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Neuroscience 201

Carol Barnes: *a Prominent Voice in the Neuroscience of Aging,*

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Carol A. Barnes is a professor at the University of Arizona and a leading expert in the neuroscience of aging. She has received numerous awards and recognitions for her pioneering work in the field, including the Ralph W. Gerard Prize from the Society for Neuroscience, "which is the highest recognition conferred by [the Society for Neuroscience and] honors an outstanding scientist who has made significant contributions to neuroscience throughout his or her career" (1). Barnes earned her Ph.D. at Carleton University in Ontario, Canada and went on to do postdoctoral work in Canada, Oslo, and London. She is also an "elected Fellow of the American Association for the Advancement of Science, and an Elected Foreign Member of the Royal Norwegian Society of Sciences and Letters," showing her academic excellence and commitment to the pursuance of neurologic advances (2). Dr. Barnes is extremely involved in the neuroscience community, both on a local, national and even international level. At the University of Arizona, she holds positions in both the Psychology and Neurology departments, is the Evelyn F. McKnight Endowed Chair for Learning and Memory in Aging, and is involved in mentoring multiple graduate programs. Through her research, Barnes interacts with neuroscientists across the US and the world, from a primate research lab in California to the Centre for the Biology of Memory in Norway, and from neuroscience researchers in Boston to engineers at the University of Houston. Summing this up, one of her graduate students, Sara Burke, is quoted as saying, "It's a very unique situation here…what Carol does, and [her] interdisciplinary [approach]… in the lab, I think gives you access to a lot of things you wouldn't have access to if you were working with someone else" (3). It is easy to see the widespread impact Dr. Barnes has had on the Neuroscience community just by her simple connections to other disciplines and other countries, without even considering the 200+ research papers she has contributed to and helped publish.

Research

Though she is very involved in the Arizona Alzheimer's Consortium, Barnes' research is centered on the changes that happen in learning, memory and behavior in *normal* aging, rather than in neurological diseases. As Barnes states, "I don't believe that you can understand Alzheimer's disease until you know what the normal developmental process is" (3). She became interested in the subject while in graduate school when her mother asked her to look up some reasons as to why her grandfather had recently become less attentive and forgetful in his old age. She was astounded by the lack of research on the subject, and began what was to become a decades-long career in the study of the aging brain. Below are just a few short summaries of some of her recent research papers on the broad subject of aging:

Her latest paper focused on the perirhinal cortex (PRC) and whether recognition memory function and stimulus recognition, housed in PRC neurons, was affected at advanced age due to either higher order stimulus systems or activity patterns in the brain. Using young and elderly rats, the researchers placed various objects in front of the test subjects as they navigated a test track. The neural activity in the PRC was recorded whenever the rat was confronted by an object, and differences between age groups were compared. The researchers found that old rats had fewer neurons firing in response to an object than young rats, but that once activity patterns in the brain had been established, they were maintained in both young and old rats. This showed that "age-associated deficits in stimulus recognition arise from impairments in high-order stimulus representation rather than difficulty in sustaining stable activity patterns over time" (4).

Another of the papers that Barnes has recently contributed to is centered on the hypothesis that, "age-related cognitive and behavioral slowing may be caused by changes in the speed of neuron signaling or by changes in the number of signaling steps necessary to achieve a given function" (5). The researchers focused on "gamma oscillation" speeds in the brains of aged and young rats, which they tested by measuring the frequency of the gamma oscillations in different parts of the brain during movement and certain behavioral tasks. They found that older rats have a markedly slower gamma oscillation in the medial frontal cortex, and that this was correlated with slower reaction times and slower movement. This same trend was not, however, seen in the hippocampus. After concluding this study, the researchers proposed that a general lengthening of certain gamma cycles is partly to blame for the observed reduction in the reaction times of aged rats (5).

Barnes has also done studies on primates, and less than two years ago published a paper discussing neurons in the medial temporal lobe (MTL) of macaque monkeys. The researchers were studying MTL activity during a "passive viewing task," in which the three test subjects were shown fifty images of varying familiarity (novel, intermediate, or familiar), while a microdrive of electrodes (implanted in their brains prior to testing) recorded neural activity. They found that there was no significant difference in neural activity across the MTL in response to novel stimuli, but that individual neurons in the "temporal area F" did, in fact, exhibit different responses to novel stimuli (6).

The above studies were just a few of the hundreds of papers Dr. Barnes has published over her forty-year career. The depth and breadth of her body of work is remarkable in itself, and she will no doubt continue to push the boundaries of the field of aging in neuroscience.

Involvement in Supporting Other Women Neuroscientists

Dr. Barnes, as a professor and a graduate mentor, is constantly in contact with the new generation of women neuroscientists, helping shape their future career paths and providing them with an uncountable number of resources. In 2010, she received the Mika Salpeter Lifetime Achievement Award, which "recognizes individuals with outstanding career achievements in

neuroscience who have also actively promoted the professional advancement of women in neuroscience" (7). She was chosen for this award because of her work as a mentor at the University of Arizona; the selection committee commented, "Her commitment to the professional development of her trainees demonstrates her desire to further the advancement of women in neuroscience" (7). Barnes also participates in programs directed at training underrepresented populations in neuroscience, such as the NIH Disadvantaged High School Student Research Program, Minority Access to Research Careers (MARC), and the McNair Achievement Program (2). Just in the past year, at the 2013 Celebration of Women in Neuroscience event through the Society for Neuroscience, Dr. Barnes was chosen to give the keynote address on "The Evolving Face of Neuroscience: Role of Women and Globalization" (8). Her involvement in these many different programs aimed at developing the role of women in neuroscience is clearly quite extensive, speaking to her passion for passing on knowledge and aiding in the effort to bring more women into the neuroscience field.

Concluding Remarks

Even more important than all of the awards Dr. Barnes has won, the papers she has published, or the many programs she is involved with, is her commitment to training the next generation of neuroscientists; Carol Barnes is not the only woman neuroscientist who has ever lived, nor is she perhaps the most influential to the field as a whole, but her dedication to carrying on research in future generations and promoting the advancement of women in neuroscience is truly inspiring. Her impact on neuroscience will be seen in the work of all the students she mentors and all the young scientists to whom she lends a helping hand; her legacy, and the legacy of all neuroscientists researching today, will be in the minds and the work of those that follow in their footsteps.

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