Response to Senator Paul's "The Festivus Report 2023"

The U.S. National Science Foundation (NSF) has been the backbone of America's science and engineering research enterprise for over 70 years. In fact, NSF is the only federal agency that supports all fields of fundamental science and engineering research and education. NSF invests in cutting-edge research projects — many of which serve as bellwethers for solutions to the myriad complex issues facing society. NSF programs also traditionally integrate research and education, fast tracking innovation excellence via hands-on learning to train our next generation of researchers and innovators.

Each year, NSF competitively awards thousands of grants that collectively advance our nation's scientific capabilities and engage the talents of hundreds of thousands of researchers, postdoctoral fellows, technicians, teachers and students in every field of science and engineering.

NSF is the primary source of federal funding for non-medical basic research, providing approximately 12,000 new awards annually. Through its merit review process, NSF ensures that proposals submitted are reviewed in a fair, competitive and in-depth manner. Competition for funding is intense, with only about one out of four proposals ultimately being approved.

Each proposal submitted to NSF is reviewed by science and engineering experts well-versed in their particular discipline or field of expertise. All proposals submitted to NSF are reviewed according to two merit review criteria: *Intellectual Merit* and *Broader Impacts*. NSF's merit review process is widely considered to be the "gold standard" of scientific review. Perhaps the best evidence of NSF's success is the repeated replication of its merit review model for discovery, education and innovation around the globe.

The results of this process — investing in the best and brightest ideas through competitive merit review — have been profound. NSF-supported research has underpinned multitudinous discoveries leading to new inventions — the Internet, web browsers, Doppler radar, Magnetic Resonance Imaging, DNA fingerprinting, and bar codes — to name a few. These diverse examples underscore NSF's significant contributions to our nation's prosperity, health and wellbeing. NSF-funded discoveries have expanded our understanding of the world in which we live, led to life-saving medical advances, enhanced our national security, improved our everyday lives and yielded insights into the creation of the universe.

NSF's task of identifying and funding work at the frontiers of science and engineering requires keeping close track of research around the United States and the world; maintaining constant contact with the research community to advance the horizons of inquiry; and choosing the most promising people to conduct the research.

The following grant cited in "The Festivus Report 2023" illustrates an example of promising NSF-funded research awarded support through the merit review process.

CAREER: Flexible control of reward-based decisions

NSF Award 1253576

Festivus 2023: “FLASHBACK: The Government Likes Its Gambling Monkeys”

One of the most important and unanswered questions in cognitive neuroscience is how human beings make decisions in an uncertain world. The results of this project advanced the understanding of decision-making and its neural basis.

A better understanding of decision-making has implications for almost every domain of human behavior, from basic job performance to economics. Making effective decisions requires people to draw on their past experiences to predict the outcomes of the various actions they can take in any given situation. Prior studies have suggested that a part of the brain called the dorsal anterior cingulate cortex plays a role in decision-making, but more research is needed to understand how it works. Natural decision-making is extremely difficult to study in a controlled laboratory setting, so it is often operationalized in gambling tasks, wherein observers are asked to “place bets” in various ways based on their predictions. These tasks allow for precise control of prior experience and precise quantifications of the value observers place on particular predictions and have a long and well-established use in the study of decision-making going back decades. Another advantage of these tasks is that they can also be used in non-human primate models, which affords the ability to directly record the electrical activity of individual neurons. These recordings are much more difficult to make in humans and were even rarer and more arduous at the time of this project.

The researchers in this project made expert use of these tasks to elucidate fundamental aspects of how individual neurons track experience to help inform decision-making. In particular, the researchers showed how the dorsal anterior cingulate cortex plays a role in cognitive control, the ability to rapidly change how past experiences are applied to current decision-making in response to changes in the environment. These results advanced the understanding of decision-making and its neural basis, resulting in seven scientific publications. Many of these publications were headed by trainees who have since gone on to post-doctoral and faculty positions where they have continued to have productive careers. The overall project was supported under the Faculty Early Career Development Program (CAREER), that offers NSF’s most prestigious awards in support of early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization.