



# Bringing People Into Focus

How Social, Behavioral and Economic Research  
Addresses National Challenges



National Science Foundation

“Bringing People Into Focus: How Social, Behavioral and Economic Research Addresses National Challenges” was produced and published by the National Science Foundation Office of Legislative and Public Affairs (OLPA).

**Editor:** Craig Fisher

**Contributors:** Neysa Call, Lee Herring, Trinka Kensill, Gwen Morgan and Christina Bartlett-Whitcomb, with thanks to the staff in the Directorate for Social, Behavioral and Economic Sciences (SBE) for their review and feedback.

**Design:** Adrian Apodaca

**References:**

National Science Board, (2012). *Science and Engineering Indicators 2012*. Arlington, VA: National Science Foundation (NSB-12-01).

National Science Board, (2012). *Science and Engineering Indicators Digest 2012*. Arlington, VA: National Science Foundation (NSB-12-02).

**Additional Resources:**

*Rebuilding the Mosaic: Fostering Research in the Social, Behavioral, and Economic Sciences at the National Science Foundation in the Next Decade* (2011). National Science Foundation, Directorate for Social, Behavioral and Economic Sciences. Arlington, VA. (NSF 11-086).

*Social, Behavioral and Economic Research in the Federal Context* (2009). National Science and Technology Council; Subcommittee on Social, Behavioral and Economic Sciences.

# Bringing People Into Focus

How Social, Behavioral and Economic Research  
Addresses National Challenges

# INTRODUCTION

---

The National Science Foundation (NSF) is the nation's preeminent federal agency that funds basic science and engineering (S&E) research across all disciplines. For more than 60 years, NSF has been a significant catalyzing factor that has figured prominently in improving everyday life for millions of Americans and people around the globe.

Central to that effort is NSF's research portfolio in the social, behavioral and economics sciences. NSF's Directorate for Social, Behavioral and Economic Sciences (SBE) funds more than half of the university-based social and behavioral science research in the nation, basic research that offers unique contributions to many areas impacting human behavior, society and survival. This publication brings people into focus by highlighting human elements through examples of basic SBE research that address critical national needs.

Space limits this publication to only a few representative examples from SBE's broad portfolio. They draw on all areas of science, at times in conjunction with other federal agencies, demonstrating the integrative, collaborative and interdisciplinary nature of SBE research NSF funds. From improving evacuation plans during natural disasters to expanding access to vital services, and from evaluating the experiences of our returning veterans to understanding the value of good teachers, SBE research has a proven track record of making us healthier, safer and more secure.

We live in extraordinary times, benefiting from unprecedented discovery and innovation. The complexities of national needs escalate with the pace of globalization and communication. As our population expands and becomes more diverse, our quality of life increasingly depends on understanding human factors that can better sustain our environment, prevent illness, maintain a robust economy, curtail conflict and advance democracy. Supporting the best and brightest scientific minds in the social, behavioral and economic sciences is imperative to these goals, enabling the nation and our fellow citizens to address the grand challenges facing our society.

# TABLE OF CONTENTS

---

**THE BASIC RESEARCH SUPPORTED BY NSF'S SBE DIRECTORATE FORMS THE NATION'S BEDROCK OF FUNDAMENTAL KNOWLEDGE ON HUMAN BEHAVIOR, INTERACTION, SOCIAL AND ECONOMIC SYSTEMS, ORGANIZATIONS AND INSTITUTIONS.**

**SBE Organizations**

**Behavioral and Cognitive**

**Sciences (BCS)** develops and advances scientific knowledge about humans, spanning brain and behavior, language and culture, origins and evolution, and geography and the environment.

**Social and Economic Sciences (SES)**

enhances our understanding of human, social and organizational behavior by building social science infrastructure and by developing social disciplinary and interdisciplinary research projects that advance knowledge in the social and economic sciences.

**National Center for Science and Engineering Statistics (NCSES)**

collects, interprets, analyzes and disseminates objective data on the U.S. science and engineering enterprise.

**SBE Office of Multidisciplinary**

**Activities (SMA)** supports multidisciplinary research that cuts across SBE divisions.

---

Introduction	i
Responding to Disasters	2
Improving Public Health	4
Optimizing the Use of Vital Resources	6
Defending Our Nation	8
Informing Human Sustainability	10
Strengthening the Legal System	12
Understanding the Brain	14
Improving International Relations	16
Providing Crucial Data for the Nation	18
Honored SBE Researchers	20

# RESPONDING TO DISASTERS

*The costs associated with natural and man-made disasters have risen to hundreds of billions of dollars per year in the United States. NSF-supported research is improving our ability to make informed decisions about prevention, preparedness, response and recovery in the face of these hazards, thus protecting our population and the economy.*



## Improving Hurricane Evacuations

Hurricanes are a unique type of severe weather event in that their progression can be tracked over the course of several days. When state and local governments decide to issue evacuation orders in the face of such events, the patterns of compliance can provide important information regarding personal well-being and public safety.

Hurricane Ike resulted in 195 people killed and over \$37 billion in damage. Researchers Susan Weller of the University of Texas Medical Branch at Galveston and Roberta Baer of the University of South Florida investigated the many reasons given by residents of Galveston Island, Texas, for compliance or noncompliance with the mandatory evacuation order issued on September 11, 2008, as Hurricane Ike approached.

Estimates indicated that approximately 40 percent of the City of Galveston did not evacuate. Of those, many cited traffic concerns as a major factor, recalling recent experiences with Hurricane Rita when some were stuck in traffic for up to 30 hours. Those who did evacuate also reported concerns about intense traffic. Other reasons people did not evacuate included extremely rapid and heavy storm surges, as well as fast-rising water that flooded roads and trapped residents. Some were also released too late from their jobs or were too exhausted from protecting their homes from the storm. While many people who planned to evacuate were unable to do so, others deliberately stayed behind to ride out the storm, evidencing the local hurricane culture. Thus, effective evacuation strategies need to consider unique cultural factors as well as residents' previous experiences.



## In the Aftermath of Katrina

During the last week of August 2005, Hurricane Katrina devastated the U.S. Gulf Coast, resulting in over 1,800 lives lost and over \$100 billion worth of damage. Due to the breaching of levees, intense flooding and collapse of the region's infrastructure, hundreds of thousands of residents were evacuated and relocated throughout the United States.

Katherine Browne and colleagues at Colorado State University conducted interviews with a large network of an extended African American family who were relocated to a military base outside of Denver. The researchers found that these extended cultural family networks (including immediate and extended family, and friends so close they are regarded as family) were often divided, which added to stress due to the disruption of social support, traditions and cultural rituals unique to New Orleans. Recovery models for response agencies and aid groups were reported to focus more on immediate families than extended networks, which heightened stress levels and increased difficulties faced by evacuees. Thus, future relocation and housing efforts should strive to preserve these crucial extended family ties.



Two years after Katrina hit, many of the Denver evacuees still did not consider themselves adjusted or settled. Of those who returned home to New Orleans, most were still living in government-provided trailers, coping with financial loss and destruction of their homes, as well as facing significant mental health concerns.

The subsequent NSF-supported documentary “Still Waiting: Life After Katrina” was broadcast on public television across the country in 2007 and every year since then on the anniversary of the hurricane.

## Perception of Danger in Tornado Alley

In mid-April 2006, at least 54 tornados were recorded in several Midwestern states including Iowa, Illinois and Indiana. These tornados caused approximately \$25 million in damage, and resulted in dozens of injuries and one fatality.

To assess the reaction of residents following this disaster, Jerry Suls and colleagues at the University of Iowa explored the perceived risk of being impacted by tornados in the future. Surprisingly, a year after the tornado, residents (including those who lived in an impacted area) estimated a lower probability of experiencing a tornado-related injury in the future when compared to people living in an unaffected area. Their gut-level expectations about future tornadoes also differed from their estimates of the statistical probabilities of future tornadoes. However, residents with frequent exposure to damage in the aftermath were more realistic in their risk assessment, suggesting limits to unrealistic optimism.



The researchers likened this unrealistic optimism to a phenomenon referred to as the Gambler's Fallacy: When an unexpected event occurs such as a tornado, expectations for future events shift in the opposite direction (in this case, decreases) in spite of awareness of true risk.

# IMPROVING PUBLIC HEALTH

*Exploring the impact of social networks, interpersonal relationships and environmental factors, NSF-supported research is advancing our understanding of health-related decisions by individuals and policymakers.*



## Limiting the Spread of Infectious Disease

Recent outbreaks of swine flu and avian flu, coupled with seasonal influenza, demonstrate the necessity of managing the threat of pandemics. New technologies now allow researchers to better understand the nature of social structure as it impacts the spread of infectious disease.

James Holland Jones and Marcus Feldman of Stanford University investigated methods to prevent the spread of flu-like infectious disease in school settings. Every student, teacher and staff member of one high school was outfitted with a credit card-sized wireless sensor to monitor contact for one whole school day and model social networks. The resulting models simulated how influenza infection would spread through the community based on real-world contact. The models also allowed researchers to explore strategies for efficient disease management such as vaccinations and school closings.



Most vaccination strategies were no more effective than random vaccinations in preventing the spread of disease. However, social distancing strategies in which schools were intermittently closed (e.g., two days open, two days closed) interrupted the contact network, and were nearly as effective as a complete three-week school shutdown. These findings provide useful insight for school administrators and public health officials into the development of effective prevention strategies.



## Controlling the Mosquito Population

Mosquito-borne illnesses pose a significant health risk in the United States and around the world. For example, the rates of West Nile virus in humans has been steadily increasing since appearing in the United States in 1999. Understanding conditions that impact mosquito populations is central to developing control strategies.

Paul Robbins and colleagues at the University of Arizona investigated the complex interactions among human institutions (health and water departments, state and local governments), climate and available water sources on mosquito populations in several U.S. cities. Surprisingly, computer simulations, which projected warmer, drier conditions, did not predict a decrease in mosquitoes. They appear highly adaptive to drier climates and are able to rely on permanent water sources such as irrigation systems in order to thrive.

The research confirms the broad adaptability of mosquitoes to a variety of changing environmental conditions. It also reinforces the need for agencies that deal with mosquito hazards and public health to collaborate and adapt their management strategies to meet shifting conditions regarding mosquito breeding sites, location of adult mosquitoes and seasonal patterns of mosquito appearance.



## Social Networks' Impact on Vaccination Decisions

Vaccinations play a vital role in providing immunity to preventable diseases such as measles and chicken pox. Understanding parents' decisions regarding whether or not to have their children vaccinated is also important due to the resurgence of diseases such as pertussis (aka whooping cough).

Bettina Shell-Duncan, Emily Brunson and colleagues at the University of Washington investigated factors that impacted parents' decisions about vaccinations. They evaluated how first-time parents obtained information and advice from people in their network, and from other sources such as websites and books. The single most important factor in parents' vaccination decisions was the percentage of people in their network who recommended non-compliance with guidelines for complete, on-time vaccinations. Networks played a more significant role than did parents' own opinions about the merits of vaccination.



These findings emphasize the need to understand the significance of social networks in how parents make important medical decisions, especially given the emphasis put on social network members above other informational sources such as the internet, books and journal articles.

# OPTIMIZING THE USE OF VITAL RESOURCES

Applying methods from the field of economics to topics ranging from public health to communication to education, NSF-supported research is helping answer questions about a wide range of important problems not commonly considered to be economic issues.



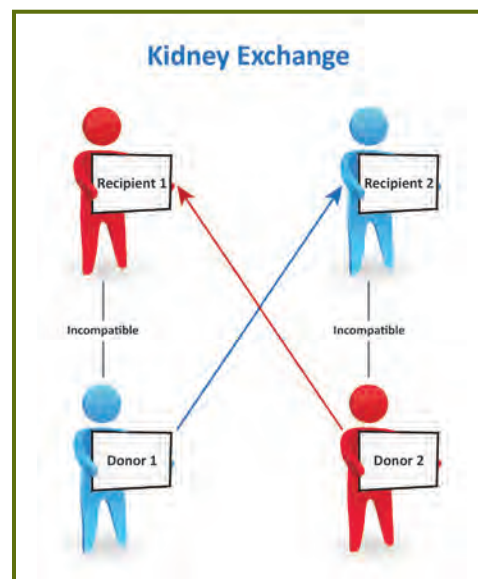
## Streamlining Kidney Transplant Exchanges

More than 65,000 kidney transplants are conducted each year. Finding suitable kidney donors for those in need of a transplant has long been a daunting challenge for both anxious recipients and the medical establishment.

To address the high demand for kidneys and the challenge of finding a donor, economists have developed algorithms to facilitate kidney matching for patients who have willing but biologically incompatible donors. Based on their knowledge in game theory and market dynamics, Alvin Roth of Harvard University, Tayfun Sönmez of Boston College and M. Utku Ünver of the University of Pittsburgh developed powerful match-making software that optimizes the process of identifying an appropriate live donor match with compatible blood types and antibodies.

This system creates kidney exchanges that match an incompatible donor-patient pair with a similarly incompatible pair so that each of the patients receives a kidney from a compatible donor. The medical programs that use this software have already saved many lives nationwide. The researchers are now investigating the increased efficiency between two-way and three-way matches, as well as more extended transplant chains.

Alvin Roth was a co-recipient of the 2012 Nobel Prize in Economic Sciences for his research on the practical applications of matching theory.



## Auctioning the Airwaves

NSF-supported researchers provided the Federal Communications Commission (FCC) with its current system for apportioning the airwaves via a fruitful, practical application of game theory and experimental economics. Since their inception in 1994, FCC “spectrum auctions” have netted over \$60 billion in revenue for the federal government.

As wireless communication blossomed in the early 1990s, the FCC received a concomitant increase in requests to use the limited commercial frequencies of the electromagnetic spectrum. The upsurge rendered the FCC’s lottery-based licensing method inadequate, but economists Paul Milgrom and Robert Wilson of Stanford University, and collaborator Preston McAfee had a solution: an auction system based on their research.



The team’s NSF-funded studies had already documented conditions under which the proposed spectrum auction was expected to perform well, and experiments in NSF-supported labs run during the FCC’s decision-making process provided additional evidence that the new system surpassed the proposed alternatives. The U.S. system of partitioning airwaves is now emulated in several other countries around the world, resulting in total worldwide revenues in excess of \$200 billion.

## The Value of a Good Teacher

Everyone remembers the teachers they considered good or bad during the course of their academic education. However, there is disagreement about how to measure the quality of teachers, as well as how to quantify the economic impact they have on students’ lives.

Raj Chetty and John Friedman of Harvard University and Johah Rockoff of Columbia University investigated the value of good teachers, defined as those who have the biggest impact on students’ standardized test scores. By tracking the performance of 1 million elementary-school



students across grades three through eight, and using public records to follow these students after high school, the researchers found good teachers indeed have a significant impact. Replacing a poor teacher with even an average one provides each student an extra \$52,000 in cumulative, lifetime earnings. This equates to \$1.4 million per classroom. The effect of good teachers on long-term earnings is so dramatic that paying to switch a child from a class with a below-average teacher to an above-average teacher, even for a single grade, can make economic sense.

This large-scale research project demonstrates that good teachers have positive, long-term impact beyond the classroom, extending years into the lives of students. Thus, good teachers have the ability to improve academic outcomes, strengthen American society and grow the nation’s economy.

# DEFENDING OUR NATION

*Understanding reactions to terrorism, addressing areas of potential vulnerability, elucidating efficient safety procedures and assessing the experiences of our veterans, NSF-supported research contributes to the security and well-being of the United States, its military and its citizens.*



## Understanding Nonverbal Communication Across Cultures

The ability to express and perceive emotion is a crucial component to communication. Errors in emotion recognition can not only lead to disruptions in communication, it can be a sign of neurological or psychological impairment. In military situations, when communication often occurs across cultures, the impact of such errors can be disastrous. For example, uncertainty about whether or not a civilian wishes you harm can needlessly and dangerously escalate an otherwise benign situation.

Hillary Anger Efenbein of Washington University in St. Louis and collaborators investigated emotion recognition using nonverbal cues such as facial expressions, vocal tones and body language. Based on this research, the Army Research Institute now incorporates education on nonverbal communication into soldier training, thereby assisting troops in understanding cross-cultural, nonverbal communication with non-English speaking citizens with whom they interact overseas. Thus, this research has the potential to provide human solutions in military situations. Enhancing troops' interpersonal skills can enable them to anticipate and diffuse conflict, as well as facilitate cooperation, negotiation and compromise.



## Assessing the Impact of Military Service on Our Returning Veterans

With over 200,000 individuals currently separating from military service each year, a growing number of veterans are faced with readjusting to civilian life. In order to understand their post-service experiences, Jay Teachman and colleagues at Western Washington University completed a series of research projects that studied the employment, health and family life of veterans of World War II, the Vietnam War and the more recent all-volunteer military era.

Across a number of Teachman's studies, some important patterns emerged. Veterans experience initial disadvantages in educational and occupational trajectories compared to civilian peers. These gaps tend to diminish over time but they also vary significantly by branch, length of service and demographic group. Active-duty veterans suffer worse than expected physical health when compared to reservist and civilian peers, even when considering factors such as smoking and alcohol consumption.

By contrast, noncombat, active-duty veterans experience better mental health than nonveterans and reservists, although the differences are less apparent after military discharge. Active-duty members of the military are more likely to choose marriage over cohabitation compared to their reserve duty service member, veteran and civilian peers, and these marriages tend to be more stable when compared to similar civilian populations.

As more young men and women return from military service, it is essential for groups such as military policymakers, employers and health care providers to understand these consequences of veterans' experiences.



## Ensuring the Safety of Our Ports

Protecting U.S. ports from potential terrorist attacks and large-scale industrial accidents requires comprehensive knowledge of the wide variety of goods and commodities, such as gas and oil, which pass through our nation's transportation hubs. The safety of shipping traffic along the nation's waterways, which are often located near major urban centers, is equally important.

To ensure the safety of these complex systems, a reliable process to inspect the millions of shipping containers that pass through U.S. ports each year is required. While several types of tests are available to inspect cargo and detect dangerous or illicit substances, including nuclear materials, developing a system that maximizes inspection efficiency while minimizing costs is a challenge.



Researcher Fred Roberts and colleagues at Rutgers University considered these factors in developing new algorithms to improve port safety. These algorithms identified optimal decision-making for shipping container screening by analyzing types of inspection tests and shipping manifests. These tools not only have the potential to increase cost-effective methods of hazardous materials detection, they also can benefit decision-making in other areas such as public health.

# INFORMING HUMAN SUSTAINABILITY

*Examining the interactions among human social behavior, cultural factors and natural resources, NSF-funded research is providing us with a better understanding of how to create a sustainable future for an expanding human population in the modern world.*



## Maintaining Our Seafood Supply

The U.S. commercial fishing industry is an important component of our nation's food system. Unfortunately, not all sections of this industry are faring equally well. James Acheson and colleagues at the University of Maine conducted research on lobstermen to explore an industry that succeeded by adopting sustainable fishing practices.

A historical review showed a significant cultural shift by Maine's lobster industry. In the 1930s, lobstermen operated under a gold rush mentality, taking as many lobsters as possible in the face of a decreasing stock.

However, this practice depleted the lobster supply. In response to the severely damaged lobster stock, lobstermen instituted new practices such as preserving egg-bearing female lobsters, setting trap limits and increasing enforcement. Thus, the lobstermen collectively adopted a conservation ethic that resulted in increased catches in the long term due to their taking fewer lobsters in the short term. Hence, their behaviors resulted in a more sustainable industry over the past 65 years.



Subsequent computer simulations modeled the contrasting fishing scenarios of collaboration versus self interest. The models supported the historical review of the lobster industry's cultural shift. The lobstermen were more cooperative, exhibited less self interest and acted more to promote the common good. This research illustrates the value of effective sustainability practices combined with forward-thinking public policy.

## Making Water Last in a Desert City

Making decisions about how to manage the water supply in the Western United States, an area that is already short of water, presents critical challenges due to an expanding population, increased demands on land and water use, and expectations of a warmer and drier climate in the coming decades.

In order to inform public policy for water sustainability, Patricia Gober and colleagues at Arizona State University developed WaterSim, simulation software designed to research water planning solutions for the Phoenix area. WaterSim models the impact of various water availability factors, including supply of surface water and groundwater, as well as consumption through commercial, residential and agricultural use. Using this interactive tool, researchers hope to better understand the implications of factors such as population change, climate scenarios and policy choices, including options such as recycling water. Rather than searching for a single, best water sustainability solution, this integrative approach balances behavioral choices against a wide range of resource availability scenarios.



Thus, WaterSim can provide policy insight by looking at interactions among social systems and the natural environment, and allow for enhanced engagement between scientists, water managers and government officials.

## Coal Miners Team Up to Ensure Safety

The U.S. coal industry underpins our nation's energy economy. Ensuring the safety of our nation's coal mining workforce not only protects workers well-being, it enhances productivity and efficiency. To that end, Jessica Smith at the University of Michigan studied the relationships among members of mining teams and the impact of teams on safety procedures.

Coal mining teams are bonded so closely that they consider themselves family. Because of such strong ties, miners feel obligated to comply with safety procedures. Due to their closeness, however, teams prefer to handle safety violations internally rather than formally report violations to management, which can result in an official audit of an individual as well as disciplinary action.



Miners also viewed their informal procedures as significantly better for safety, in part, because the procedures are more likely to be followed, compared to management-driven safety procedures that are viewed as impractical. Subsequently, management decided to implement more behavior-driven safety programs developed through actual practices of the miners, based on their unique level of closeness and the knowledge of what works in real-world settings.

# STRENGTHENING THE LEGAL SYSTEM

*Conducting research on the connections between laws, legal processes and human behavior, NSF-supported research is bolstering the effectiveness of the criminal justice system by providing insight into the functioning of law enforcement and the courts.*



## Understanding the Decision to Shoot

When is the use of deadly physical force justified? How do people make split-second, life-and-death decisions, especially when holding a gun? Jessica Witt and colleagues at Purdue University investigated factors that influence the decision to shoot.

In a shooting simulation, participants holding a toy gun or neutral object faced off with images of people also holding either a gun or a neutral object. Participants holding the gun were more likely than participants holding a neutral object to think the person in the simulation was also holding a gun. Thus, the action of actually holding a gun

influenced the perception of whether others were or were not holding a gun, biasing subjects in the direction of seeing guns. Even when a real gun was present in the testing area, it had no effect on perception. The results demonstrate that visual perception, and subsequently the decision to shoot, does not depend solely on whether or not another person is actually holding a gun.

Thus, context matters: When someone holds a gun, they are more likely to perceive others as holding a gun and to perceive nonthreatening objects as being a gun, even when a gun is not actually present. This research reveals important patterns about how people assess risks and make decisions in the real world, especially in law enforcement and public safety situations.





## Tracking Sex Offenders

No one would choose to risk endangering their family by living or attending school near a registered sex offender. However, monitoring the location and movements of sex offender residences provides many challenges for federal, state and local lawmakers. While there is strong public concern for limiting the presence of sex offenders in the community, little evidence exists on the optimal way to integrate community sentiment and public policy.

Tony Grubestic of Drexel University, William Pridemore of Indiana University and Alan Murray of Arizona State University developed spatial models to help manage the location of sex offenders. Their research addressed concerns regarding the impact of sex offender residency laws on a community, as their end results are often unknown. They considered important factors such as whether residency restrictions lead to high concentrations of offenders in specific areas, distribute the risk across a community equitably, and keep sex offenders from living near minors. These modeling techniques can provide legislators, law enforcement and public policy officials with the unique ability to make informed decisions about new policies prior to their actual implementation.

Thus, improving the development and evaluation of sex offender residency policies in advance of any legislation will allow public officials the opportunity to consider the resulting distribution of offenders in terms of local residents, better meeting the needs of communities.



## Improving Child Eyewitness Testimony

Children's courtroom testimony plays an important role in legal proceedings in cases of child abuse. Children's disclosures, statements and descriptions of events can sometimes be the deciding factor in how juries assess defendants' guilt or innocence.

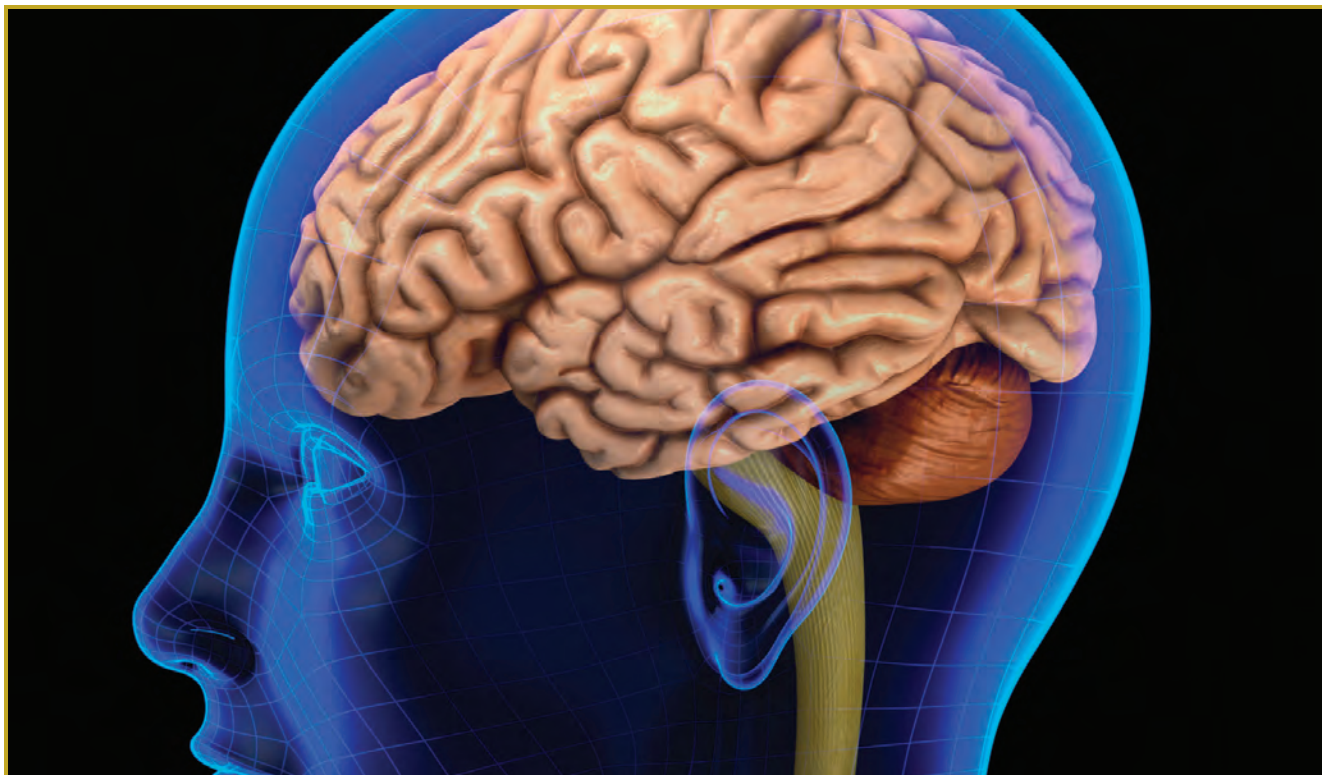
Jason Dickinson and colleagues at Montclair State University investigated the accuracy of child eyewitness testimony by comparing different types of interviewing techniques on children's disclosure of being touched. Specifically, a standard interview that used open-ended questions such as "tell me what happened in your own words," was compared to an interview that included an anatomical body diagram.



The type of interview significantly affected reports of touching. Although the interview that used the body diagram resulted in an increase in accurate reports of touching, it also led to an increase in spontaneous false reports (i.e., reporting touching that had not happened). Subsequently, to reduce the potential for inducing false testimony, the researchers recommended discontinuing the use of body diagrams during forensic interviews until a child makes a spontaneous disclosure or a disclosure is obtained through a standard interview.

# UNDERSTANDING THE BRAIN

*Investigating cognitive and behavioral functions such as thought, perception, emotion, attention, memory, language and motor control, NSF-supported research is helping to decipher the functional relations among the tens of billions of neurons in the human brain and their trillions of interconnections.*



## Buffering the Brain From the Effects of Aging

We are often presented with the challenge of understanding speech in the presence of background noise. This task becomes increasingly difficult as we age. Though general hearing loss associated with aging accounts for part of the difficulty, declining attention and memory capabilities also contribute to this problem.

In young adults, musical training correlates with auditory and cognitive advantages. Hence, Nina Kraus and colleagues at Northwestern University assessed speech perception of older musicians by investigating the potential protective quality of musical training as it relates to the deterioration of speech perception in noisy environments. In their study, a group of older adults completed a series of hearing, memory and perception tests. In spite of expected levels of age-related hearing decline, these adult musicians had more accurate and faster speech perception in noisy environments, as well as better memory, when compared to non-musician peers.

The results suggest that musical training may have long-lasting effects on the nervous system, helping to offset the negative effects of aging-related deterioration in speech processing by improving associated perceptual and cognitive functions.

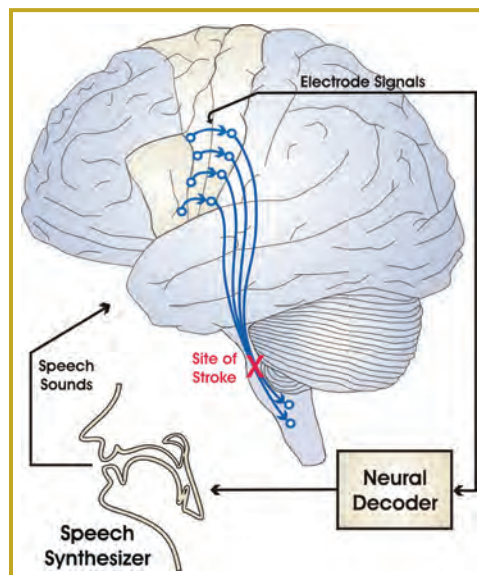


## Helping Paralyzed People Communicate

The inability of profoundly paralyzed individuals to communicate severely impacts their quality of life. Researchers are now developing a brain-computer interface that allows paralyzed individuals to create speech sounds. Boston University's Frank Guenther and Philip Kennedy created synthetic speech sounds from the thoughts of a paralyzed volunteer as he imagined producing those sounds. The fully conscious volunteer, completely paralyzed by a brainstem stroke, suffered from a condition known as locked-in syndrome.

When the person was thinking about speaking, an electrode implanted into his brain picked up signals from nearby activated neurons and transmitted them to a computer. The computer then translated the neural signals into vowel sounds that the volunteer was thinking of making.

In addition to providing insight into how speech is represented in the brain, the team also created sophisticated computational techniques for a software decoder that could rapidly translate neural signals into coherent sound output. This rapid feedback allowed the patient to further improve his performance with practice.



## Why Teens Make Risky Decisions

Making decisions during times of stress can be difficult for anyone. Understanding how teenagers make decisions is important given their susceptibility to stress and tendency to take risks. Researcher Adriana Galvan and her colleagues at the University of California, Los Angeles, are investigating the impact of stress on adolescent brain functioning as it relates to risk-taking behavior.

When teenagers performed risk-and-reward tasks during periods of high stress, they made risky decisions more often than did their adult counterparts. Moreover, they made riskier choices regardless of whether incorrect choices were rewarded or punished. However, during periods of low stress, the possibility of punishment reduced the prevalence of teenagers' risky choices. Scans of the teenagers' brains using functional magnetic resonance imaging (fMRI) also showed different patterns of brain activation: When stressed, the scans showed adolescents had greater neural activity in reward sensitive regions; when not stressed they showed greater neural activity in threat and punishment regions.



Knowing more about how adolescent brain activity and behavior interrelate under different circumstances may have far-reaching implications regarding health care, education, public policy and the legal system.

# IMPROVING INTERNATIONAL RELATIONS

*Advancing our knowledge of democracies, governments, international relations, global conflict and the worldwide political economy, NSF-supported research is helping to inform diplomatic international relations as well as our national security.*



## Assessing Military Threats

International leaders often make threats against other countries, only some of which are sincere. The public's ability to evaluate these statements can play an important role in providing their leaders with needed support. When leaders make threats, especially military threats, then fail to follow through on them, is their credibility undermined in the eyes of their citizens?

Michael Tomz of Stanford University investigated citizens' reactions to military threats made by their national leader in response to an international crisis. He found that significant public disapproval, or "audience costs," resulted when leaders made threats, then backed down. Citizens preferred a leader who stayed out of a conflict altogether, rather than one who issued an empty threat by escalating a situation and then backing down. In these cases, citizens' support decreased, in part, due to concerns that backing down from a threat could undermine the international reputation of their country and the credibility of its leader.



Hence, international threats, including threats to use military force, should be considered credible as leaders face significant risk to their international and domestic reputations.

## International Treaties Impact on Conflict

Throughout history, international treaties have been instrumental in establishing and maintaining diplomatic alliances. In order to evaluate their impact on international relations, politics and policy, Brett Ashley Leeds and colleagues at Rice University evaluated the effectiveness of different types of military alliance treaties dating from 1815 through 1989.

Overall, military treaties are reliable tools in forming alliances, and leaders generally fulfill the promises they make. There are limits, however. If the benefits of breaking a treaty outweigh the costs of keeping it, leaders may violate the agreement. Defensive alliances are especially successful in helping to ensure peace as they deter adversaries from initiating military action. However, when a defensive alliance fails, the resulting military conflict is more likely to escalate to a large, full-scale war. Offensive alliances (finding an ally willing to aid in military action) and neutrality agreements (agreeing not to help an enemy) also increase the likelihood of military conflict.

Thus, this research has the potential to inform stakeholders in crafting effective international agreements by anticipating their consequences.



## Understanding the Effectiveness of Sanctions

Economic sanctions are frequently used as a strategy in international relations. Countries impose various penalties such as tariffs, trade barriers and import duties on their international counterparts as a mechanism to manage economic, humanitarian and political disputes. Although sanctions are sometimes viewed as ineffective, there is limited empirical evidence to support this hypothesis.

To investigate, T. Clifton Morgan and colleagues at Rice University evaluated over 850 instances in which economic sanctions were threatened or imposed from 1971 to 2000. They also explored how sanctions were implemented and the targeted country's response.



Multilateral sanctions were indeed found to be effective. This was especially the case if they were imposed through an existing international organization with a formalized internal structure, institutionalized rules and an outlined process for decision-making. Sanctions were less effective if imposed through an informal, ad hoc coalition. Therefore, economic sanctions, when structured appropriately, are a useful foreign policy tool.

# PROVIDING CRUCIAL DATA FOR THE NATION

*Collecting data, conducting analyses, developing databases, publishing reports and creating partnerships, NSF provides research infrastructure vital to a wide range of scientists, stakeholders and students.*



The social and behavioral sciences have a long history of developing databases important to SBE scientists as well as those in other disciplines such as computer science and national defense. One of NSF's oldest databases, the American National Election Survey (ANES), has collected data on U.S. elections since 1948. The ANES provides a platform to investigate voting, public opinion and political participation. Another tool, Time-sharing Experiments for the Social Sciences, allows researchers to launch studies requiring a nationally representative sample on topics as diverse as health, perception, violence and social networks. NSF also supports other important databases including the General Social Survey, the Panel Study of Income Dynamics, and the Business Research and Development and Innovation Survey. These vital tools allow students, professors, policymakers, journalists, teachers and the public to answer important scientific questions based on high-quality data.

The work conducted by The National Center for Science and Engineering Statistics (NCSES) is also critical to SBE's commitment to research infrastructure. NCSES, a federal statistical agency, compiles and publishes data on areas such as employment in science, technology, engineering and mathematics (STEM) fields, achievement among women and minorities, investment in research and development, and patterns of innovation.

Every two years, under the guidance of the National Science Board, NCSES also produces "Science and Engineering Indicators (SEI),"<sup>1</sup> a volume comprising the major high-quality data on the scope, quality and vitality of the U.S. and international S&E enterprise. SEI gives the general public, policymakers and academic researchers valuable ways to understand the context of U.S. S&E. The following page includes notable examples from this report.

---

<sup>1</sup> National Science Board (2012). *Science and Engineering Indicators 2012*. Arlington, VA: National Science Foundation (NSB-12-01).

## Key Indicators: Trends in U.S. Science and Engineering

### Individuals in S&E occupations and as a percentage of the U.S. workforce: 1983-2010<sup>2</sup>

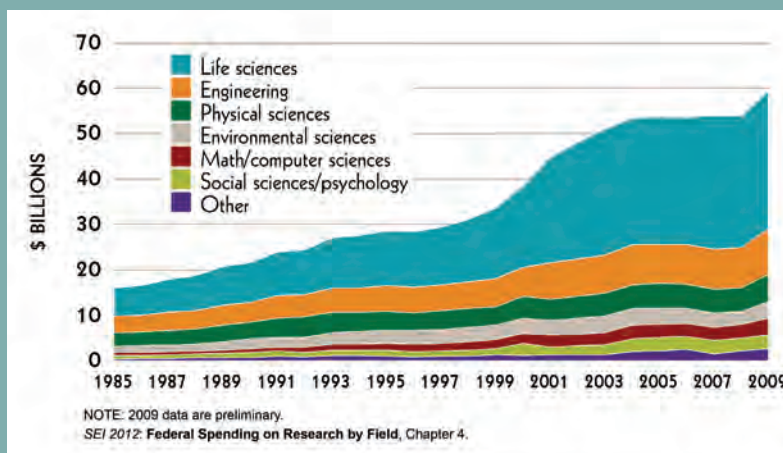


#### U.S. S&E Workforce Growth

The U.S. S&E workforce—made up of chemists, mathematicians, economists, engineers and other such workers—has grown faster than the workforce overall. Over the past quarter century, it has more than doubled in size and now represents about 4.3 percent of all U.S. jobs.

The job losses from the 2007–09 recession have been relatively less severe for those in S&E or S&E related jobs than for those in the U.S. workforce overall.

### Federal basic and applied research funds by S&E field: 1985-2009<sup>2</sup>



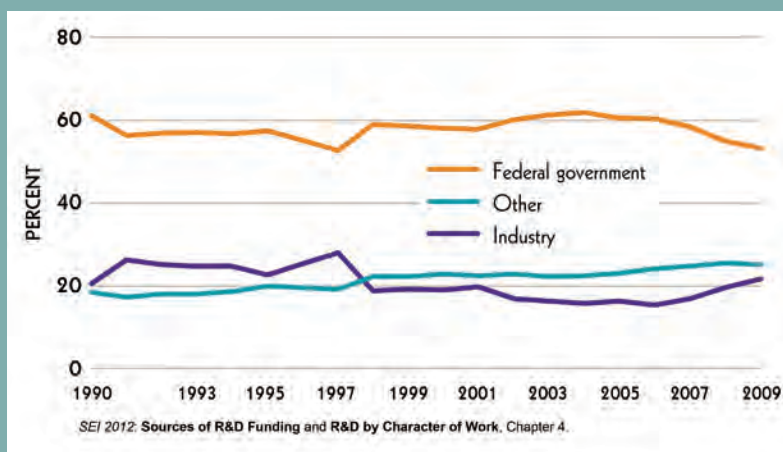
#### Support for S&E Fields

The life sciences have accounted for half of the federal research portfolio since 2001.

Over the past decade, federal research funds for the life sciences and math and computer sciences have increased by more than one-third, after inflation; engineering funds rose by one quarter.

Inflation-adjusted federal funding over the decade was flat for the physical sciences, and shrank for environmental sciences, social sciences and psychology.

### Funding sources for U.S. basic research: 1990-2009<sup>2</sup>



#### Funding U.S. Basic Research

Basic research is directed primarily toward increasing knowledge or understanding, and has long relied on federal government support. Federal support dropped from 62 percent of the total in 2004 to 56 percent in 2009. Support from industry remained below that from higher education and other nonprofit institutions.

2 National Science Board (2012). *Science and Engineering Indicators Digest 2012*. Arlington, VA: National Science Foundation (NSB-12-02).

# HONORED SBE RESEARCHERS

NSF is pleased to have supported 47 of the researchers (more than 60 percent) who have received the Nobel Prize in Economic Sciences since it was first awarded in 1969. NSF has also supported 17 of the social, behavioral and economic scientists awarded the National Medal of Science, the highest scientific honor in the United States, since 1980 when Congress expanded the distinction to include the social and behavioral sciences. Although these NSF-funded SBE researchers are not the most recent award winners, they are representative of the groundbreaking scientists conducting pioneering research.



## Managing Common Resources

**Elinor Ostrom**

*Nobel Prize, Economic Sciences (2009)*

Elinor Ostrom challenged conventional wisdom and long-held theories on how best to manage common natural resources. She explored the role of cooperation among people and the impact on overall economic benefit, especially during a time of increasing global population and subsequent strain on available resources.

Ostrom investigated efficient management of shared community resources such as forests, fish and water. She found that cooperative management of these resources by individuals, compared to outside agencies such as governments or private companies, can be highly efficient, resulting in greater sustainability and mutual economic benefit. She received numerous NSF grant awards over the past 35 years including research on human and environment systems interactions, dynamics of rules in division of common resources and land-use decisions.

Ostrom is the first, and thus far only, woman to be awarded the Nobel Prize in Economic Sciences.





## Decision-making Under Uncertainty

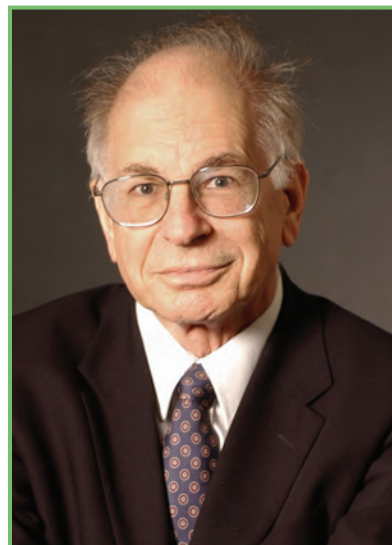
**Daniel Kahneman**

*Nobel Prize, Economic Sciences (2002)*

Daniel Kahneman's pioneering work in behavioral economics addressed how people make decisions when presented with potential risks and uncertain outcomes. He challenged standard economic theory that depicted people as largely rational and logical decision-makers in these situations.

Kahneman demonstrated that the way information is presented can strongly influence people's decision-making. Such information framing is also referred to as "anchoring." Kahneman is known, too, for his work on prospect theory, in which he and collaborator Amos Tversky investigated how people make decisions, especially with respect to finances, when presented with alternatives that have known outcomes regarding gain or loss. They found that people often make predictably irrational decisions, due in part to a disproportionate aversion to losses compared to their level of desire for gain and a tendency to deny true risks that carry the potential for negative outcomes.

Kahneman received the Nobel Prize in Economic Sciences in 2002, the first psychologist to win the award in economics.



## Rethinking Race and Urban Poverty

**William Julius Wilson**

*National Medal of Science (1998)*

William Julius Wilson's groundbreaking research dramatically reshaped the study of race and urban poverty through the 1980s and beyond. His career has been defined by his quest to understand the nature of race, poverty and inequality and to examine the factors that influence how people become deeply entrenched in a culture of inner-city decay.

Wilson wrote a series of seminal books on urban poverty and policy that tapped into issues of race and class in inner-city African-American culture. His most notable book, "The Truly Disadvantaged," outlined the role of the loss of employment opportunities, the breakdown of family structure and economic segregation as major issues in perpetuating a cycle of poverty and further social collapse. Wilson's research stressed the need to examine the institutional, economic and cultural factors that shape the lives of African-Americans and other socioeconomically disadvantaged groups. With support from NSF, Wilson also established the Research Training Group in Studies of Urban Poverty, Race and Social Policy at the University of Chicago.

Wilson was awarded the 1998 National Medal of Science, the highest American scientific prize.



**Image Credits:**

Cover	Thinkstock
Page 2	Ed Edahl, FEMA; Infrogmation, Wikipedia, licensed under the Creative Commons Attribution 2.5 Generic license
Page 3	Katherine E. Browne and Lori Peek; NOAA
Page 4	Thinkstock; Linda A. Cicero, Stanford News Service
Page 5	Thinkstock
Page 6	Thinkstock; National Science Foundation
Page 7	Thinkstock
Page 8	Thinkstock; Sebastian McCormack, U.S. Navy
Page 9	Staff Sgt. Eric Harris, U.S. Air Force; Thinkstock
Page 10	Thinkstock; Ann Acheson
Pages 11-13	Thinkstock
Page 14	Thinkstock; Kraus Auditory Neuroscience Lab, Northwestern University
Page 15	Frank Guenther, Boston University; Thinkstock
Pages 16-18	Thinkstock
Page 19	Science and Engineering Indicators Digest 2012
Page 20	National Science Foundation; © Holger Motzkau 2010, Wikipedia/Wikimedia Commons (cc-by-sa-3.0)
Page 21	Larry Levanti; Kent Dayton for Harvard University



NSF 13-062



National Science Foundation

[www.nsf.gov](http://www.nsf.gov)

4201 Wilson Boulevard | Arlington | Virginia 22230