Response to Senator Lankford's "Federal Fumbles, Vol. 2"

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

Each year, NSF competitively awards thousands of grants that 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. Each proposal submitted to NSF – including those deemed "wasteful" and "irresponsible" in the "Federal Fumbles" report authored by Senator James Lankford – is reviewed by science and engineering experts well-versed in their particular discipline or field of expertise according to two merit review criteria: Intellectual Merit and Broader Impacts.

NSF has led the way in supporting America's leadership role in the sciences, and provided the public with access to information about research grants through searchable online databases. NSF agrees with the Senator that access to publicly supported research benefits all Americans and promotes the advancement of scientific discovery and understanding as well as transparency and accountability.

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. The following summaries of the projects highlighted in "Federal Fumbles" illustrate examples of promising NSF-funded research that were awarded support through the merit review process.

***Evaluating Mantle and Crustal Processes in Off-axis Volcanism on Iceland***
NSF Award 1550415
***The Calcium and Strontium (radiogenic and stable) isotope geochemistry of weathering in Iceland***
NSF Award 1613359
***Ventilation of Denmark Strait Overflow Water in the Iceland and Greenland Seas***
NSF Award 1558742
***High-amplitude midge fluctuations and the ecosystem dynamics of Lake Myvatn, Iceland***
NSF Award 1556208
***Colonization and Christianity: the development of Viking Age and medieval hierarchies in Skagafjordur, North Iceland***
NSF Award 1417772
***Assessing the Reliability of the Geophysical identification of Early Christian Churchyards and burials in Northern Iceland***
NSF Award 1345066
***Testing Geophysical Prospection and Mapping Methods for Early Christian Cemeteries in Iceland***
NSF Award 1242829
Federal Fumbles: "Icelandic Grave Diggers"
University of Iowa, Northwestern University, Woods Hole Oceanographic Institution, University of Wisconsin-Madison, University of Massachusetts Boston, Field Museum of Natural History

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Senator Lankford's entry titled "Icelandic Grave Diggers" links seven awards that have Iceland as a common research location -- the Senator identified studies in the fields of geological science, ocean science, polar science, earth science, and biological science. The underlying concern is that NSF should fund research in the U.S. or in places where the research will provide a benefit to the American people. However, in contrast to the arguments in the Senator's report, each of these research topics directly impacts American taxpayers.

For example, ***Ventilation of Denmark Strait Overflow Water in the Iceland and Greenland Seas***, aims to quantify how "dense water" is formed north of Iceland by winter storms before flowing southward along the East Coast of the United States as the lower limb of the global ocean circulation. The North Atlantic carries a petawatt of heat from the equator to the Nordic Seas and the Arctic. The warm water exerts a moderating effect on the weather of the eastern United States and Western Europe.

The project ***The Calcium and Strontium (Radiogenic and Stable) Isotope Geochemistry of Weathering in Iceland*** studies how carbon dioxide is removed from the atmosphere during weathering of silicate rocks, which helps to counter-balance increases in $CO_2$ in the atmosphere.

Iceland is a dynamic and geologically active place, home to volcanoes that erupt frequently. The project titled ***Evaluating Mantle and Crustal Processes in Off-Axis Volcanism on Iceland*** examines the chemistry of rocks and minerals to understand the source of some types of magma beneath those volcanoes. Creating improved early-warning and eruption mitigation systems requires the ability to predict not only the timing of volcanic activity, but the area over which it may occur. This study will help develop models to better predict where and how volcanoes might erupt in the future, preventing loss of resources, loss of life, and preventing trans-Atlantic flight disruptions.

***Fish as a Delicacy and a Staple: Social Status and the Daily Meal at the 14th to 16th Century Town of Songo Mnara, Tanzania***
NSF Award 1514486
Federal Fumbles: "Really Old Fish Bones"
Rice University

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This award was provided as part of NSF's Social, Behavioral and Economic Sciences Postdoctoral Research Fellowships (SPRF) program. The goal of the SPRF program is to provide support for promising, early career doctoral-level scientists. SPRF awards involve training under the sponsorship of established scientists and encourage postdoctoral fellows to perform independent research. Each postdoctoral fellow must address important scientific questions that advance their respective disciplinary fields.

This award went to a fellow from a population underrepresented in science. Not only did it provide that fellow with valuable opportunities, it generated benefits that went beyond its immediate recipient. The award allowed the postdoctoral fellow to involve undergraduate students in all aspects of the research, transferring to them STEM research skills that can help them develop their own independent research projects, and potentially their own careers. The beneficiaries of this award gained training and skills in archaeology, analyzing and recording ceramic and zooarchaeological data. The fellow also developed a community outreach program that provided students with the opportunity to develop leadership and communications skills.

The fellow's program was designed in partnership with a local, low-income school to increase participation in science by underrepresented minorities. The research aspect of the award examines fish bone and ceramic fragments from a selection of households representing diverse levels of social standing to explore how variation in food consumption practices is indicative of social status. It highlights how a detailed investigation of regularly consumed food, such as fish in coastal communities, reveals how social interactions and can help form the fabric of a society. The results of this research have broad implications for how we understand the roles social diversity and inequality can play in social mobility.

***Complex Effects of Climate Change on Nature Reserve Networks at Macroscales***
NSF Award 1340812
Federal Fumbles: "Panda Problems"
Michigan State University

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Wise and informed decisions about the human use of natural resources require both adequate and reliable information and the capability to make sound predictions. Nature reserves have been a foundation for conserving important, wide-ranging animals such as buffalo, wolves, bears, and panthers – creatures that require large geographical habitats in order to survive. U.S. conservation strategies are often based on preserving individual nature reserves, which alone may not be adequate for the preserving wide-ranging animal populations. Societal impacts may also limit the effectiveness of conservation reserves by making them less suitable for such animals. This study is the first detailed evaluation of whether a network of reserves could collectively improve species survival and conserve biodiversity.

The system of nature reserves that provide habitat for the giant panda in China is a tractable case of species survival because of already available long-term data, extensive spatial imagery, and the limited number of economic and societal factors affecting conservation. This research project works to develop a theoretical basis and predictive capability for assessing animal persistence and diversity in a network of individual reserves, and the extent to which that network of preserves can enhance species survival while it undergoes environmental change. Moreover, this investigative approach is suitable to nearly all species of similar concern, and the results to date have been impressive. Two years into the four-year project, this study has already produced one book and seven scholarly articles, including an often-referenced article in the journal *Science*.

This research will further scientists' understanding of the links between conservation and the global environment, and will aid natural resource managers in making management choices that will sustain nature reserves and biodiversity for future generations. By adopting the perspective that individual nature reserves are part of a larger interconnected system, managers and conservationists can take a more holistic view of species conservation, in which the suitability of an individual nature reserve can be evaluated within a network that supports the same species.

***Affordable Care Act and the Labor Market***
NSF Award 1459353
Federal Fumbles: "We Already Know That"
University of Pennsylvania

The Affordable Care Act (ACA) presented a major change in U.S. health insurance. Scientific work to test the accuracy of predictions about the ACA's effects only became possible once researchers were able to obtain data on the law's actual effects. This research makes two major contributions to that field of study. Both measure the effects of the ACA on firms, effects that were not considered by the Congressional Budget Office (CBO) or other researchers. The first part of the research measures whether firms have changed the kinds of insurance they offer workers. In the past, firms had an incentive to offer spousal benefits (health insurance to spouses of employees). Economic theory predicts that the ACA could mean firms have fewer incentives to include spouses in employee group health insurance. The second part of the research looks at whether the ACA creates incentives for firms to increase their level of automation in order to reduce the number of low-skilled workers they employ.

The research team is using a cutting-edge method called structural equation modeling to conduct these analyses, a method that was not used by the CBO. Their scientific contribution is to test hypotheses developed from economic theory about how the ACA is affecting U.S. firms. The method has an important second benefit: The completed model provides a method, based on actual experience with the ACA, to predict the effects of possible changes to the law. For example, it will allow economists to give Congress better information about how alternatives to the ACA would affect the U.S. economy.

In the long run, this study develops methods and tools that can be used by other economists, including CBO researchers, to give policymakers better information about how changes in U.S. laws affect not just access to health care, but how firms pay their workers and conduct their businesses.

***A Programmable Network Data Plane for Resource Management in Datacenters***
NSF Award 1526791
Federal Fumbles: “Government-Funded Research for a Billion-Dollar Industry”
Massachusetts Institute of Technology

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Modern science is increasingly driven by large volumes of heterogeneous data. Our ability to store, move, and analyze such data effectively and efficiently is critical to advancing discovery and innovation in all areas of inquiry.

This research project explores and tests a novel networking paradigm capable of managing the movement of large-scale data in order to enable seamless storage and analytics in real time. If successful, this work would support rapid transfer of data across large distances, such as across multiple academic institutions, enabling data-driven discovery in all fields of science and engineering, as well as in key sectors of society such as health, energy, and transportation. While technology companies like Google and Microsoft can benefit from the innovations that may emerge from this project, the fundamental research will greatly advance the academic enterprise.

In addition, this project will help to ensure that the future computer science workforce is knowledgeable and skilled in state-of-the-art networking through the development of undergraduate instructional materials and hands-on educational opportunities.

***Glaciers and Glaciology: How Nature, Field Research, and Societal Forces Shape the Earth Sciences***
NSF Award 1253779
Federal Fumbles: "Glacier Identity Issues"
University of Oregon

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This is a Faculty Early Career Development (CAREER) Program award. CAREER awards support junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations. The award focused on the history of glaciology and glaciers – specifically the nature of how knowledge of glaciers is produced and shared in society, or how that knowledge has changed over time.

Sen. Lankford's report mischaracterizes this award was "research for a paper arguing glaciers should be studied and seen from a feminist point of view." In fact, NSF funded a study that examines the early development and subsequent evolution of five core aspects of glaciology: ice dynamics; ice-ocean interactions; landforms and glacial geology; ice as archive of climatic records; and ice as natural resource. This area of research has received comparatively little scientific analysis, but has potentially great societal value.

NSF did not issue its award to specifically support the paper referenced in Sen. Lankford's report, and the award proposal did not mention a paper on gender and glaciers as a potential outcome. The paper represents one small piece of scientific research accounting for just a fraction of the award's value. The award involved five case studies: the formation of glaciology and theories of ice dynamics; the role of the International Ice Patrol (1913-present) in iceberg analysis and ocean-glacier interactions; the establishment of theories about catastrophic glacial lake megafloods; the Cold War context for ice coring and climatology; and hydrological aspects of glacier retreat. This award supported research that resulted in two books, multiple peer-reviewed journal articles and educational materials. The project also has a number of educational activities that will produce broader impacts for students, the university, and the general public. They include the creation of a Science and Society Group, the foundational step to establishing a Center for the Study of Science and Society at the University of Oregon, the construction of a new honors college course on the history of the earth sciences, as well as the employment and training of undergraduate students and the mentoring of a postdoctoral fellow.

Hundreds of millions of people worldwide live near glaciers, depend on glacier runoff for their water, reside in zones subjected to ongoing glacier hazards, inhabit coastal areas that could be flooded by melting ice sheets, and vacation in glaciated landscapes that hold particular cultural value, such as national parks. In addition, the U.S. Intelligence Community recognizes that the effects of glacier retreat potentially threaten national security.

New research about glaciers and glaciology – such as the work supported by this award – will contribute to policy developments impacting the economy, security and social well-being in the U.S. and around the globe.

***Persistence After Failure: Understanding Neural and Behavioral Responses to Negative Outcomes***

NSF Award 1305994

Federal Fumbles: "Epic Failure"

Rutgers University-Newark

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This award was provided as part of NSF's Social, Behavioral and Economic Sciences Postdoctoral Research Fellowships (SPRF) program. The goal of the SPRF program is to provide support for promising, early career doctoral-level scientists. SPRF awards involve training under the sponsorship of established scientists and encourage postdoctoral fellows to perform independent research. Each postdoctoral fellow must address important scientific questions that advance their respective disciplinary fields. This particular award went to a fellow from a population underrepresented in science.

Success in science, technology, engineering, and mathematics (STEM) often requires persistence through negative outcomes that occur along the way. This research aims to understand how the physiological effects of stress can impair the ability to effectively cope with failure. This award is part of a continuum of NSF research into STEM learning and teaching with the potential to generate economic benefits and spur innovation by enhancing the STEM workforce pipeline.

Results of this research have already advanced science by identifying the distinct neural, emotional, and learning responses that support successfully coping with failure. The research has also revealed that highlighting aspects of failure that one can control promotes adaptive brain and behavioral responses. These findings provide an understanding of how the stress experienced by traditionally underrepresented groups in science and engineering can undermine diversity in STEM. Furthermore, it shows that presenting feedback to students in an effective manner can counteract the effects of stress. Additional research into the brain mechanisms underlying this process may result in improved future training options for STEM education.

Sen. Lankford's report acknowledges that "It is scientifically valuable to know more about how the brain works." This is correct, but the report's subsequent assertion that federal investment should be limited to "areas in which private investment is not available and the funds go directly to a clear medical benefit," appears to demonstrate a misunderstanding of this award, the function of basic research and the funding sources that have allowed basic research to serve for decades as a major driver of the U.S. economy.

The long-term benefits and potential applications of the research are profound. By understanding these factors, scientists and educators may be able to design learning experiences that promote persistence in the face of failure. Knowledge of what neural and behavioral mechanisms contribute to failures in persistence may aid in promoting persistence with goals under stress. But reaching that point – and yielding the benefit of a larger, stronger STEM workforce – requires investment in basic, foundational research.

***Transfer of Learning from Touchscreens During Early Childhood***
NSF Award 1023373
Federal Fumbles: "Breaking News: Kids Learn With Technology"
SUNY Binghamton

The goal of this project was to address an important question: Why is learning that occurs via technology less effective than learning in the presence of a live model when the learner is less than 3 years of age? When this grant was funded, no one yet knew why young children's learning from technology is inferior to their learning from live models, and there were not even any good theories in place to explain this deficit. The proposal was funded to address these holes in our knowledge. In contrast to what the Senator suggested, it was not to address "the appropriate balance between learning from technology…and traditional, interactive classroom-style learning." The goal was not to establish what might be best for children, but to address questions about how children learn.

Of course, once we understand how children learn – and why they learn better in some situations than others – parents and teachers can likely use that information by to enhance children's cognitive development, and perhaps ultimately improve their performances in school. As such, this information has the potential to be extraordinarily valuable. It could influence policy, ultimately producing positive effects across society as children benefit from adults' use of more appropriate teaching methodologies.

In addition to helping to explain why media exposure can have both positive and negative effects on children's development, the work undertaken was expected to contribute to general theories of the development of learning and memory. Far from simply providing parents with simplistic rules about how to balance children's exposure to technology with their exposure to social interactions (or generating a simple statement about the best way to use technology to educate children) this study was designed to further our understanding of how children learn from various sources and why some sources are more effective in certain cases. By utilizing innovative methodologies to address these profoundly important but complex questions, the investigators awarded this grant were able to produce results that promise to yield deep insights that would not have been forthcoming otherwise. Deeper understandings of the mechanisms that lead to learning in early childhood could potentially transform the nature of educational instruction itself.

***Russia, Ukraine and The Dynamics of Public Attitudes Towards U.S. and Global Security***
NSF Award 1443216
Federal Fumbles: "What Does it Cost to Discover Americans Don't Like Russian Aggression"
University of Texas-Dallas

This study was funded during a period where U.S. national security was potentially threated by Russia's military intervention in the Ukraine. The principle investigators maintained an ongoing panel survey in the United States, the United Kingdom, and France. With NSF support, they could use that instrument to study how the U.S. public reacts to the deepening crisis over Russia's and potential future actions. The study would allow one to see how the opinions of individual members of the U.S. public vary over time. In addition, it could allow researchers to start to tease out the factors that influenced public opinion. The research would allow for comparisons between U.S. public reaction compared to the U.K. public and the French public, thanks to complimentary surveys in those countries funded by the U.K. Economic and Social Research Council.

People have long wondered about the link between a nation's internal factors and how its public views international crises. Researchers, for example, have long known about a "rally around the flag" effect that occurs when U.S. public support rises for military action when the public feels that the U.S. has been attacked. Likewise, scholars have noted that as casualties among U.S. participants increase the popularity of the conflict decreases. However, it is difficult to say much beyond that. Most surveys, such as those ran by Gallup, report only aggregate percentages. In addition, these surveys usually do not provide the data at an individual level, or interview the same people over a period of time.

The survey from this NSF-supported research includes an examination of how people's opinions about a crisis change over time. The data it produces and releases will be at the individual level, allowing users to examine how factors such as religious affiliation, gender, economic status, education attainment and employment status can impact people's opinions about the crisis. The team will make all of this data available to other researchers at this same level of analysis. Analyses of the United States data can be repeated on the data produced by the U.K. and France to see if they show similar causal factors.

Many domestic factors affect American foreign policy, and the foreign policies of other nations. This study could help researchers further understand what individual factors affect a person's opinions on certain types of foreign policy, and whether those factors are universal. This will help policymakers better understand possible choices of other countries with regards to these types of crises as well as when it might be advantageous for the U.S. to take a hard line against some countries and when it might be disadvantageous to do so.

***The Responsibility of Judges to Assure Due Process: Tension Among Neutrality, Rights Protection, and Role***
NSF Award 1456772
***The social psychology of judicial decisions affecting stigmatized groups***
NSF Award 1543826
Federal Fumbles: "How Does That Ruling Make You Feel?"
Barnard College, University of California – Santa Barbara

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Sen. Lankford's report acknowledges the importance of Americans' confidence in a neutral and fair court system – a topic which requires research into people's perception of the courts – but includes the misleading assumption that the research would "judge the neutrality and fairness of American courts by only one court." The goal of these awards, as with much fundamental scientific research, was not to make broad judgements, but to generate data, information and analysis that could help lead to advances within a field of research. The knowledge gained from this research will advance our understanding of the effects of historic government-level decisions.

One of the studies referenced in Sen. Lankford's report involves a recent ruling by the U.S. Supreme Court – Turner v. Rogers– which obligated judges to be especially engaged when ensuring that all parties, including those individuals who represent themselves, have the necessary base legal knowledge to ensure a fair hearing in all settings, as required by the U.S. Constitution.

This research project examines the efficacy of training of judges to enhance their ability to subsequently impart essential legal information to parties appearing before the bench, and to do so without jeopardizing the appearance of impartiality and fairness required of the judiciary. The study was especially interested in the question of how judges might effectively engage with the greater needs for such information of those many individuals who represent themselves in the most utilized court settings, such as parents in child custody hearings and tenants in eviction cases. The findings from this study have the potential for direct benefits to the court systems, as they were to be incorporated into the continuing education programs of judges and attorneys.

The other study referenced involves the well-documented disadvantages minority groups face, due to discrimination and stigma. Minority group membership often serves as a source of chronic stress, with known negative consequences for health, productivity, education, and prosperity. On occasion, however, societal events that support the goals and identities of group members can reduce the stigma associated with minority group membership. The goal of this research is to study the psychological consequences of one such event. In June of 2015, the Supreme Court of the United States ruled in favor of same-sex marriage – Obergefell v. Hodges. Although research has examined the structural implications (economic, educational, healthcare, legal) of high profile judicial decisions for members of stigmatized social groups, very little work has studied the psychological consequences. Anticipating this court ruling, investigators conducted a longitudinal study of over 1,000 gay, lesbian and heterosexual individuals one month before the ruling, and again two months and 10 months after. The research focuses on outcomes relating to mental and physical health, perceptions of discrimination, attitudes, and social identity.

***NSF IG Audit Report No. 16-1-004***
Federal Fumbles: "$1K Custom Snuggies!?"
University of Washington

Each federal agency has an Office of Inspector General (OIG) that provides independent oversight of the agency's programs and operations. The office is responsible for promoting efficiency and effectiveness in agency programs and for preventing and detecting fraud, waste, and abuse. The National Science Foundation (NSF) OIG conducts financial audits of NSF's awards and awardee institutions to determine whether costs claimed by awardees are allowable, reasonable, and properly allocated. Such audits also seek to identify uneconomical practices that may be modified so that funds can be used for other purposes that taxpayers consider more important.

Sen. Lankford highlights the findings of the NSF OIG audit of the University of Washington's sponsored agreements with NSF during the period April 1, 2010 to March 31, 2013. This provided an audit universe of approximately $296 million, in more than 731,000 transactions, across 1,207 individual NSF awards. Of the $296 million in the universe, the OIG audit questioned $2,003,109 of costs claimed on 140 NSF awards because the University of Washington did not comply with federal and NSF award requirements.

The OIG specifically questioned costs related to, among other things, senior personnel salary charges, unreasonable equipment, materials, and supplies expenses, and unallowable meal expenditures. NSF and the University of Washington have worked to develop a mutually agreeable resolution to the audit findings -- the audit is not "closed" until NSF determines that all recommendations have been adequately addressed by the University, and corrective actions satisfactorily implemented.