Written Statement
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Subcommittee on Labor, Health and Human Services, Education & Related Agencies
Appropriations Committee, United States Senate
In support of FY2012 Appropriations for the National Institutes of Health
April 11, 2011

Introduction

Mr. Chairman and Members of the Subcommittee, my name is Susan Amara, Ph.D. I am the Thomas Detre Professor of Neuroscience and Chair of the Department of Neurobiology as well as Co-Director of the Center for Neuroscience at the University of Pittsburgh and President of the Society for Neuroscience. My major research efforts have been focused on the structure, physiology, and pharmacology of a group of proteins in the brain that are the primary targets for addictive drugs including cocaine and amphetamines, for the class of therapeutic antidepressants, known as reuptake inhibitors, and for methylphenidate, which is used to treat attention deficit hyperactivity disorders.

On behalf of the more than 41,000 members of the Society for Neuroscience (SfN) and myself, I would like to thank you for your past support of neuroscience research at the National Institutes of Health (NIH). Over the past century, researchers have made tremendous progress in understanding cell biology, physiology, and chemistry of the brain. Research funded by NIH has made it possible to make advances in brain development, imaging, genomics, circuit function, computational neuroscience, neural engineering and many other disciplines. In this testimony, I will highlight how these advances have benefited taxpayers and why we should continue to strengthen this investment, even as the nation makes difficult budget choices.

Fiscal Year 2012 Budget Request

The Society respectfully requests that Congress provide a fiscal year 2012 appropriation in the amount of $35 billion for NIH. This level of funding will enable the field to serve the long-term needs of the nation by continuing to improve health for the benefit of the American people and the world, advance science, and promote America’s near-term and long-range economic strength. This level will build on the research activities supported under prior year appropriations, enabling neuroscience-related NIH institutions to aggressively fund strategic plans that will significantly advance the understanding of the brain and the nervous system. In so doing, these investments will 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, hospitality industries as well as many others.

SfN hopes that such an appropriation will be the first step on the path to providing a consistent and reliable long-term investment in the NIH and in particular the field neuroscience. This will ensure that there is not a dramatic drop in research activity or a loss of jobs, and serve as an inducement to keeping our young researchers in the training pipeline.

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. Support active and continuing discussions on ethical issues relating to the conduct and outcomes of neuroscience research.

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 ranging from computers to special dyes to examine molecules, nerve cells, networks, brain system, and behavior. From these studies, they learn how the nervous system develops and functions normally and what goes wrong in neurological and psychiatric disorders.

Neuroscience is now a unified field that integrates biology, chemistry, and physics with studies of structure, physiology, and behavior, including human emotional and cognitive functions. Neuroscience research includes genes and other molecules that are the basis for the nervous system, individual neurons, and ensembles of neurons that make up systems and behavior. Through their research, neuroscientists work to demonstrate normal functions of the brain and determine how the nervous system develops, matures, and maintains itself through life. They seek to prevent or cure many devastating neurological and psychiatric disorders.

As the committee works to set funding levels for critical research initiatives for FY 2012 and beyond we need to do more than establish a budget that is “workable” in the context of the current fiscal situation. We ask you to help establish a national commitment to advance the understanding of the brain and the nervous system – an effort that has the potential to transform the lives of thousands of people living with brain-based diseases and disorders. Help us to fulfill our commitment to overcoming the most difficult obstacles impeding progress, and to identifying critical new directions in basic neuroscience.

Brain Research and Discoveries

The power of basic science unlocks the mysteries of the human body by exploring the structure and function of molecules, genes, cells, systems, and complex behaviors. Every day, neuroscientists are advancing scientific knowledge and medical innovation by expanding our knowledge of the basic makeup of the human brain. In doing so, researchers exploit these findings and identify new applications that foster scientific discovery which can lead to new and ground-breaking medical treatments. Basic research funded by the National Institutes of Health continues to be essential to ensuring discoveries that will inspire scientific pursuit and medical progress for future generations. The funds provided in the past have helped neuroscientists make tremendous strides in diagnosing and treating neurological and psychiatric disorders. Due to federally funded research, scientists and health care providers now have a much better understanding of how the brain functions.

As we look ahead to the long-term trajectory for NIH funding, steady, sustainable growth is essential to maintaining a continuous research pipeline that spans from basic science to clinical outcomes. Without a long-term sustainable plan for investing in research, dramatic swings in the funding cycle have a stifling, often irreversible impact on progress, shutting down laboratories, driving away talented young investigators and disillusioning students who have just discovered a passion for biomedical research. As support declines, gaps emerge between levels of funding and the need for scientific advance. There are two kinds of gap — the ones you see and the ones you don't. In times of limited resources, it is easier to deal strategically with the gaps you know. For example, with an aging population it makes sense to maintain support for research on Alzheimer's and other chronic neurodegenerative diseases. But it's the gaps we are unaware of that I also worry about. We know from past experience that it is not always clear where the next critical breakthrough or innovative approach will come from—progress in science depends on imaginative curiosity-driven research that makes leaps in ways no one could have anticipated. Where would neuroscience and cell biology be without a rainbow of fluorescent proteins from jellyfish, which are now illuminating neurological diseases and disorders? Where would cutting edge work in systems neuroscience be today without research on channel rhodopsins from algae, which now hold promise for novel, noninvasive treatments for brain disorders? When resources are limited, balancing support for high-risk high-payoff ideas with disease-driven translational research presents a huge challenge—it is easy to see why the latter is important, yet ultimately both kinds of research have the potential to contribute to the development of life changing therapies and cures for different diseases. More than ever is it important to support and fund research at many levels from the most basic to translational. The following are just two of the many basic research success stories in neuroscience research emerging now thanks to strong historic investment in NIH and other research agencies:

Nicotine Addiction

Although tobacco has been used legally for hundreds of years, nicotine addiction takes effect through pathways similar to those involving cocaine and heroin. During addiction, drugs activate brain areas that are typically involved in the motivation for other pleasurable rewards such as eating or drinking. These addictions leave the body with a strong chemical dependence that is very hard to get over. In fact, almost 80% of smokers who try to quit fail within their first year. The lack of a reliable cessation technique has profound consequences. Tobacco-related illnesses kill as many as 440,000 Americans every year, and thus the human and economic costs of nicotine addiction are staggering. One out of every five US deaths is related to smoking.

Past federal funding has enabled scientists to understand the mechanisms of nicotine addiction, enabling them develop successful treatments for smoking cessation. The discoveries that lead to these findings started back in the 1970's, when scientists identified the substance in the brain that nicotine acted on to transmit its pleasurable effects. They found that nicotine was hijacking a receptor, a protein used by the brain to transmit information. This receptor, called the nicotinic acetylcholine receptor, regulates the release of another key transmitter, dopamine, which in turn acts within reward circuits of the brain to mediate both the positive sensations and eventual addiction triggered by nicotine consumption. This knowledge has been the basis for the development of several therapeutic strategies for smoking cessation: nicotine replacement, drugs that target nicotine receptors, as well as drugs that prevent the reuptake of dopamine have all been shown to increase the long-term odds of quitting by several fold.

More recently, using mice genetically modified to have their nicotinic acetylcholine receptors contain one specific type of subunit, scientists determined that some kinds of receptor subunits are more sensitive to nicotine than others, and because each subunit is generated from its own gene, this discovery indicated that genetics can influence how vulnerable a person is to nicotine addiction. Further research to spot genetic risk factors and to generate genetically-tailored treatment options is on-going. Other studies are also testing whether a vaccine that blocks nicotine's effects can help discourage the habit. Since people who are able to quit smoking immediately lower their risk for certain cancers, heart disease and stroke, reliable and successful treatments are clearly needed. Today's continued research funding can make it possible for these emerging therapies to ultimately help people overcome the challenges of nicotine addiction.

Brain-machine interface

The brain is in constant communication with the body in order to perform every minute motion from scratching an itch to walking. Paralysis occurs when the link between the brain and a part of the body is severed, and eliminates the control of movement and the perception of feeling in that area. Almost 2% of the US population is affected by some sort of paralysis resulting from stroke, spinal cord or brain injury as well as many other causes. Previous research has focused on understanding the mechanisms by which the brain controls a movement. Research during which scientists were able to record the electrical communication of almost 50 nerve cells at once showed that multiple brain cells work together to direct complex behaviors. However, in order to use this information to restore motor function, scientists needed a way to translate the signals that neurons give into a language that an artificial device could understand and convert to movement.

Basic science research in mice lead to the discovery that thinking of a motion activated nerve cells in the same way that actually making the movement would. Further studies showed that a monkey could learn to control the activity of a neuron, indicating that people could learn to control brain signals necessary for the operation of robotic devices. Thanks to these successes, brain-controlled prosthetics are being tested for human use. Surgical implants in the brain can guide a machine to perform various motor tasks such as picking up a glass of water. These advances, while small, are a huge improvement for people suffering from paralysis. Scientists hope to eventually broaden the abilities of such devises to include thought-controlled speech and more. Further research is also needed to develop non-invasive interfaces for human-machine communication, which would reduce the risk of infection and tissue damage. Understanding how neurons control movement has had and will continue to have profound implications for victims of paralysis.

A common theme of both these examples of basic research success stories is that they required the efforts of basic science researchers discovering new knowledge, of physician scientists capable adapting those discoveries into better treatments for their patients and of companies willing to build on all of this knowledge to develop new medications and devices.

The future of American science

Finally, as the subcommittee considers this year's funding levels and in future years, I hope that the members will consider that significant advancements in the biomedical sciences often come from younger investigators who bring new insights and approaches to bear on old or intractable problems. Without sustained investment, I fear that flat or falling funding will begin to take a toll on the imagination, energy and resilience of younger investigators and I wonder about the impact of these events on the next generation. America's scientific enterprise – and its global leadership – has been built over generations, but without sustained investment, we could lose that leadership quickly, and it will be difficult to rebuild. When we undermine a research enterprise—whether a single lab or a national infrastructure built through decades of federal funding—it is a loss to us all and difficult to recover. In the United States—traditionally a pacesetter for strong investment—threatened cuts in science funding jeopardize a global training system that fosters and encourages scientific creativity, flexibility, and enterprise. As a young girl interested in science, I was inspired by the idea that the United States was a place where *anyone* with imagination, drive, and a passion for research could come, learn, and potentially do something great. Without funding, that culture of entrepreneurship and curiosity–driven research could be hindered for decades.

Conclusion

We live at a time of extraordinary opportunity in neuroscience. When I read an exciting research article, I get a sense of awe and pride at the extraordinary progress in our field. A myriad of questions once impossible to consider are now within reach as a consequence of new technologies, an ever-expanding knowledge base, and a willingness to embrace many disciplines. As a result of NIH investments, the field of neuroscience research holds great potential for making great progress to understand basic biological principles and for addressing the numerous neurological and psychiatric illnesses that strike more than 100 million Americans annually. And we have entered an era in which knowledge of nerve cell function has brought us to the threshold of a more profound understanding of behavior and of the mysteries of the human mind. However, continued progress can only be accomplished by a consistent and reliable funding source.

An NIH appropriation of $35 billion for fiscal year 2012 and sustained reliable growth is required to take the research to the next level in order to improve the health of Americans and to maintain American leadership in science worldwide. As a field we look forward to realizing that goal. Thank you for this opportunity to testify.