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Protecting the Mature Mind

by Julie O'Connor

One of the major unsolved mysteries of aging is why some people age gracefully with little to no memory or cognitive dysfunction, while others are afflicted with debilitating diseases such as Alzheimer's and other forms of dementia.

An adult brain contains about 100 billion nerve cells – neurons - that branch out and connect to more than 100 trillion points. Signals traveling through the neurons form the basis of thoughts, feelings and memories. It is these cells that are destroyed by Alzheimer's disease, leading to tissue loss throughout the brain, affecting nearly all of its functions.

Dr. Scott Moffat's research is focused on understanding these complex elements of the mind which may one day lead to new solutions to slow or stop debilitating diseases such as Alzheimer's.

Dr. Moffat, associate professor in the Institute of Gerontology, and his research team are investigating two principal areas of research associated with aging. The first which is conducted in his Neuroscience of Aging Lab, seeks to understand the cognitive, structural and functional brain changes associated with aging. He has developed virtual reality technology that incorporates functional MRI studies to assess the behavioral and neural mechanisms of age-related decline in human spatial cognition.

His second area of research focuses on human behavioral endocrinology, which is examining two hormones thought to influence the brain's health and functions: testosterone and cortisol. By understanding how some hormones may affect people's brain functions, Dr. Moffat may one day have an answer to the causes of brain atrophy and loss of brain function.

A virtual – reality approach to studying spatial memory

Throughout our lives, we must navigate on a daily basis, whether driving to work or finding our way to someplace new. As people age, navigation becomes more difficult. Using real-world situations to evaluate this problem is complicated according to Dr. Moffat. Problems include the fact that navigation takes place over relatively large spaces; physical limitations make it difficult for many older individuals to walk long distances; learning a new route often takes repeated tries; and researchers cannot control the location and placement of landmarks.

Through virtual reality technology, these barriers are eliminated, and allow simulations to explore a variety of three-dimensional environments. It also allows researchers to design the environments including cues and landmarks the study participants will see, and also to record detailed analyses of their behavior during the study. Dr. Moffat's studies of young and elderly individuals solving a virtual navigation task in the lab and later in a functional MRI scanner reveal that older participants had significant challenges in performing the spatial memory task, and had different patterns of brain activation while solving the task.

"Our results demonstrate that elderly individuals may encounter greater difficulty learning the layout of unfamiliar environments than younger individuals," said Dr. Moffat. "Because navigating successfully is a necessary activity for people of all ages, our research has important implications for understanding how navigation skills may change with age," he added.

Dr. Moffat and his research team may one day understand wandering in Alzheimer's disease, in which people with the disease become lost and disoriented. Wandering affects up to 60 percent of patients with Alzheimer's and is often one of the early warning signs of the condition.

Understanding the role of hormones in brain health

Dr. Moffat is interested in understanding how some hormones may negatively and positively affect people's brain functions. In earlier research, Dr. Moffat and his colleagues found that higher levels of circulating testosterone may have a broad range of positive influences on the brains of aging men. Moreover, the loss of testosterone may play a key role in the development of certain types of memory loss and Alzheimer's.

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In the Baltimore Longitudinal Study of Aging, Dr. Moffat investigated age-associated decreases in testosterone concentrations and neuropsychological performance of more than 400 men ages 50 to 91 for ten years. The study showed that men with higher testosterone levels had higher scores on visual and verbal memory, and visual spatial function. Dr. Moffat and his research team are currently conducting placebo-controlled testosterone intervention studies in elderly men to test whether administering testosterone to men with low levels may enhance cognitive brain function.

Dr. Moffat recently began studying cortisol, a stress hormone thought to influence the brain's health and functions, funded by a grant from the National Institutes of Health's National Institute on Aging. A high level of cortisol – produced by the adrenal gland – has been found in animals to be associated with poor cognitive abilities. "Researchers believe that cortisol attacks certain brain regions and causes some atrophy and loss of brain function," said Dr. Moffat. "In humans, we think that exposure to stress and high levels of cortisol may cause memory loss and ultimately increase the risk for dementia."

While early in the research stage, Dr. Moffat's studies may be the key that reveals additional risk factors for age-related declines in cognitive and neural function, someday leading to new treatments to eliminate or delay these debilitating and often deadly dysfunctions.

About Dr. Scott Moffat: Dr. Moffat received his B.S. from the University of Toronto where he studied psychology and neuroscience. He received his Ph.D. in neuropsychology from the University of Western Ontario in London, Ontario, Canada. He was a visiting fellow at the National Institute of Aging. He joined Wayne State University in 2002.

Dr. Scott Moffat, associate professor, department of psychology and the Institute of Gerontology