Research At Rutgers-Newark

Rutgers-Newark Professor Bart Krekelberg Is Named One of Twenty U.S. Pew Scholars for 2007

August 06, 2007

NEWARK, N.J. – In life, it's not always what we perceive but often also what we ignore that allows us to function with ease. Take for example, the process of seeing. As we look and see the world around us, the brain is able to ignore some critical information, most specifically the movement of our own eyes. If the brain failed to suppress that movement, then seeing would be like looking through a video camera held by an unsteady hand jerking from spot to spot every few seconds. It also would lead to a barrage of information that would prevent us from seeing anything at all.

Recently named a Pew Scholar in the Biomedical Sciences, Bart Krekelberg, assistant professor in the Center for Molecular and Behavioral Neuroscience (CMBN) at Rutgers University in Newark, seeks to provide a map of the neural activity involved in visual processing during eye movements. Such knowledge could provide a better understanding of the visual perception dysfunctions involved in dyslexia, and the hallucinations experienced by those who suffer from schizophrenia.

As one of 20 U.S. Pew Scholars selected for the 2007 awards, Krekelberg has received a $250,000 grant from the Pew Charitable Trusts to fund his work in vision and eye movements. The highly selective program supports researchers in studying unexplored areas so they can generate the knowledge that may lead to new medical treatments and save lives. Krekelberg is the only researcher in New Jersey named a 2007 Pew Scholar in the Biomedical Sciences.

Working at the neural systems and network levels, Krekelberg and his research team plan to pinpoint those areas of the brain involved in visual perception and eye movements and how they work in unison. Traditionally, such research has focused on the function of specific cells in individual areas of the brain, but not on the connections between cellular function and global neural networks, says Krekelberg. The failure to integrate the two, he says, "reminds one of the 10 blindfolded wise men trying to identify an elephant by touching its different parts."

As a grant program that encourages researchers to take calculated risks, the Pew funding will allow Krekelberg to connect both methods to reveal the components of the neural networks involved in visual processing, how they influence each other, and how individual cells affect the whole. The research will involve both studying the function of individual cells in his electrophysiology lab and functional resonance imaging of the whole brain at the University Heights Center for Advanced Imaging in Newark.

"With this grant, we will be allowed to develop the techniques to look at the brain to determine how the pieces fit together," says Krekelberg. "My long term goal is to take off the blindfolds to provide a more complete picture of how the neural mechanisms of visual perception deal with all those eye movements we make."

The human eye is designed with the most sensitive photoreceptors at the center of the retina. In order to see clearly, the eye needs to move so light can hit that area, which also is the only area that sees color, and pass that information to the brain. "Essentially, it's like having a very expensive camera at the center of your eye and a cheaper camera around the rest of your eye," explains Krekelberg. "To see correctly, you need to move the expensive camera around."

On an average day, the human eye moves about 100,000 times. In the process of seeing, however, the brain instructs itself to ignore that movement, says Krekelberg. Anyone can demonstrate this by looking into a mirror and looking right, then left, and repeating that action. The eye will not be seen as moving. But look at someone else who is asked to look right, then left and then right again and you will clearly see his or her eyes moving back and forth.
"You know your eye is going to move before you move it, and the brain tells you, 'It's just your eye moving; it's nothing to worry about; ignore it,'" explains Krekelberg. It's what allows us to see fixed objects as stationary and to determine the correct motion of moving objects.

Any break in that communication link, and visual processing can become a challenge. Schizophrenic patients, for example, have impaired motion perception and spatial localization, and difficulty detecting simple visual stimuli due to what may be an increase in eye movements. And while dyslexia traditionally has been interpreted as a deficit in language development, it also has been found to be associated with oculomotor deficits. By identifying what areas of the brain are involved in visual processing and eye movements, it may be possible to develop more effective treatments or early detection methods for such disorders.

Born in the Netherlands and now residing in Hoboken, NJ, Krekelberg has a masters degrees in theoretical astrophysics and in cognitive artificial intelligence from Utrecht University, and earned his Ph.D. in mathematics from the University of London (King's College) in 1997. Prior to joining the Rutgers University faculty in 2005, he worked as a post-doctoral fellow at Ruhr University, in Bochum, Germany, and as a research associate at the Salk Institute in La Jolla, California. His recent publications include "Interactions Between Speed and Contrast Tuning in the Middle Temporal Area: Implications for the Neural Code for Speed" in the *Journal of Neuroscience*, "Adaptation: From Single Cells to BOLD Signals" in *Trends in Neuroscience*, and "Implied Motion from Form in the Human Visual Cortex" in the *Journal of Neurophysiology*. At Rutgers University in Newark, he teaches undergraduate and graduate lectures on sensory systems, neuroimaging, and the neural correlates of perception.

Other funding supporting the work of Krekelberg's Neuroscience Laboratory at CMBN are a $1.5 million grant from the National Eye Institute, as well as grants from the Charles and Johanna Busch Foundation, and the Human Frontiers Science Program to Dr. Tamara Watson, a post-doctoral fellow in the laboratory. More information on the lab's research can be found at http://vision.rutgers.edu/klab/.