Written Statement

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Chairman Culberson, Ranking Member Fattah, and members of the Subcommittee, my name is Steven E. Hyman. I am privileged to offer this testimony in my capacity both as president of the Society for Neuroscience (SfN) and as a Fellow of the American Association for the Advancement of Science (AAAS). I am also director of the Stanley Center for Psychiatric Research at the Broad Institute of MIT and Harvard, and Harvard University Distinguished Service Professor of Stem Cell and Regenerative Biology. I present this testimony in support of increasing the federal investment in neuroscience research.

SfN's mission is to advance the understanding of the brain and nervous system. Given the enormous—and with an aging population, growing—human toll and economic burden of brain disorders worldwide, neuroscience is an area of research in which continued progress is most powerfully needed. Similarly, AAAS's mission is to "advance science, engineering, and innovation throughout the world for the benefit all people." AAAS, led by newly installed CEO Dr. Rush Holt, supports the use of all sciences to improve the lives of people worldwide. On behalf of both SfN and AAAS, I thank you for your past support of neuroscience research.

All told, debilitating neurological and psychiatric diseases strike over 100 million Americans each year. As large as the number of affected Americans is, it does not tell the whole story because brain disorders also exact an enormous toll on caregivers, often removing them from the workforce. According to the Global Burden of Disease study, brain disorders are the largest aggregate cause of disability in the United States. Autism, schizophrenia, epilepsy, mood and anxiety disorders, and many other diseases of the nervous system represent the most common and costly chronic diseases of the young. Alzheimer's disease, Parkinson's disease, and other neurodegenerative conditions are the dreaded and debilitating chronic diseases of later life. Although brain research remains a challenging frontier, recent discoveries and new technologies made possible by federally-funded research are bringing the day closer to when we can restore healthy brain function and thus the ability of affected young people to learn in school and of adults to work effectively.

Consistent and significant support of neuroscience is essential if we are to unlock the full potential of major research advances. Progress has accelerated during the last five years facilitated by new technologies and powerful new computational tools. A central goal of the neuroscience community is to make good on the opportunities coming from basic neuroscience to advance human health. Opportunities have been created by the application of new genomic tools to disabling conditions including intellectual disability, schizophrenia, and multiple sclerosis. Advances in cellular reprogramming and genome engineering have created new possibilities for studying human diseases in a dish, including amyotrophic lateral sclerosis (ALS) and Alzheimer's disease. Optogenetics and other remarkable new methods have opened new frontiers in the study of brain circuitry as have the advances in microscopy that were recognized

by Nobel Prize this past year. The progress being made in neuroscience can be found in institutions from coast to coast. This work would be impossible with the support of a host of federal agencies, most notably the National Institutes of Health (NIH) and the National Science Foundation (NSF).

Federally funded basic research is essential for discoveries that will inspire scientific and medical progress for generations. The work supported by NSF has been central to the development of many of the new technologies that have revolutionized neuroscience research as well as many of the basic discoveries without which applications would not be possible in areas such as health. There are any number of examples showcasing the remarkable creativity and ingenuity of neuroscientists funded by the federal government.

Researchers at Baylor College of Medicine are asking questions at the intersection of spatial navigation, decision-making, and memory to investigate how the brain integrates and makes sense of information coming in from different senses. This research may ultimately aid in the development of prosthetic devices or treating deficits in sensory perception.

At the University of Pennsylvania, scientists are studying the brain basis of language development using songbirds. These birds are a significant model because they learn their precise songs by listening to older birds, with important analogies to how human infants learn language. These researchers employ cutting-edge tools like optogenetics to manipulate the brain activity of birds and understand, with great precision, how the brain learns and how brain activity produces behavior.

One component of the overall federal investment in neuroscience is the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative, a collaborative public-private effort that includes support form NIH, NSF, and the Defense Advanced Research Projects Agency (DARPA). Earlier in my testimony, I emphasized the importance of new tools and technologies to recent progress in neuroscience. Tool building is so important in neuroscience because studying the human brain presents special challenges based on its remarkable complexity and its inaccessibility to direct examination in life. Thus the BRAIN Initiative has wisely chosen as its initial focus the development and use of tools for acquiring fundamental insight about how the nervous system functions. This includes characterizing the enormous number of cell types in the brain and creating maps of brain circuits. Beyond these basic observations, BRAIN looks at new ways to manipulate those circuits in order to understand how brain activity gives rise to cognition and behavior. How is it that individual brain cells work together to produce thought and action? In many cases, we just do not know. To even ask these questions, scientists need to develop new technologies: in molecular analysis of single cells, in brain imaging, in nanoscience, in analysis of huge datasets, and in many more fields. To continue supporting these efforts, the President proposed an increase in BRAIN funding in his FY16 budget. These tools will benefit researchers across neuroscience as well as other scientific disciplines.

The BRAIN Initiative, along with other multi-agency efforts such as the Interagency Working Group on Neuroscience, NSF's Understanding the Brain project, and as previously mentioned, the NIH's support of wide-ranging efforts are critical to the future of neuroscience research.

However, neuroscience research is more than just the sum of these and similar initiatives. NSF, NIH, DARPA and other federal agencies support the nation's best and brightest researchers at the forefront of promising discoveries, graduate students at the start of their careers, and the development of advanced scientific tools and infrastructure that will be broadly available to the research community.

Without a robust, sustained investment – and an end to sequestration – America's status as the preeminent leader in biomedical research is at risk. Other countries are investing heavily in biomedical research to take advantage of new possibilities. While we should commend growing philanthropic investment in research, the private sector cannot and must not be expected to close the gap. The lag-time between discovery and treatments means that the pharmaceutical, biotechnology, and medical device industries rely on the foundation laid by federally-supported basic research to develop products and treatments. The foundation that basic research provides is at risk if federal support declines.

Ultimately, Congress can help make sure that the discoveries made through federal investment are turned into practical applications by funding as much as possible. It's impossible to predict what results will come from an individual study before it's performed. In fact some of our biggest breakthrough discoveries have come from unexpected places. Nobody could have predicted that one scientist's quest in the 1960s to figure out why jellyfish glow would become the foundation for a now ubiquitous tool in cell biology that allows scientists to look at brain cells in unprecedented detail. Technologies based on the resulting green fluorescent protein have proven so transformative that in 2008, a marine biologist, a neurobiologist, and a chemist shared the Nobel Prize for Chemistry for its discovery and application.

In addition to life-altering discoveries, federal investment in neuroscience research supports quality jobs and increases economic activity. In FY 2013, NSF supported research through 10,829 awards, directly involving approximately 299,000 senior researchers, post - doctoral associates, teachers and students. NSF alone has awarded over 46,500 Graduate Research Fellowships since 1952. Many young scientists receive their first grants from NSF on their way to having careers as independently-funded investigators. Without sustained investment, we could quickly lose that leadership, potentially hindering our culture of entrepreneurship and curiosity-driven research for decades. Meanwhile, NIH supports 400,000 jobs and $58 billion in economic output each year. Ninety percent of the NSF budget, and 85 percent of the NIH budget, goes right back to fund extramural research in every state.

Here in Congress, there is an active bipartisan Neuroscience Caucus chaired by Rep. Cathy McMorris Rodgers and Rep. Earl Blumenauer, and includes influential members, such as the subcommittee's Ranking Member Chaka Fattah. Indeed, Rep. Fattah has been a tireless champion for neuroscience including touting both the BRAIN Initiative and the Interagency Working Group on Neuroscience wherever he can, and I thank him for his support. If you are not a member of the Caucus, I encourage you to join its ranks. Finally, I would like to thank Chairman Culberson for his previous support of science and research as well as for convening this panel to discuss the important issues associated with neuroscience research. It is through committees like this taking an interest in neuroscience that we will progress towards the discoveries we searching for.

We live at a time of extraordinary opportunity in neuroscience. A myriad of questions once impossible to consider are now within reach because of new technologies, an ever-expanding knowledge base, and a willingness to embrace many disciplines. To take advantage of the opportunities in neuroscience we need strong support from our federal government. That, in turn, will lead to improved health for the American public and will help maintain American leadership in science worldwide.

Thank you for this opportunity to testify and I look forward to taking your questions.