Response to Senator McCain's "America's Most Wasted: Runaway Spending"

The National Science Foundation (NSF) has been the backbone of America's science and engineering research enterprise for more than 60 years. In fact, NSF is the only federal agency that supports all fields of fundamental science and engineering research and education. NSF supports 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 five proposals ultimately being approved.

Each proposal submitted to NSF—including those deemed "wasteful" and "out-of-touch" in the "America's Most Wasted: Runaway Spending" report (authored by Senator John McCain)—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. Nearly every proposal is evaluated by a minimum of three independent reviewers consisting of scientists, engineers and educators who do not work at NSF or for the institution that employs the proposing researchers.

On average, roughly 50,000 experts share the benefit of their knowledge and give their time to serve on review panels each year. NSF selects reviewers from the national pool of experts in each field, and their evaluations are confidential. NSF's merit review process is considered by some 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 in nations around the globe.

The results of this process — funding the best and brightest ideas through competitive merit review — have been profound. NSF-supported research has underpinned multitudinous discoveries — 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 well-being. 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.

Yet, a simple truth remains regarding fundamental scientific breakthroughs: Before these discoveries were made, these ideas, too, might have been considered novel or outside-of-the-box. Sometimes, based solely on the title of the project, these ideas might have even seemed impractical or inappropriate at first glance. However, if one used project titles instead of merit review to make funding decisions, Google® might not exist today. What was the original name of this search engine when it was funded as an NSF Digital Library project? BackRub.

Technical titles might also easily be misconstrued by anyone but a scientist or engineer versed in technical jargon. For example, a NSF-funded award titled, "Implementation of Maximum Likelihood Decoding for Trellis Codes and Trellis Coded Modulation," actually led to the development of an electronic chip that enables mobile communications worldwide. Who knew "trellis codes" was slang for what would became one of the the most important technologies underpinning global wireless communication, an innovation vital to Qualcomm, a world leader in next-generation mobile technologies? These examples highlight the problem with discarding a project based solely on its title.

Moreover, the ripple effect of fundamental research can rarely be anticipated. Fundamental social and economic research on "game theory" revolutionized the way our nation apportions its airwaves, resulting in $60 billion for the U.S. Treasury derived from spectrum auctions. In this particular case, the link between fundamental research and direct application was unclear — until it offered the Federal Communications Commission a viable solution for partitioning our wireless bandwidth.

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 summaries of the four projects highlighted in "America's Most Wasted: Runaway Spending" illustrate examples of promising NSF-funded research that were awarded support through the merit review process.

Children's Use of Visual Information to Guide Selection and Timing of Motor Behaviors; and Shared Virtual Environments for Studying Social Influences on Risky Cycling and Pedestrian Behavior

NSF Awards 1251694 and 1305131

America's Most Wasted: "$872,164 To Study How Children Cross the Street"

University of Iowa

Crossing the street is one of the first experiences in a child's life where the concept of taking steps to be safe--looking both ways, listening for danger--comes into play. Researchers are looking to learn more about that decision-making process, with ultimate goals that include giving parents information that could help them when they're discussing safety with young children. The risks children face on the road are real: 531,340 people were treated in emergency rooms in 2013 after being injured on a bicycle, according to the National Safety Council.

"America's Most Wasted" mischaracterizes the nature of this award, stating that "NSF spent close to a million dollars to tell us that children take greater risks when crossing the street than adults – something generations of American parents already knew." However, this research was not simply about studying how children cross the street. Rather, the grant is focused on better understanding perception, judgement, and decision making – by examining children's use of visual information to guide selection and timing of motor behaviors.

Most of the data the team has collected focus on children crossing the "street" on bicycles. However, the street and the traffic is actually a computational simulation in a laboratory, allowing behavioral researchers to do the sort of experimental work that would be impossible in the field. Researchers record when children believe it's safe to cross the street--the point at which they think they see a big enough gap in traffic--and how well that matches up to adults' responses. Adults are able to take visual information and fine-tune their physical responses to it in ways children have yet to master. Scientists are still studying why children's visual judgment about when traffic is safe to cross differs from their ability to time their crossing, but they think it may have to do with the cerebellum, an area of the brain that plays a big role in motor control and is still developing during puberty.

This behavioral research is possible due to NSF also providing computational infrastructure funding for the researchers' simulator, known as the Hank Virtual Environments Lab, which can render the correct viewpoint for a person in real-time. When the person speeds up or turns, the virtual world immediately follows suit. This grant has helped to advance the technology for immersive, interactive virtual environments by developing methods to represent full-body movements in avatars moving through large-scale environments, and by studying how the fidelity of avatar movements influences rider and pedestrian interactions.

Dissertation Research: The Nutritional Context of Hunting Decisions in the Bosawas Biosphere Reserve, Nicaragua
NSF Award 0413037
America's Most Wasted: "$10,960 To Study Old, Male Hunting Dogs"
Pennsylvania State University

Ten thousand years ago, all human beings were foragers, who hunted and gathered the food they needed to live. Today, there are very few such people left in the world. Social scientists value the opportunities to study those few who still pursue a hunting and gathering mode of living because this research informs the conditions under which humans evolved physically and socially. This dissertation research award funded 18 months of intensive research on one such indigenous people, who continue to practice hunting small game as an important part of their subsistence in Nicaragua's Bosawas Biosphere Reserve. The Reserve is part of the largest unbroken tract of neotropical rainforest in Central America, north of the Amazon Rainforest.

The results of these studies have been exceptionally valuable. For example, it has been suggested that the reason modern humans have high rates of heart disease, diabetes, and obesity is that our lives are too sedentary. But a careful study of actual foragers has shown that even though they are more active, they don't actually expend more energy. Consequently, although being physically active is important, reducing the number of calories we take in is more important to human health than increasing our activity levels.

The data for the NSF-supported dissertation research also analyzed the importance of food-sharing networks and cooperative behavior to nutritional status. As a small part of this project, the researcher evaluated the role of dogs in hunting success and, thereby, in household access to protein. Because dogs are a domesticated animal, they would not have been available to our earliest ancestors. The goal of this evaluation was to know how much of difference dogs made to the nutritional status of individual households. Contemporary people who still forage for a significant part of their diet can provide important clues about our evolutionary origins, but only if we take into account their different circumstances and resources.

Race and gender stereotyping in evaluative language
NSF Award 1349043
America's Most Wasted: "$125,000 For Feds to Study the Word 'Good' and Other Adjectives"
University of Kansas

This research addresses how evaluative language content varies depending on the gender and race of the person being described, and how in turn others interpret and use that content. In other words, would the language used to describe equally qualified job candidates differ in tone or valence on the basis of whether the individual is part of a stereotyped group? This research has broad implications for understanding bias in real world, evaluative settings.

The language we use to describe people influences who receives access to further education, new opportunities, and even jobs. This research uses actual letters of recommendation for graduate school and examines their content, the credentials and demographics (ethnicity, gender) of applicants, and graduate school admission outcomes.

It is critical to our nation that we identify how unintentional bias may contribute to the underrepresentation of women and ethnic groups in STEM education, which undermines the ability of all talented individuals to pursue STEM careers. For example, consider the case where two students, equally qualified, are applying to graduate programs in STEM. They have similar test scores, grades, and research experience. When writing letters of recommendation for these students, professors would of course take this objective information into account; however, they may also unintentionally use stereotypes about the students' group memberships when crafting the language, describing for example a female student differently than a male student.

If different language is being used to describe similarly qualified candidates, this could disadvantage those from stereotyped groups. It is critically important to understand biases that could in part determine who gets hired in important positions, or accepted into selective programs that determine future employment prospects. The US scientific workforce and economic vitality is dependent on the best and the brightest being able to pursue educational and career opportunities in STEM. It is critical to identify how unintentional bias may undermine the ability of talented individuals to pursue STEM careers.

Indianapolis as a Living Laboratory: Science Learning for Resilient Cities
NSF Award 1323117
America's Most Wasted: "$2.9 Million for Art, Poetry, and Jokes Along Indianapolis Waterways"
Butler University

This research, which explores how people understand and become engaged in the science underpinning critical urban challenges that affect a city's economic vitality and well-being, is part of a collaborative partnership of over 100 public, private, and cultural institutions in and around Indianapolis dedicated to changing the way science knowledge is advanced in communities.

The overall collective effort in Indianapolis is called Reconnecting to Our Waterways (ROW). The premise and significance of ROW is that: (1) urban waterways are vital to a city's well-being, are under threat, and are not well understood by the public, (2) the design and use of urban landscapes can act as important science learning environments and serve many city residents in their neighborhoods, and (3) integrating the arts and sciences in a public space context can foster affective modes of engaging learners, encourage reasoning and learning skills, connect the science content with the culture, and draw on people's interests, prior experiences and learning.

Researchers will generate knowledge about how the public becomes engaged and learns about science via such an interdisciplinary approach, specifically what the public learns about urban ecology and sustainability; the impact of integrating the sciences and arts; the impact on critical thinking skills and on reasoning about urban water resource management; and the impact of multiple learning opportunities on engagement and learning.