaged in the following clinical trials:

A Placebo-controlled, Double-blind, Parallel-group, Bayesian Adaptive Randomization Design and Dose Regimen-finding Study to Evaluate Safety, Tolerability and Efficacy of BAN2401 in Subjects with Early Alzheimer's Disease. Protocol # BAN2401-G000-201. (PI: Ahern)

Effect of Passive Immunization on the Progression of Mild Alzheimer's Disease: Solanezumab (LY2062430) versus Placebo. Protocol # H8A-MC-LZAX. Lilly Pharmaceuticals. (PI: Ahern)

A Phase III, Randomized, Placebo-Controlled, Parallel-Group, Double-Blind Clinical Trial to Study the Efficacy and Safety of MK-8931 (SCH 900931) in Subjects with Amnestic Mild Cognitive Impairment Due to Alzheimer's Disease (Prodromal AD). Protocol # 019-00. Merck Sharp & Dohme. (PI: Ahern)

Randomized, Double-Blind, Placebo Controlled, Multi-center Registration Trial to Evaluate the Efficacy and Safety of TTTP488 in Patients with Mild Alzheimer's Disease Receiving Acetylcholinesterase Inhibitors and/or Memantine. Protocol # TTP488-301. Trans Tech Pharma, LLC. (PI: Ahern)

Budget update

Budget update and actual results – July 1, 2017 to June 30, 2018

Evelyn F. McKnight Brain Institute	**Budget**	**Expenditures**
Personnel	$500,000	$309,717
Operations	$250,000	$135.707
Total	$750,000	$415.412

Cowen Recruitment Account	**Budget**	**Expenditures**
Cowen Start-up	$90,888	$28,287

(a) Status of matching funds (to date)

	MBRF Gift	Match
10/1/14 – 9/30/15		$62,254
10/1/15 – 9/30/16	$1,000,000	$54,000
10/1/16 – 9/30/17	$1,000,000	$ 2,500
10/1/17 – 9/30/18	$1,000,000	$50,200
10/1/18 – present	$1,000,000	$ 7,050

(b) Project budget – July 1, 2018 – June 30, 2019

Evelyn F. McKnight Brain Institute	
Personnel	$500,000
Operations	$250,000
Total	$750,000

Cowen Recruitment	
Cowen Recruitment/start-up	$62,601

Budget update

(c) Extramural funding

Subcontract PI's:	Ahern, Geoffrey L.; Rapcsak, Steven Z. (PI: Reiman)
Project:	Arizona Alzheimer's Disease Core Center Clinical Core (P30 AG019610)
Sponsor:	National Institute on Aging
Project Dates:	July 2016 – June 2021
Subaward Amount:	$132,268 (current year)

Subcontract PI:	Alexander, Gene E. (PI's: Reiman, Caselli)
Project:	Brain Imaging, APOE & the Preclinical Course of Alzheimer's Disease (RO1 AG031581)
Sponsor:	National Institute on Aging
Project Dates:	May 2014 – March 2019
Subaward Amount:	$14,630 (current year)

PI:	Alexander, Gene E. (Multi-PI: Cohen, Woods, Marsaki, Alexander)
Project:	Augmenting Cognitive Training in Older Adults – The ACT Grant (RO1 AG054077)
Sponsor:	National Institute on Aging
Project Dates:	July 2016 – June 2021
Subaward Amount:	$255,352 (current year)

Subcontract PI:	Alexander, Gene E. (PI: Reiman)
Project:	Arizona Alzheimer's Disease Core Center Educational Core (P30 AG019610)
Sponsor:	National Institute on Aging
Project Dates:	July 2017 – June 2021
Subaward Amount:	$18,950 (current year)

Co-Investigator	Alexander, Gene E. (PI: Su)
Project:	Ultra-sensitive and Label-free Detection of Alzheimer's Disease Biomarkers (R03 AG055020)
Sponsor:	National Institute on Aging
Project Dates:	August 2017 – July 2019
Award Amount:	$85,653 (current year)

Univ Arizona PI:	Alexander, Gene E. (Multi-PI: Cohen, Rundek, Visscher)
Project:	Neuroimaging Core and Brain Imaging Registry
Sponsor:	McKnight Brain Research Foundation
Project Dates:	January 2015 – December 2018
Subaward Amount:	$228,730 (project period)

Univ Arizona PI:	Alexander, Gene E. (Multi-PI: Cohen, Levin, Wadeley, Alexander); UA co-I's: Glisky, Ryan
Project:	Cognitive Aging Assessment Core
Sponsor:	McKnight Brain Research Foundation
Project Dates:	September 2015 – December 2018
Subaward Amount:	$200,000 (project period)

Univ Arizona PI:	Alexander, Gene E.
Project:	A Pilot Intervention with Near Infrared Stimulation: Revitalizing Cognition in Older Adults
Sponsor:	McKnight Brain Research Foundation
Project Dates:	May 2018 – April 2020
Subaward Amount:	$60,000 (project period)

Univ. Arizona PI:	Andrews-Hanna, Jessica (PI: Bryan)
Project:	Enhancing Function in Later Life: Exercise and Function Network Connectivity
Sponsor:	National Institutes of Health
Project Dates:	July 2017 – June 2019
Subaward Amount:	$15,232 (current year)

Pilot PI:	Andrews-Hanna, Jessica (Grilli co-investigator)
Project:	Uncovering Neurocognitive Links between Alzheimer's Disease and Depression in Mid-Life to Early Aging (P30 AG019610)
Sponsor:	National Institutes of Health (ADC Pilot Award)
Project Dates:	July 2018 – June 2019
Subaward Amount:	$46,050 (project period)

Co-Investigator:	Andrews-Hanna, Jessica (PI: Edgin)
Project:	Brain Development, Sleep, and Learning in Down Syndrome
Sponsor:	LuMind Foundation
Project Dates:	July 2017 – June 2018
Award Amount:	$193,500 (current year)

PI:	Barnes, Carol A. (Ekstrom co-investigator)
Project:	Neurobehavioral Relations in Senescent Hippocampus (R01 AG003376)
Sponsor:	National Institute on Aging
Project Dates:	January 2016 – November 2020
Award Amount:	$736,431 (current year)

PI:	Barnes, Carol A.
Project:	Cell Assemblies, Brain Adaptation and Cognitive Aging (R01 AG050548)
Sponsor:	National Institute on Aging
Project Dates:	September 2015 – May 2020
Award Amount:	$516,626 (current year)

PI:	Barnes, Carol A. (co-I's: Alexander, Billheimer, Huentelman, Trouard)
Project:	Neural System Dynamics & Gene Expression Supporting Successful Cognitive Aging (RO1 AG049465)
Sponsor:	National Institute on Aging
Project Dates:	August 2014 – March 2019
Award Amount:	$734,165 (current year)

PI's:	Barnes, Carol A. and Huentelman, Matt J. (co-I: Okuno)
Project:	CATT: Development and Application of a Neuronal Cell Activity-Tagging Toolbox (RO1 AG049464)
Sponsor:	National Institute on Aging
Project Dates:	September 2014 – May 2019 (no cost extension)
Award Amount:	$300,969 (current year)

Subcontract PI: Barnes, Carol A. (PI: Stern)
Project: Collaboratory on Research for Cognitive Reserve and Resilience (P30 AG061421)
Sponsor: National Institute on Aging
Project Dates: October 2018 – September 2021
Subaward Amount: $18,945 (current year)

Subcontract PI: Barnes, Carol A. (PI: Reiman)
Project: Arizona Alzheimer's Disease Core Center Ad Hoc Review (P30 AG019610)
Sponsor: National Institute on Aging
Project Dates: July 2016 – June 2021
Subaward Amount: $24,476 (current year)

PI: Barnes, Carol A. (co-I's: Bimonte-Nelson, Coleman, Huentelman, Reiman)
Project: Postdoctoral Training, Neurobiology of Aging and Alzheimer's Disease (T32 AG044402)
Sponsor: National Institute on Aging
Project Dates: May 2016 – April 2021
Award Amount: $260,293 (current year)

PI: Barnes, Carol A. (Mentor on Pre-Doctoral Training Grant for Daniel Gray)
Project: Neurobiological Basis of Age-related Deficits in Attentional Shirting and Monitoring (F31 AG055263)
Sponsor: National Institute on Aging
Project Dates: January 2017 – December 2018
Award Amount: $36,185 (current year)

PI: Brinton, Roberta
Project: Sex Differences in the Molecular Determinants of Alzheimer's Disease Risk: Prodromal Endophenotype (R01 AG057931)
Sponsor: National Institute on Aging
Project Dates: September 2018 – August 2023
Award Amount: $1,192,861 (current year)

PI: Brinton, Roberta
Project: Translational Research in AD and related Dementias (TRADD) (T32 AG057931)
Sponsor: National Institute on Aging
Project Dates: September 2018 – August 2023
Award Amount: $146,898 (current year)

PI: Brinton, Roberta
Project: Aging and Estrogenic Control of the Bioenergetic System in Brain (R01 AG053589)
Sponsor: National Institute on Aging
Project Dates: March 2017 – February 2022
Award Amount: $309,287 (current year)

PI: Brinton, Roberta
Project: Perimenopause in Brain Aging and Alzheimer's Disease (R01 AG026572)
Sponsor: National Institute on Aging
Project Dates: September 2016 – May 2021
Award Amount: $2,070,810 (current year)

PI:	Brinton, Roberta
Project:	Metabolic Networks and Pathways Predictive of Sex Differences in AD Risk and Responsiveness to Treatment (R01 AG059093)
Sponsor:	National Institute on Aging
Project Dates:	August 2018 – June 2023
Award Amount:	$153,500 (current year)

PI:	Brinton, Roberta
Project:	Allopregnanolone a Regenerative Therapy for Alzheimer's: FDA-Required Toxicology (U01 AG047222)
Sponsor:	National Institute on Aging
Project Dates:	June 2018 – June 2019
Award Amount:	$215,348 (current year)

PI:	Brinton, Roberta
Project:	Allopregnanolone Novel Patentable Formulations to Advance Commercialization
Sponsor:	Alzheimer's Drug Discovery Foundation
Project Dates:	June 2017 – December 2019
Award Amount:	$150,000 (project period)

PI:	Brinton, Roberta
Project:	Perimenopause in APoE4 Brain: Accelerated Myelin Catabolism for Fuel
Sponsor:	Alzheimer's Association
Project Dates:	May 2017 – April 2020
Award Amount:	$249,280 (current year)

Pilot PI:	Chou, Ying-hui
Project:	Use of TMS and fMRI Measures to Assess the Risk of Conversion of MCI to Dementia (P30 AG019610)
Sponsor:	National Institute on Aging (ADC Pilot Award)
Project Dates:	July 2017 – June 2018
Subaward Amount:	$46,050 (project period)

PI's:	Coleman, Paul D., Barnes, Carol A., and Alexander G.E. (co-I's: Billheimer, Huentelman, Trouard)
Project:	Epigenetic, Neuroimaging & Behavioral Effects of Hypertension in the Aging Brain (RO1 AG049464)
Sponsor:	National Institute on Aging
Project Dates:	August 2014 – March 2019
Award Amount:	$458,236 (current year)

Subcontract PI:	Cowen, Stephen, L.
Project:	Restoring Functional Connectivity Following TBI (R01 NS084026)
Sponsor:	National Institute of Neurological Disorders and Stroke
Project Dates:	February 2014 – January 2019
Award Amount:	$20,413 (current year)

Co-investigator: Cowen, Stephen, L. (PI: Witte)
Project: High Resolution Electrical Brain Mapping by Real-time and Portable 4D Acoustoelectric Imaging (R01 MH109060)
Sponsor: National Institute of Mental Health
Project Dates: November 2015 – August 2018
Award Amount: $20,413 (current year)

PI: Cowen, Stephen, L.
Project: Identification of Network, Oscillatory and Behavioral Signatures of LRRK2 Expression
Sponsor: Michael J. Fox Foundation for Parkinson's Research
Project Dates: August 2017 – July 2019
Award Amount: $199,386 (project period)

Co-investigator: Cowen, Stephen, L. (PI: Edgin)
Project: Brain Development, Sleep and Learning in Down Syndrome
Sponsor: LuMind Foundation
Project Dates: July 2017 – June 2018
Award Amount: $10,750 (project period)

PI: Cowen, Stephen, L.
Project: High Density, Miniaturized, Zero Switching, Stimulation and Recording Headstage for Small Animals
Sponsor: Advanced Medical Electronics Corp.
Project Dates: August 2017 – January 2018
Award Amount: $28,750 (project period)

Subcontract PI: Ekstrom, Arne
Project: Representation of Spatiotemporal Information in Human Episodic Memory and Navigation (R01 NS07856)
Sponsor: National Institute of Neurological Disorders and Stroke
Project Dates: July 2012 – June 2022
Award Amount: $347,985 (current year)

PI: Fernandez, Fabian
Project: 2016 Bisgrove Scholar Program
Sponsor: Science Foundation Arizona
Project Dates: August 2016 – July 2018
Award Amount: $200,000 (project period)

Co-investigator: Mehl, Matthias (PI: Stone)
Project: Reducing Implicit Verbal and Nonverbal Bias toward Hispanic Patients (R01 MD008940)
Sponsor: National Institute on Minority Health and Health Disparities
Project Dates: September 2014 – May 2019
Award Amount: $90,000 (current year)

Subcontract PI:	Mehl, Matthias (PI: Nugent)
Project:	Reducing Implicit Verbal and Nonverbal Bias toward Hispanic Patients (R01 MD008940)
Sponsor:	National Institute on Minority Health and Health Disparities
Project Dates:	September 2014 – May 2019
Award Amount:	$90,000 (current year)

Subcontract PI:	Mehl, Matthias (PI: Nugent)
Project:	Understanding the Interplay of Social Context and Physiology on Psychological Outcomes in Trauma-Exposed Adolescents (R01 MH108641)
Sponsor:	National Institutes of Mental Health
Project Dates:	July 2016 – June 2021
Award Amount:	$59,078 (current year)

Co-investigator:	O'Connor, Mary-Francis (PI: Palitsky)
Project:	Untangling the Health Influence of Religion in Bereavement: The Role of Affect
Sponsor:	Society for Scientific Study of Religion
Project Dates:	July 2018 – September 2019
Award Amount:	$3,000 (project period)

PI:	Rance, Naomi E.
Project:	Role of Preoptic NK3R Neurons in the Estrogen Modulation of Body Temperature (RO1 AAG047887)
Sponsor:	National Institute on Aging
Project Dates:	August 2014 – April 2019
Award Amount:	$302,094 (current year)

Co-I:	Rance, Naomi E. (PI: Teske)
Project:	Pre-Clinical Model for Sleep Deprivation-Induced Obesity and Hedonic Intake Due to Noise Exposure
Sponsor:	National Institute of Neurological Disorders and Stroke
Project Dates:	July 2017 – June 2019
Award Amount:	$169,601 (current year)

Co-investigator:	Ryan, Lee (PI: Sweitzer; co-I's: Bedrick, Hay, Khalpey, Konhilas, Ryan)
Project:	Evaluation of the Safety and Efficacy of Angiotensin 1-7 to Enhance Cognitive Function in Participants Undergoing Coronary Artery Bypass Graft (CABG) Surgery (UO1 HL131014)
Sponsor:	National Heart, Lung, and Blood Institute
Project Dates:	March 2017 – February 2021
Award Amount:	$546,197 (current year)

PI:	Ryan, Lee (co-I's: Alexander, Barnes, Brinton, Chen, Edgin, Gaffney, Glisky, Grilli, Guzman-Perez, Khanna, Saranathan, Su, Trouard, Yin)
Project:	Arizona Alzheimer's Consortium State-Funded Projects
Sponsor:	State of Arizona, DHS
Date:	July 2018 – June 2019
Amount:	$300,000 (current year)

PI:	Ryan, Lee
Project:	Establishing Pipelines for Biomarker Collection and Data Sharing for Cognitively Healthy Older Adults at the University of Arizona
Sponsor:	State of Arizona, DHS
Date:	July 2018 – June 2019
Amount:	$439,868 (current year)

PI:	Ryan, Lee (co-I's: Alexander, Ahern, Andrews-Hanna, Barnes, Brinton, Edgin, Fernandez, Glisky, Grilli, Mehl, Rapcsak, Saranathan, Su, Trouard, Yin)
Project:	Arizona Alzheimer's Consortium State-Funded Projects
Sponsor:	State of Arizona, DHS
Date:	July 2017 – June 2018
Amount:	$439,868 (current year)

PI:	Wilson, Robert (Grilli: co-investigator)
Project:	Uncovering Risk Profiles of Deception and Mitigating Susceptibility to Scamming
Sponsor:	McKnight Brain Research Foundation
Date:	April 2018 September 2020
Amount:	$110,000 (project period)

PI:	Wilson, Robert C. (Co-I's Andrews-Hanna; Chou)
Project:	Evaluating the Neurocomputational Mechanisms of Explore-Exploit Decision Making in Older Adults (R56 AG06188)
Sponsor	National Institute on Aging
Date:	9/30/18 – 8/31/19
Award Amount:	$339,230 (project period

Univ. Arizona PI:	Wilson, Grilli, Levin, Ebner, Oliveira, Getz (Multi-PI)
Project:	Evaluating the Neurocomputational Mechanisms of Explore-Exploit Decision Making in Older Adults
Sponsor:	McKnight Brain Research Foundation
Date:	5/1/18 – 4/30/20
Award Amount:	$31,555 (project period)

Pilot PI:	Wilson, Robert C. (co-I: Chou)
Project:	The Neural Substrates of Explore-Exploit Decisions in Old Age (P30 AG019610)
Sponsor	National Institute on Aging (ADC Pilot Award)
Date:	7/1/17 – 6/30/19
Award Amount:	$46,041 (project period)

Educational programs focusing on age-related memory loss

Barnes was probably the first person in the United States (and the world) to develop a 'true Gerontology' course that covered the entire spectrum of this discipline. The course was designed for senior undergraduates and graduate students from many disciplines – with the first class being taught when she was at the University of Colorado, Boulder in 1984. Barnes has taught this course almost yearly since then, and still teaches this course at the University of Arizona – it has had the same name for these 35 years – "Gerontology: A Multidisciplinary Perspective".

Barnes, together with other University of Arizona faculty in the Department of Psychology began to develop in 2018 an on-line on Gerontology Certificate program focused on "Best Practices for Caregivers: Providing Quality Care and quality of Life for Older Adults". The Fundamental "first course" in this program will be fashioned after Barnes' upper level course in terms of content areas covered, and then there will be a number of other courses to follow, to allow students to customize their learning experience to best suit their interests, or professional specialty.

Graduate Certificate Program: The graduate certificate in Gerontology is designed to provide a broad overview of the field of aging, while offering targeted information directly applicable to individuals working with an aging population. In this series of courses, the University of Arizona's renowned scientists and clinicians will discuss research-supported principles and information that are translated into practical applications for anyone working with older adults, in order to enhance the quality of life for older adults and caregivers alike.

The certificate program consists of a minimum of five courses taught in an enhanced interactive online format that gives students an exceptional educational experience with the freedom to work from anywhere, on your own schedule. Each course requires approximately 40 hours to complete. Students begin the program with an introductory core course, Fundamentals of Gerontology. The remaining four courses can be selected from the list of available options listed below.

Fundamentals of Gerontology
This course provides a broad overview of the social, cultural, psychological, cognitive, and biological aspects of aging, as well as a look into the challenges faced by aging adults, their families, their caregivers, and their communities.

Cognitive and Psychological Aspects of Healthy Aging
This course explores healthy aging with an emphasis on understanding how aging affects the quality of life for older adults through changes in cognitive functioning, mental health, personality, and adjustment. Students will learn facts and myths about aging and how caregivers can help optimize well-being among older adults.

Relationships and Aging in a Social-Cultural Context
In this course, students will discuss social and cultural influences on aging, including social support, sexuality, and family dynamics, as well as the impact of an increasingly older population for society.

Dementias and Chronic Conditions in Older Adults
This course focuses on dementias and other chronic conditions commonly experienced by older adults, how these disorders impact daily functioning, and the warning signs that an individual may need additional care. Students will learn about the most recent advances in the assessment and treatment of cognitive and mental health disorders among the elderly.

Caring for Aging Adults and their Caregivers

This course covers basic concepts in the therapeutic care of aging adults with an emphasis on self-care and stress-management for older adults and caregivers alike. Topics include therapeutic communication, managing depression and stress, and coping with death and loss.

Elder Care: Law, Policy, and Elder Mistreatment
The course explores the intersection of law, policy, and elder abuse and neglect. Students will discuss legal and ethical issues relating to older adults. They will also learn about risk factors of abuse, perpetrator profiles, current approaches to elder abuse prevention, and legal responsibilities for reporting suspected abuse.

Collaborative programs

with McKnight institutions and research programs and non-McKnight institutions and research programs

The Director, Associate Director, and Affiliate Faculty of the Evelyn F. McKnight Brain Institute at the University of Arizona have many collaborative interactions among themselves and other Institute faculty in Tucson and with other McKnight Brain Institutes. In addition, we have extensive collaborations with faculty inside the University of Arizona, across the state, across the country, and around the world. Discussion of publications this year that have relevance to the aging brain and memory and that document these interactions include the manuscripts that have been highlighted in the "Summary of scientific achievements since last report" section. In this section, the collaborations among Tucson EMBI members, and members from the three other Evelyn F. McKnight Brain Institutes are noted. If the new U19 grant submitted in January 2019 is funded, the Miami EMBI (Rundek and Levin) is directly involved as an important experimental site in the project, and we hope to engage the other two EMBI sites to participate in our efforts towards making a Precision Aging Network a reality.

Most important scientific achievements this year

There were many significant findings published this year, each of which contributes to our understanding of the aging brain and memory loss that occurs during the aging process. I have outlined a selection of the accomplishments of the Director and Associate Director's laboratories, as well as those of our affiliate members in the synopsis found under the section "Summary of scientific achievements since last report".

Plans for future research

The director of the Evelyn F. McKnight Brain Institute at the University of Arizona is in a strong position in the coming year to conduct significant research on memory in the aging brain. In addition to support from the McKnight Brain Research Foundation, her work is supported through five RO1 grants and one postdoctoral training grant.

During the past year and a half Barnes has worked to put together a group of scientists within Arizona, as well as in Atlanta, Miami, Baltimore and Texas to prepare a U19 grant to submit to the National Institute on Aging to support a Precision Aging Network centered at the University of Arizona. We obtained the final permission to submit the 5 year, $35M (direct costs, $55M costs) grant in December 2018 for a submission date of January 25, 2019. There are 40 individuals participating in this grant, and there were 24 different budgets to align to submit through the University of Arizona. We were successful in finalizing the grant entitled "Precision Aging Network: Closing the Cognitive Healthspan, Human Lifespan Gap" for the submission deadline. Barnes is the PI of this U19 grant, and the Associate Directors of the grant are all Tucson EMBI Affiliate Faculty (Brinton, Hay, Huentelman and Ryan). This undertaking was quite challenging, and we are pleased that the 1132 page submission went through without errors at the end of January 2019. We are very excited to learn the outcome of our review, which should occur in early summer 2019. If we are

awarded this grant, 2019 will be an exceptional year for us, and a full report of our intended milestones and targets will be explicitly outlined in our 2019 report.

Investment report

July 1, 2017 – June 30, 2018

Endowed Chair

Summary for 12 months ending June 30, 2018

Account Name: Evelyn F. McKnight Chair for Learning and Memory in Aging

A.	Beginning Balance on July 1, 2017	$ 879,319
B.	Investment Growth	$ 63,678
C.	Distributions (to Endowed Chair Expendable)	$ (34,759)
D.	Additional Contributions	$ --
E.	Ending Balance on June 30, 2018	$ 908,238

Institute – Quasi Endowment

Summary for 12 months ending June 30, 2018

Account Name: Evelyn F. McKnight Brain Institute

A.	Beginning Balance on July 1, 2017	$ 1,839,105
B.	Investment Growth	$ 59,796
C.	Distributions (to Endowed Chair Expendable)	$ (100,000)
D.	Additional Contributions	$ --
E.	Ending Balance on June 30, 2018	$ 1,798,901

Institute – Permanent Endowment

Summary for 12 months ending June 30, 2018

Account Name: Evelyn F. McKnight Brain Institute

A.	Beginning Balance on July 1, 2017	$ 2,034,594
B.	Investment Growth	$ 182,704
C.	Distributions (UAF Development Fees)	$ (57,000)
	Distributions (to Expendable Account	$ (107,376)
D.	Additional Contributions	$ 1,050,100
E.	Ending Balance on June 30, 2018	$ 3,103,022

Additional notes

Were any funds used for a Prohibited Purpose during the report period?

No

Do you recommend any modification to the Purpose or mandates in the Gift Agreement?

No

Did all activities during the report period further the Purpose?

Yes

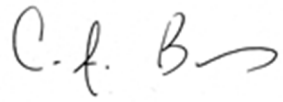
Negative Events

N/A

Technology transfer

Nothing to report

Respectfully Submitted,



C.A. Barnes, Ph.D.
Regents' Professor, Psychology, Neurology and Neuroscience
Evelyn F. McKnight Chair for Learning and Memory in Aging
Director, Evelyn F. McKnight Brain Institute
Director, Division of Neural Systems, Memory and Aging