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OVERSIGHT HEARING – NATIONAL SCIENCE FOUNDATION AND YOUTH VIOLENCE RESEARCH

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COMMERCE, JUSTICE, SCIENCE, AND RELATED AGENCIES

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**Dr. Subra Suresh
Director
National Science Foundation**

**Before the
Committee on Appropriations
Subcommittee on Commerce, Justice, Science and Related Agencies
United States House of Representatives**

March 19, 2013

Chairman Wolf, Ranking Member Fattah, and Members of the Subcommittee, it is my privilege to be here with you today. My testimony today will be the last time I am to address you and the Subcommittee in my official capacity as Director of the National Science Foundation. I have greatly appreciated the strong working relationship we have had over the past three years, and this moment is bittersweet for me.

As I indicated in my memo to NSF staff last month¹, it is with mixed emotions that I face this transition from one exciting professional journey to another, and from one remarkable institution fostering research and education to another. I am saddened by the prospect of leaving the National Science Foundation, an organization that has become the dominant part of my life for the past three years. At the same time, I am excited about the new opportunities and challenges as I assume the leadership of an outstanding university.

With the strong partnership of this Subcommittee, and despite the economic crisis and the lingering uncertainties that have ensued, NSF funding has sustained growth through the turbulent times of the recent past. The hard-working and dedicated staff at NSF have created the “gold standard” for science funding for more than six decades. The programs and practices they have established have been emulated around the world, and they have nurtured the creative talents of hundreds of thousands of scientists, engineers, students and educators in every part of the U.S. Their work has also supported the discoveries of some 200 American Nobel Prize winners who represent about 70% of all U.S. Nobelists since 1950.

Transitions such as the present one provide reasons to reflect on, and to take stock of, one’s journey and to examine the key milestones encountered along the way. I would like to take this opportunity to share some of them with you, providing here excerpts from the letter to NSF staff last month. Although no list can be truly complete, I have reflected on a few accomplishments that, with the Committee’s strong support, we have achieved in these last few years together. They are grouped in several major thematic areas: the OneNSF philosophy and creation of new

paradigms for cross-disciplinary interactions and organizational efficiency; addressing national priorities and grand challenges; support of major infrastructure projects; nurturing and expanding the innovation ecosystem; new models for global engagement; and principled commitment to human capital development and broadening participation. These activities have not only been launched successfully, but they have also established strong roots with support from a broad group of dedicated NSF staff. I therefore have confidence in their potential for continued success and growth in the years to come.

The OneNSF philosophy and the creation of new paradigms for cross-disciplinary interactions and organizational efficiency

- o The intellectual and cultural flavors and associated activities in different offices and directorates of NSF are strongly influenced by the communities they serve in different fields of science and engineering. The OneNSF philosophy, introduced in 2011, seeks to facilitate greater coordination and collaboration among different entities within NSF and among different NSF-funded activities across the country and around the globe so as to extract the best value from investments. Many activities emerging from this approach also were designed to help mitigate barriers to successful interactions among different NSF communities.
- o An example of the OneNSF approach to foster cross-disciplinary research involves the design of the new **Integrative NSF Support Promoting Interdisciplinary Research and Education (INSPIRE) Program**, by a working group of program officers representing different parts of NSF. These innovative colleagues worked hard to create novel mechanisms to support transformative, high-risk ideas that might otherwise not be selected for funding by traditional means. Their work has produced several new solicitations for innovative funding schemes for small projects in interdisciplinary research, mid-scale research projects and support of best scholars. In July 2012, INSPIRE established nearly 40 new interdisciplinary projects in its first funding cycle, with collaborative support and engagement from every office and directorate at NSF.
- o The OneNSF approach has also enabled **greater integration of the educational and research activities** of NSF. We are forging much stronger ties between the Education and Human Resources Directorate and the educational activities embedded within research directorates by integrating cutting-edge research programs into educational activities to inspire young minds.
- o In order to improve organizational efficiency and to foster a more streamlined and effective integration of offices supporting infrastructure and directorates supporting scientific research, a **realignment** and consolidation of different units was announced in September 2012. This led to the creation of the new Office of International and Integrative Activities, and the merger of the Office of Cyber Infrastructure with the Computer and Information Science and Engineering Directorate, and the merger of the Office of Polar Programs with the Geo Sciences Directorate. The realignment was completed at the beginning of 2013.

Addressing national priorities and global challenges

- o The establishment, in partnership with our sister agencies in the federal government, of a variety of multi-agency initiatives intended to enhance the technological strength, global competitiveness and economic wellbeing of the nation. A partial list of the major programs launched during the past two years includes: the **National Robotics Initiative**, the **Big Data Initiative**, the **Materials Genome Project**, the **Secure and Trustworthy Computing Program**, and the **Advanced Manufacturing Initiative**.
- o Creation of pan-NSF activities through the **Science, Engineering and Education for Sustainability (SEES)** program, and the **Cyber-Infrastructure Framework for the 21st Century (CIF-21)** program.
- o Soon after the earthquake in Christchurch in New Zealand (which is a key launching pad for NSF activities in Antarctica) and the disaster involving the combined effects of earthquake, tsunami and nuclear reactor failure near Sendai in Japan in 2011, NSF quickly funded a number of **RAPID research projects** to facilitate time-sensitive and critical research interactions between U.S. scientists and their counterparts in New Zealand and Japan, respectively. These interactions have generated valuable research information on such topics as risk analysis, emergency preparedness, disaster mitigation, etc. NSF sponsored a workshop on “**Reckoning with the Risk of Catastrophe**” in October 2012 in partnership with the German National Science Foundation. These activities, in concert with existing NSF-funded networks such as the **Incorporated Research Institutions for Seismology (IRIS)** and the **George E. Brown, Jr. Network for Earthquake Engineering and Simulation (NEES)**, provide a national and international framework to generate much-needed scientific knowledge and infrastructure to respond to natural and human-made disasters.
- o NSF serves as the Chair of the **Interagency Arctic Research Policy Committee (IARPC)**, a subcommittee of the National Science and Technology Council (NSTC). We have worked with the principals of other federal agencies and their working groups, to develop a five-year, national **strategic plan** for coordinated research in the Arctic region.
- o NSF serves as the co-chair of the NSTC **Committee on STEM Education (Co-STEM)**, and have engaged the principals of a number of federal agencies and their staff to create the first detailed inventory of targeted STEM programs across the federal government. Various working groups of Co-STEM are also collaborating to develop a strategic plan. Efforts to harmonize the definitions and activities of a multitude of programs aimed at broadening participation across the federal government have also been initiated.

Support of Major Infrastructure Projects

- o Despite the severe economic downturn, NSF has shown unwavering commitment to support the U.S. research community through a number of major infrastructure projects. New projects that have received significant funding during the past several years include: the **National Ecological Observatory Network (NEON)**, the **Ocean Observatory Initiative (OOI)**, the **Atacama Large Millimeter/sub-millimeter Array (ALMA) facility** in Chile (the official opening of which I participated in just last week), and the **Advanced Technology Solar Telescope (ATST)**.
- o In order to support cutting-edge research in computational modeling and simulation, three new NSF-funded supercomputing facilities have been established within the past year. These include: the **NCAR-Wyoming Supercomputing Center**, the **Blue Waters Project** at the National Center for Supercomputing Applications at the University of Illinois, and the **Stampede supercomputer** at the Texas Advanced Computing Center at the University of Texas in Austin.
- o The construction and launch of the R/V **Sikuliaq** in October 2012, on time and on budget, to provide a state-of-the-art research vessel for scientific exploration of the Arctic for hundreds of scientists and students every year for several decades to come.
- o Concurrently with the selection of a new contractor to manage the U.S. Antarctic Program (USAP) for the next decade, we benefited from two key reports: the **National Research Council Report** on science drivers for the USAP, and the **Blue Ribbon Panel Report** with recommendations for more and better science in Antarctica through increased logistical effectiveness. The NSF “Tiger Team” commissioned in response to these reports has already developed a robust set of action plans with clear timelines for implementation of key recommendations.

Nurturing and expanding the innovation ecosystem

- o NSF has long played a key role in fostering innovation through the SBIR (Small Business Innovation Research) and related programs, Industry-University Collaborative Research Centers, and Engineering Research Centers. The launch, in July 2011, of the **NSF Innovation Corps (I-Corps) Program**, expands NSF’s rich history of supporting innovation arising from fundamental scientific discoveries. The I-Corps Program provides a unique mechanism to extract considerable further value from basic research by providing opportunities for NSF-funded researchers and students to tap into a new, virtual innovation ecosystem at the national level. Within its first two years of existence, I-Corps would support approximately 300 projects and five outstanding groups of institutions and networks of mentors that will serve as the geographically diversified hubs of the national innovation ecosystem. The I-Corps program has also drawn significant interest from other federal agencies, with ARPA-E now partnering with NSF to support several I-Corps projects.

- The **I-Corps** program also helped establish a new paradigm for **public-private partnerships** by partnering with two non-profit foundations with significant experience in fostering innovation.

New Models for Global Engagement

- The launch, in October 2011, of a coherent set of policies and streamlined practices to leverage NSF-funded research within the U.S. with significant new resources from around the globe through the **Science Across Virtual Institutes (SAVI) Program**. Since its launch, 17 SAVI programs have been created involving dozens of countries and hundreds of American researchers, educators and students across the spectrum of activities covered by NSF.
- NSF's leadership role in the hosting of the **Global Merit Review Summit** in Arlington, VA, at the invitation of the White House and the creation of the **Global Research Council (GRC)** in May 2012. This summit brought together, for the first time, the heads of major research funding agencies from nearly 50 countries representing the developing and developed world, and established a new paradigm for harmonizing global science. This event demonstrated the convening power as well as the leadership role of NSF on a global stage. Subsequent to the establishment of GRC, more than a hundred countries have participated in five regional meetings held across the globe by our overseas partners to prepare the principles of research integrity and a multi-year process for collectively addressing the complex issue of public access to publications and data. The next GRC annual meeting will take place in Berlin in May 2013 with NSF serving a pivotal role along with the organizers, Germany and Brazil.
- **An implementation agreement with the European Research Council**, signed in July 2012, to provide new international opportunities for scientific collaboration for a large cohort of early career American researchers with their European counterparts from 27 countries. This program will enable **NSF CAREER awardees and post-doctoral fellows** to work with leading scientists and gain access to research infrastructure in prominent institutions throughout Europe through a streamlined "one-stop shop" process and financial support from partner organizations. It is very encouraging to note that more than 750 indications of interest have already been received from Europe to host these early career scientists even before the program has officially begun.
- The creation of a new model, in December 2012, to provide international experience for American graduate students through the **Graduate Research Opportunities Worldwide (GROW) Program**. This program, announced in conjunction with the 60th Anniversary of the prestigious NSF Graduate Research Fellows (GRFs) Program, will enable many hundreds of graduate students to spend extended research stays at strategically selected overseas partner institutions. The program will also offer new mechanisms for financial support, in partnership with overseas funding agencies, for U.S. graduate students who will work with key collaborators in foreign countries. Since its launch less than two months ago with eight partner countries, the program has attracted many additional

overseas funding agencies to collaborate with NSF. At steady state, the GROW program will leverage several tens of millions of dollars of overseas support to host NSF-funded GRFs in their host institutions abroad.

- o The creation, in July 2011, of the **Partnership for Enhanced Engagement in Research (PEER) Program** in collaboration with the U.S. Agency for International Development to link, strategically and in a well-coordinated manner, American scientists with counterparts from developing countries. Within a year of creation of this unique partnership, some 42 projects have been funded through this program. The NSF PEER program is also serving as a model for other agencies to create similar activities tailored to their mission.
- o Continued leadership in fostering international collaborations for U.S. scientists, engineers, educators and policy makers with overseas counterparts through such activities as the **Belmont Forum, Partnerships for International Research and Education (PIRE) Program**, the **Human Frontiers Program**, **joint funding of projects through the G8**, and **East Asia Pacific Student Internship (EAPSI) Program**, to name just a few among a large number of NSF programs. These activities not only connect early career and established scientists with their counterparts abroad, they also address such global challenges as environmental change, access to clean water, and the mobility of young researchers across national borders.

Principled commitment to human capital development and broadening participation

- o *Principled commitment to support the development of young talent for the future scientific health of the country.* This passionate adherence to a core principle, unanimously endorsed by our senior leadership team and staff, has helped **double the number of NSF Graduate Research Fellowships (GRFs)** to 2,000 per year since 2010 (from the prior year) even during the worst financial crisis of our lifetime. These policy decisions, coupled with new programs such as **GROW**, are intended to address the critical need for future science and engineering workforce for the nation. In addition, adjustments have been made to allow for much-needed increases in tuition subsidy and stipend for GRFs. This commitment for human capital development also helped preserve strong support for **NSF CAREER awards and post-doctoral fellowships**.
- o *Unwavering commitment to broadening participation and diversity.* Leveraging NSF's experience with such programs as **ADVANCE** and by incorporating best practices for enhancing diversity in the scientific workforce, we launched, in September 2011, the **NSF Career-Life Balance Initiative**. Hosted by First Lady Michelle Obama, this marked the first-ever NSF event held at the White House, and included a joint statement by the leadership of NSF, the Association of American Universities and the Association of Public and Land-grant Universities to work together to foster greater diversity. The importance of the policies and practices accompanying this initiative to be equally applicable to NSF staff was highlighted in a special event held at the NSF building several months later.

Conclusion

It has been my extraordinary honor to lead the National Science Foundation, which is blessed with a marvelous cohort of highly talented and devoted staff, as well as hundreds of thousands of innovative grantees and investigators from every field of science and engineering. I am grateful for the opportunity to serve the country in this capacity and to be the beneficiary of many wonderful life experiences as I witnessed, and played a small role in helping to advance, science over the past several years.

Mr. Chairman, I am most grateful for the strong working relationship with you, with Ranking Member Fattah, and with your Subcommittee. I thank you for your leadership and for the warmth that you have shown me during my tenure at NSF.

I look forward to answering any questions you may have.

¹ Director's memo to NSF staff and contractors, "Transition" dated February 5, 2013

Testimony of Brad J. Bushman, Ph.D.

*Before the House Subcommittee on Commerce, Justice, Science and Related Agencies
19 March 2013*

Chairman Wolf, Ranking Member Fattah, and distinguished Members of the Subcommittee, my name is Brad J. Bushman. I am a professor of communication, a professor of psychology, and the endowed chair of mass communication at The Ohio State University. In the summer, I am a professor of communication science at the Vrije Universiteit (Free University), Amsterdam, the Netherlands. I have been doing research on the causes of aggressive and violent behavior for almost 30 years. I have published over 130 articles in peer-reviewed journals, including in the top scientific journals such as *Science* and *Nature*. I have conducted over 50 studies on violent media effects.

In the wake of the Newtown shooting, Chairman Wolf asked the National Science Foundation (NSF) to find out what researchers know and don't know about the connection between exposure to media violence and youth violence, and other factors that contribute to these devastating events. NSF approached Katherine Newman, Dean of the Arts and Sciences at Johns Hopkins and an expert in rampage shootings, and I to assemble a committee* with relevant expertise (e.g., communication, law, sociology, computer science, adolescent development, natural language analysis, gun policy, data analysis) to address this urgent and important topic. The committee gathered at NSF headquarters on February 1st and 2nd to write a report titled *Youth violence: What we need to know*. My purpose today is to summarize the results from that report.

When rampage shootings occur, people want to identify “the” cause of such tragedies. However, there is no single cause. Legislators and the mass media have focused on three risk factors—guns, violent media, and mental illness. Of course there would be no school shootings without guns. The same day as the Newtown shootings, a man attacked several primary school children with a knife in China, wounding 22 of them.¹ Fortunately, none of these children died, perhaps because they were stabbed with a knife rather than shot with a gun. Guns, especially automatic or semi-automatic guns with magazines that hold a large number of bullets, allow the perpetrator to kill a greater number of victims in a shorter amount of time. Guns also provide psychological distance between the perpetrator and victim, which makes killing easier. But focusing on guns

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alone will not solve the problem of youth violence. Even a three-pronged approach, with a focus on guns, mental health, and violent media, is insufficient. Violent behavior is very complex and is determined by numerous factors, often acting together.

Before discussing risk and protective factors for youth violence, it is important to note that rampage shootings in schools differ in dramatic ways from “street violence” in urban areas. School rampages typically occur in stable, close knit, low-crime, small towns. The shooter often is a white adolescent male, with no recorded history of disciplinary problems, and no documented history of medical treatment for mental disorders. The shooter is often at the high end of the intelligence and academic achievement spectrum, but lacking in attributes highly valued by peers (e.g., athletic ability, social skills, physical attractiveness, popularity). In contrast, street violence often occurs in densely populated areas plagued by high levels of crime, low levels of social trust, and illicit drug and gun markets. Although rampage shootings like the tragedy in Newtown are rare, they are devastating because they often includes random victims. Urban bloodshed, which often unfolds between known antagonists, is far more ubiquitous and hence exacts a terrible toll on families and communities destabilized by persistent violence.

We already know a great deal about youth violence. For decades social scientists have conducted research on this youth violence, including research supported by the National Science Foundation, the National Institutes of Health, the National Research Council, the Centers for Disease Control, and other federal agencies. Numerous excellent and well-validated theories have been proposed to explain the causes of youth violence. In my opinion, such research is an excellent use of tax payer money.

EXPOSURE TO MEDIA VIOLENCE

Public debate on the link between violent media and aggressive and violent behavior can be contentious, especially following a shooting rampage. Anders Breivik, who killed 77 people in Norway, said he used the violent video game *Modern Warfare 2* as a military simulator to sharpen his shooting skills.² Eric Harris and Dylan Klebold, who killed 13 fellow students in Colorado, said they used the violent video game “Doom” to practice their shooting rampage.³ Violent video games have also been implicated in other school shootings (e.g., Bethel, Alaska; Paducah, Kentucky; Jonesboro, Arkansas, Newtown, Connecticut). However, it is not possible to know whether playing violent games *caused* Breivik, Harris, Klebold (or any other killer) to shoot their victims.

We haven’t “proven” that violent video games directly cause violence because it can’t be proven. There is no way to ethically run experiments that see if playing a violent game like *Call of Duty* can push a person into violence. But that doesn’t mean we are left without evidence. We know that video game violence is correlated with violence^{4, 5} – just like smoking is correlated with lung cancer. However, this does not mean that the research does not indicate causal effects; in fact it does. The most comprehensive review of violent video game effects to date included 381 effects from 136 research reports involving over 130,000 participants from around the world.⁶ These studies show that violent video games increase aggressive thoughts, angry feelings, physiological arousal (e.g., heart rate, blood pressure), and aggressive behavior. Violent games also decrease helping behavior and feelings of empathy for others. The effects were observed for males and females of all ages, regardless of what country they lived in.

Similar effects have been found for other forms of violent media (e.g. TV programs, films, music).⁷

People who consume a lot violent media come to view the world as a hostile place,⁸ where violence is “normal” behavior.⁹ When people expect others to behave aggressively, they are more likely to behave aggressively themselves.¹⁰

Aggressive youth often consume violent media because it allows them to justify their own behavior as being normal.¹¹ A child's own aggressive behaviors usually elicit guilt, but this guilt is relieved if the child who has behaved aggressively consumes violent media. The reduction in guilt that consuming violence provides makes continued aggressive and violent behavior by that child even more likely.

There is also a downward spiral¹² between aggression, rejection, and violent media consumption. Aggressive youth tend to be rejected by prosocial peers,¹³ and therefore spend more time consuming media and associating with other rejected, aggressive youth, which, in turn makes them even more aggressive.

It is useful to consider a child's life as filled with a succession of social challenges that must be met. Indeed, many young rampage shooters are depressed and suicidal. To meet these challenges, the child draws on a set of programs (called *scripts*). In theater, scripts tell actors what to do and say. In memory, scripts define situations and guide behavior: The person first selects a script for the situation, assumes a role in the script, and behaves according to the script. Children learn scripts by observing others, including mass media characters. In many shooting sprees, the perpetrator puts on a uniform (e.g., hockey mask, trench coat, movie costume, military uniform), as if following a script from a movie or video game. This allows the perpetrator to identify more closely with other killers. The perpetrator then collects a bunch of guns, and ammunition, most often from relatives, goes to a place where there are a lot of people gathered, kills as many people as possible, and then often kills himself. For most people, carrying out such a script would be impossible. But it is possible for some who perceive the act as a means of realizing a more satisfying identity as an anti-hero or a notorious and hyper-masculine figure, lionized in popular culture and admired by peers. In this way, those who feel marginal and socially inadequate in real life achieve a sense of accomplishment through these tragic acts: they leave a mark on the world.

Parents are key in reducing children's exposure to media violence, but they need help. Media literacy programs, such as *Media Power Youth*¹⁴, may help children become more intelligent media consumers. A universal rating system on all media (TV, films, video games), with universal symbols that are easy for parents to understand, may also help parents. The PEGI (Pan European Game Information) system, for example, has 5 age-based ratings (3+, 7+, 12+, 16+, 18+) and 6 well-recognized symbols for potentially objectionable material (violence, sex, drugs, discrimination, fear, gambling). The current rating system in the United State is like alphabet soup (e.g., R for movies; TV-MA for television, AO for video games), which is confusing to parents.¹⁵ Violence is especially likely to be condoned in media, with films rated as acceptable for children under age 13 (i.e., PG-13) having as much violence as those rated R.¹⁶ A warning label on violent video games might also help parents.¹⁷ In 1972 the U.S. Surgeon General issued a

warning regarding violent TV programs: “It is clear to me that the causal relationship between televised violence and antisocial behavior is sufficient to warrant appropriate and immediate remedial action...There comes a time when the data are sufficient to justify action. That time has come.”¹⁸ Unfortunately, one unintended side effect of warning labels is that they make violent media “forbidden fruits” for children.¹⁹ Educating parents about the research on violent video games is also important. This is an uphill battle, because the news media, entertainment industries, and other mass media purveyors may be reluctant to report that they are marketing products that can be harmful to children.^{20, 21}

Although researchers have learned a great deal about violent media effects, additional research is still needed to address new and important questions, particularly given the rapid evolution of the technology. Little is known, for example, about the impact of social media on youth violence. Technology also is flooding young consumers with ever more realistic depictions of violent behavior on screen. Future research is needed to investigate:

- What types of youth are most susceptible to violent media effects (e.g., those with certain mental illnesses)?
- What kinds of relationships do youth form with onscreen characters?
- When does fantasy behavior transfer to enacted violent criminal behavior among youth?
- What is the impact of immersive technology (e.g., 3D, large screens) on aggression?
- How does competition and collaboration between game players influence aggression?
- How do consumption patterns of violent media vary by geography (rural/suburban/urban), socioeconomic status (SES), gender, ethnicity, or household composition?
- Do video games tap into biological reward systems, and are they addictive in ways comparable to drugs, alcohol, or gambling?
- What role does self-control play in the use of video games?
- How do violent media impact brain development and function?

PEER REJECTION AND HIERARCHIES

Most youth who engage in lethal violence have a history of social rejection, but are highly concerned about acceptance. An analysis of 15 school shooters found that social rejection (e.g., from a romantic partner, peers) was present in 13 of 15 cases.²² Two factors make adolescents particularly sensitive to rejection and likely to overreact in aggressive ways. First, adolescence is a time when identities are being formed and consolidated. Thus, adolescents are particularly vulnerable to identity threat and may be particularly attuned to the reactions of peers. Second, adolescence is a time of considerable biological change. Functional imaging research has found that some adolescents show both heightened reactivity in the amygdala (implicated in threat response) and lower activity in the prefrontal cortex (implicated in self-regulation) relative to either adults or younger children.²³ One feature of individuals who are highly sensitive to rejection is that when in a state of physiological threat, they perceive the danger posed by the threat source as exaggerated.²⁴ When guns are on hand they may be used because they may be perceived as eliminating a potentially lethal sense of psychological threat to the self.

Youth also care a great deal about peer hierarchies. In schools, self-perceived low positions in popularity hierarchies are linked to heightened stress in male adolescents.²⁵ High-achieving students can be stigmatized by peers as “nerds” or “geeks.”²⁶ How peers deal with such stress varies a great deal across interpersonal and school contexts.

Research shows that school climates and cultures of social trust can act as protective factors against violence and conflict. Some schools are better at establishing and sustaining these healthy environments than others. The same school may take a turn for the better on this score, or become significantly less supportive of healthy social relations among adolescents and between kids and adults.²⁷ The “natural history” of adult/youth relations needs to be better understood in these key contexts because they are central to conflict resolution and better peer relations, and to building the trust needed for young people to come forward when they hear threats about violent intentions from their peers. Future research should investigate:

- How does heightened sensitivity to rejection develop among youth? How does violence serve the goals of those youth who use or plan to use it in response to rejection? Does violence provide a sense of escape from feelings of powerlessness?
- How does self-regulation capacity moderate reactions to rejection and promote more adaptive responses to social threat?
- How do security and exclusionary disciplinary regimes affect social trust and adult-youth interaction, particularly with respect to peer hierarchies and youth conflict?
- How do off-campus, third-parties (e.g., alumni, community members) facilitate or inhibit the production of social trust in schools?
- How do youth seek out help and support from adults when dealing with troubling situations, either in face-to-face or online situations?
- Among marginalized youth, what kinds of relationships might reduce risk of extreme reactions to rejection, promote help seeking and, interrupt plans for revenge that might involve lethal violence? How do youth learn to seek help?
- How do youth handle peer conflict across different contexts? What social and institutional conditions (strong and weak relational ties) facilitate non-violent as compared to violent responses?
- A number of rampage shooters have been college students or dropouts.

Understanding what contributes to risk of lethal violence among college age students is important because they have aged out of adolescent peer groups and may be even more difficult to identify as a result.

COMPARATIVE CRIMINOLOGY

There is a characteristic distribution of violent behavior over the life-course, such that incidents of violence increase in frequency with age up to late adolescence or early adulthood and then rapidly and continuously decline throughout life. Violent crime, like most problem behaviors, occurs disproportionately during adolescent and young adult years. Individual differences in self-control or self-regulation are among the strongest and most consistently shown individual correlates of crime, delinquency, violence and other problem behaviors.²⁸

Many rampage shooters commit suicide following their acts, placing their behavior into

the highly unusual category of murder-suicide²⁹. Although murder-suicides are rare³⁰, they are disproportionately likely to involve multiple homicide victims³¹. It is likely that suicidal youth who consider killing others as well as themselves have hostile attitudes toward others, perhaps blaming them for their condition.

The news media cover rampage shootings heavily, but very little is known about the effects of such coverage. Does such coverage increase thoughts of imitation, as it does in suicide? Is it more likely to influence thoughts of imitation among youth who already have thoughts of suicide and homicide? Do some youth use such events as ways to achieve notoriety, as has been suggested in sensational coverage of suicides?

More research is required to discover the similarities and differences between rampage shootings and more common forms of violent crimes and delinquencies (e.g., the extent of planning, the relationship between levels of self-control or self-regulation and violence, the solitary or group nature of the offending, and the time, place, and method of occurrence). Future research should investigate:

- The relationship between suicide and homicide, and the intersection between the two, especially in regard to ideation for committing both acts.
- Whether there are differential effects of self-control or self-regulation for the development of suicidal and homicidal ideation.
- How school and other social institutions can create enhanced social efficacy and bonding effects for students, and how differences in school climate can reduce levels of crime and violence particularly during adolescence.

FAMILY INFLUENCES ON VIOLENT BEHAVIOR

There is a large body of research suggesting that many family-based qualities and processes are important risk or protective factors for antisocial behavior, including youth violence.^{32, 33, 34, 35} Risk factors based in the family include low social status, poverty, harsh and rejecting parents, chaotic family life, inter-parental conflict, domestic violence, child abuse and neglect, family stress (prenatal and post-natal exposure), poor monitoring by parents, criminal behavior or incarceration of parents, and mental illness in parents. Protective factors based in the family include close attachment bonds with consistent caregivers, effective parenting, good cognitive skills or education in parents, and families that are organized, safe, and well-regulated.

Yet there are many gaps in knowledge about the roles of families in violent behavior that could inform policy and interventions to reduce risks for youth violence and promote resilience among high-risk youth. Important data could be gathered from large child longitudinal development data sets and planned studies, such as the National Children's Study. Future research should investigate these questions:

- How do early experiences, toxins, and stress in the family, both prenatal and post-natal, alter child development to increase vulnerabilities or risks for later violence?
- What are the most cost-effective protective interventions for families in different phases of child development to reduce risks for later violence?
- Do family-focused interventions that improve self-control skills in children reduce youth violence? What interventions and timing are the most beneficial and cost-effective?

- What are the most effective interventions and timing for educating parents about effective and age-appropriate ways to monitor child behavior, including their media use, peer interactions, and school involvement?
- Given that high-risk families (e.g., unstable, impoverished or poorly educated, with incarcerated parents, substance abuse, or violence in the home) contribute disproportionately to violence in inner-city neighborhoods, what are the most effective and timely interventions to prevent intergenerational transmission of these problems in families?
- Do some systems intended to help children, such as foster care, juvenile justice, or special education systems, unintentionally increase their vulnerability for exposure to violence and risks for developing violent behavior?
- What kind of mental health and community resources are needed for families concerned about a child who demonstrates signs of preoccupation with violence, violent media, or violent behavior?
- Do large-scale interventions underway that aim to increase academic achievement (e.g., Race to the Top or Promise Neighborhoods) also mitigate youth violence?

DATA MINING FOR PREDICTION AND INTERDICTION OF SHOOTINGS

Online data sources may have multiple potential uses for understanding, predicting, and preventing violence, such as: (a) tracking population-level demographic and geographic trends in risk behaviors, (b) geographic “hot spot” prediction for urban violence, (c) “risk stratification” to identify—with appropriate safeguards—those who are signaling violent intentions and who would benefit from early intervention, (d) facilitating the reporting of planned or potential attacks by others (e.g. friends and classmates) with knowledge of impending events, and (e) understanding “bullying” behavior and its role in influencing violence. Each of these potential applications should be explored further to analyze its potential impacts (benefits and risks) and feasibility of implementation. Many of the methodological tools needed for these analyses (such as anomalous pattern detection, predictive modeling, sentiment analysis, and social network analysis) have already been developed in the fields of machine learning, data mining, computational linguistics and statistics. Research in any of these domains must address the potential biases and limitations of these online data sources, as well as mitigate serious risks to privacy.

The focus should be on developing tools that can be broadly used, and framing methodological questions (e.g., early event detection and prediction) that generalize across multiple domains. The solutions to such problems would then advance the science (e.g., of language understanding, massive data analysis, and pattern discovery), as well as potentially preventing or reducing youth violence. Future research should investigate:

- Can Twitter and other online data sources (e.g., gaming forums) be used to track the demographic and geographic trends in consumption of violent media and correlate these with other indicators (e.g., use of violent language), accounting for demographic and other biases in these data sources?
- Can new data sources (e.g., Twitter, or specialized systems to monitor, identify, and track graffiti) be integrated with currently used law enforcement and 911 call data to enhance the timeliness and accuracy of prediction (“where” and “when” street shootings are likely to occur, as well as predicting “who” may be the perpetrators and victims).

- Can we identify “risk factors” for individual mass shooters that are both predictive, and can be reliably extracted from online data, such as latent user attributes (location, age, gender), socioeconomics (poverty), family (divorce, single parents), access to guns, expressions of violent sentiments, intentions, and plans, signs of certain mental illnesses, attitudes toward violence, social relationships (marginality, social rejection, encouragement by peer groups), etc.? Can administrative data be integrated with online data for more accurate risk predictions?
- Can we accurately model both the probability that these risk factors are present given noisy, unstructured online data, and estimate overall risk of violence given these factors?
- Is there a role for monitoring of online data in early warning and rapid response to mass shootings, similar to its role in disaster response more generally, to inform law enforcement and potential victims?
- Can we understand and develop a framework to inform and encourage best practices of online interventions at various stages leading up to a potential mass shooting (teachers providing online, positive influences; availability of mental health counseling; mitigating negative impacts of social rejection; facilitating reporting of potential threats and at-risk individuals in need of help)?
- Can online data from occurrences of “cyber-bullying” be captured and analyzed to understand the causes, processes, and impacts of bullying behavior more generally? What are the similarities and differences between online and offline bullying behavior (e.g., online anonymity and greater spread of embarrassing information), and how do these change the impacts on victims of bullying?
- What are the risks of mining online data to individual privacy, and how can these risks be mitigated or eliminated? For example, when are aggregated counts and de-identified data sufficient to study violent behavior? On the other hand, under what conditions is it acceptable to use online data to intervene at the individual level (which may not be possible without identifying at-risk individuals)?

GUN POLICY AND YOUTH

All mass killing and more than 80% of homicides involving youth are committed with guns. It is critical to reduce access to guns in youth, especially those with a history of delinquency, crime involvement, and certain mental illnesses. Future research topics:

- What is the relationship between minimum age or youth-focused firearm restrictions (e.g., safe storage) and youth-perpetrated violence? Is the effectiveness of these laws dependent upon other gun regulations designed to deter the diversion of guns to prohibited persons (e.g., universal background checks, licensing provisions)?
- How do penalties and illegal gun suppression tactics by police affect illegal gun carrying and use by youth?
- How do factors such as price, trust in gun sellers, gun characteristics (new/used), and perceived risks of prosecution affect youth illegal acquisition of firearms? How easily do youth adapt to interdiction strategies (e.g., access sources outside of state if state gun laws reduce gun diversions)?
- Do youth steal guns opportunistically or target homes, stores, or individuals for gun theft? How important are stolen guns to the underground gun market where youth acquire guns? How commonly do youth discard guns, lose them to theft, sell them, have them confiscated by parents, police, or school authorities?
- How do youth access ammunition?

- How much do community members know about how youth are illegally acquiring guns, stashing, and carrying guns, and are they willing to share this information (anonymously) with police?
- When do youth share guns?
- Can mediators (e.g., street outreach workers, peers) keep guns away from youth planning rampage shootings?
- What is the potential for new technologies (personalized guns) to reduce youth violence? How will consumers react to the introduction of these new technologies?

CONCLUSION

It is estimated that the social cost of gun violence is roughly \$174 billion a year.³⁶ The costs include medical and mental health care costs, criminal justice costs, wage losses, and the value of pain, suffering and lost quality of life. Beyond this enormous financial toll, is the devastating emotional impact of lost lives, neighborhood destabilization, and fear of attack. For children in particular, exposure to violence erodes confidence in social institutions and the society they live in. These costs alone justify the dedication of our federal research agencies and the scientific community to understanding the problem of youth violence.

Thank you all for allowing me to appear before you today. The National Science Foundation advisory group that I am here to represent hopes that you will find their research and their suggestions for future research that could help the country understand and prevent gun violence, useful and practically valuable. I am happy to answer any questions you might have.

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<http://www.childrensafetynetwork.org/cost-gun-violence>