**Written Statement — Society for Neuroscience**

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## Introduction

Mr. Chairman and Members of the Subcommittee, my name is Moses Chao, PhD. I am a professor of Cell Biology, Physiology and Neuroscience, and Psychiatry at the New York University School of Medicine, and President of the Society for Neuroscience. My major research efforts have been focused on growth factors (also called neurotrophins). These proteins are crucial for everything from neuron differentiation, growth, and survival during development to learning and memory in children and adults. Deficits in neurotrophins are involved in neurodegenerative disorders such as Alzheimer's, Parkinson's and Huntington's diseases, and Amyotrophic Lateral Sclerosis (ALS) as well as limiting recovery after stroke or brain injury.

Founded in 1969, SfN has grown from a membership of 500 to more than 42,000, representing researchers working in more than 80 countries. This rapid growth reflects the tremendous progress made in understanding brain cell biology, physiology, and chemistry, and the tremendous potential and importance of this field. Today, the field sits on the cusp of revolutionary advances, and NIH-funded research has played an essential role by enabling advances in brain development, imaging, genomics, circuit function, computational neuroscience, neural engineering and many other disciplines.

To continue this important work SfN stands with partners in the medical and scientific community to request at least $32 billion for NIH in FY 2013. In this testimony, I will highlight how these advances have benefited taxpayers, and some of the challenges that need to be addressed to prevent lapsing further behind other nations throughout the world both scientifically and economically.

## What is the Society for Neuroscience?

SfN is a nonprofit membership organization of basic scientists and physicians who study the brain and nervous system. The SfN mission is to advance the understanding of the brain and the nervous system by bringing together scientists of diverse backgrounds, by facilitating the integration of research directed at all levels of biological organization, and by encouraging translational research and the application of new scientific knowledge to develop improved disease treatments and cures; provide professional development activities, information, and educational resources for neuroscientists at all stages of their careers, including undergraduates, graduates, and postdoctoral fellows, and increase participation of scientists from a diversity of cultural and ethnic backgrounds; promote public information and general education about the nature of scientific discovery and the results and implications of the latest neuroscience research, and support active and continuing discussions on ethical issues relating to the conduct and outcomes of neuroscience research; and inform legislators and other policymakers about new scientific knowledge and recent developments in neuroscience research and their implications for public policy, societal benefit, and continued scientific progress.

## What is Neuroscience?

Neuroscience is the study of the nervous system. It advances the understanding of human function on every level: movement, thought, emotion, behavior, and much more. Neuroscientists use tools across disciplines—from biology and computer science to physics and chemistry—to examine molecules, nerve

cells, networks, brain system, and behavior. Through research, neuroscientists work to understand normal functions of the brain and determine how the nervous system develops, matures, and maintains itself through life. This research is the foundation for preventing, treating or curing more than 1,000 neurological and psychiatric disorders that result in more hospitalizations in the U.S. than any other disease group, including heart disease and cancer. In 2007, the World Health Organization estimated that neurological disorders affect up to one billion people worldwide. In fact, neurological diseases make up 11 percent of the world's disease burden, not including mental health and addiction disorders.

Neuroscience includes basic, clinical and translational research. Basic science unlocks the mysteries of the human body by exploring the structure and function of molecules, genes, cells, systems, and complex behaviors, and basic science funding at NIH continues to be a springboard for discoveries that spur medical progress for future generations.

The following are just three of many emerging stories of important progress in neuroscience research, and these are based in large part on strong historic investment in NIH and other research agencies:

*Neurotrophic Factors:* Maintaining brain health throughout life is an important public health goal. Extensive research has demonstrated that cognitive function can be enhanced with increased levels of Brain-Derived Neurotrophic Factor (BDNF) and other growth factors. These proteins are released in the brain with exercise, neuronal activity and behavioral stimulation, resulting in increased resistance to brain injury, the birth of new neurons and improved learning and mental performance. BDNF increases and strengthens the number of connections in the brain and promotes plasticity, by generating positive signals in neurons. Depression and anxiety are also influenced by neurotrophic factors. Future research will define new ways to use the knowledge from neurotrophic factors to protect the nervous system from damage and maintain brain function and plasticity during aging.

*Epigenetics Research:* Is it "nature" or "nurture" that influences behavior and health outcomes? Researchers now know these factors are not independent: experience and environment ("nurture") modify genes ("nature") — a phenomenon known as *epigenetics*. Some of these modifications can be passed to the next generation, suggesting it may be possible for our life experiences to affect our children and grandchildren. Recent research finds epigenetics affects normal brain processes — such as development or memory — and abnormal brain processes like depression and disease. Emerging studies in people suggest epigenetics may affect human behavior and be a factor in neurological and psychiatric disease. One example is Rett syndrome, a genetic disorder that almost exclusively affects young girls and currently has no cure, as well as schizophrenia, autism, and Alzheimer's disease. Also, unlike most genetic mutations, epigenetic marks can be reversed. In fact, the U.S. Food and Drug Administration have approved several drugs that work to improve health outcomes by modifying these marks. Many of these drugs were originally identified by cancer researchers, and brain scientists are now working to develop safer, more effective drugs to improve cognitive function and behavior in people — highlighting the importance of collaboration across scientific institutes and disciplines and the powerful potential to apply basic and applied research well beyond its original intent.

*Fear and Post-Traumatic Stress Disorder:* In a given year, about 3.5 percent of Americans suffer from post-traumatic stress disorder (PTSD), a punishing disorder marked by intense fear, anxiety, and flashbacks that follow a traumatic experience. For U.S. military personnel returning from Iraq and Afghanistan, the prevalence of PTSD may be as high as one in five. Until now, there have been few treatment options for PTSD. However, new basic science and clinical research on the biological basis of fear suggests promising new therapeutic avenues. Rat studies determined that those with lesions in a brain region called the amygdala failed to associate a neutral stimulus, like a tone, with a fearful event, like a mild shock. Furthermore, people who had surgery to remove the portion of the temporal lobe that contains

the amygdala, a treatment for some forms of epilepsy, had difficulty learning to associate a flash of light with an unpleasant noise. These findings suggest that fear is a special type of learning and memory.

Rewriting fearful memories or forgetting them altogether might therefore help conquer fears. But as researchers learn how fear memories are encoded in the brain, and as animal research helps to identify new treatments, there may be new therapeutic options. One new treatment is the antibiotic D-cycloserine. This drug activates receptors in the amygdala that are important in extinction. Additionally, drugs called beta blockers are used to treat people with high blood pressure — they stabilize the body's response to a stressor, preventing the fight-or-flight response. A recent human study showed that, when given during recollection of a frightening memory, the beta blocker propranolol reduced fear but did not affect knowledge of an event. Researchers are currently evaluating propranolol's ability to prevent PTSD in trauma patients. These promising results of repurposing existing drugs would not have been possible without basic scientific research, funded largely by the NIH, National Science Foundation, and Department of Defense.

**Economic Impact**

These and thousands of other studies are advancing our understanding of the brain and nervous system, and are translating into potential treatments for patients in the future. Federal investments in scientific research fuel the nation's pharmaceutical, biotechnology and medical device industries. The private sector utilizes basic scientific discoveries funded through NIH to improve health and foster a sustainable trajectory for American's Research and Development (R&D) enterprise. Basic science generates the knowledge needed to uncover the mysteries behind human diseases, which eventually leads to private sector development of new treatments and therapeutics. This important first step is not ordinarily funded by industry given the long-term path of basic science and the pressures for shorter-term return on investments by industry.

Also, these investments contribute to economic growth in hundreds of communities nationwide, as more than 83 percent of NIH funding is distributed to more than 3,000 institutions in communities in every state. Moreover, it will help preserve and expand America's role as leader in biomedical research, which fosters a wide range of private enterprises in the pharmaceutical, biotechnology, medical device, and many others. For example, in FY 2010, NIH investments led to the creation of 487,900 jobs, and produced more than $68 billion in new economic activity – helping 16 states to experience job growth of 10,000 jobs or more at a time when unemployment was otherwise rising.

**Conclusion**

With its rapid growth in countries worldwide, the SfN membership is a metaphor for the extraordinary opportunity and future of neuroscience. Like SfN, the study of neuroscience is growing rapidly, with young people flocking to the field. Tools to study the living brain and to connect brain structure and function to physiology, disease, and behavior give unmatched opportunities for scientists to understand how the brain works. The growth of neuroscience also reflects increased societal recognition of the field's importance. Understanding the brain is vitally important and *urgent* if humankind is to address successfully major challenges facing our society and our world, such as drug addiction, obesity and depression. As populations grow and age, understanding how to enhance human development and performance, and preserve function during aging, are critical to social and economic prosperity.

I also submit that it is vital for this subcommittee to continue to recognize and sustain U.S. leadership in the global scientific arena. Neuroscience, like all fields of science, is an increasingly global enterprise, creating opportunities for both collaboration and competition. Fundamentally, neuroscientists worldwide are motivated to answer the question "*I wonder why?*"— often, they seek to pursue those answers collaboratively, working across borders to tackle large problems with sophisticated technologies and

coordinated sub-specialties. To that end, many countries other than the U.S. demonstrate established and growing scientific excellence in the field, and this is a healthy and very positive trend.

At the same time, for the U.S. there is growing competition for *leadership* in science worldwide, as many nations recognize it will be the foundation for economic prosperity in the coming decades. Over the last century, the U.S. has served as the global pace-setter on investment in science, and leveraged research as a primary engine for economic growth and prosperity, but this leadership is at risk. The U.S. has an opportunity to retain its strong and unassailable leadership in global neuroscience by continuing to invest strongly in biomedical research. An investment in basic research is an essential component for reducing health care spending and improving health care delivery. We now stand at the precipice of an economic disaster because the costs of treating many diseases, such as Alzheimer's, will be astronomical in the next 50 years. Additional scientific research is necessary to develop new treatments and cures, which will produce longer, healthier and more productive lives for Americans and create greater economic growth for our nation.

In conclusion, NIH investments have made it possible for the field of neuroscience research to make tremendous progress to understand basic biological principles and to advance the knowledge and treatments for hundreds of neurological and psychiatric illnesses. However, continued progress can only be accomplished by consistent and reliable support. This year's investment is a building block for success ten, fifteen, even twenty years or more from now.

The administration's budget request for NIH is $30.7 billion, the same amount that was funded last year. This is a welcome start but it is insufficient to maintain the scientific progress and leadership required of the U.S. in the 21st century. This subcommittee knows that a flat budget is a cut, given the rate of inflation. The Society for Neuroscience does not believe that reducing our commitment to research is medically or economically justified. An FY2013 NIH appropriation of at least $32 billion and sustained reliable growth in the future is essential to take the research to the next level in order to improve the health of Americans and to maintain American leadership in science worldwide. Thank you for this opportunity to testify.