

# Combating Terrorism

Research Priorities in the Social,  
Behavioral and Economic Sciences



**Report of the NSTC**  
**Subcommittee on Social, Behavioral and Economic Sciences**

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EXECUTIVE OFFICE OF THE PRESIDENT  
**NATIONAL SCIENCE AND TECHNOLOGY COUNCIL**  
WASHINGTON, D.C. 20502

Dear Colleague,

The events of September 11, 2001 profoundly affected the lives of all Americans and were a call to action to which Americans and our government have responded in many ways. Beyond the efforts of the newly created Department of Homeland Security, numerous federal agencies are investing in science and technology to combat terrorism. We have developed new technologies or modified existing ones to improve detection and remediation of biological, chemical, radiological, or nuclear threat agents. We have developed and deployed new tools to secure our airports, other critical infrastructure, and the communities in which we live.

This impressive deployment of technology, however, is only part of a complete response to the threat of terrorism. Our ability to maintain our American way of life also depends on our understanding of human behavior, which is the domain of the social, behavioral, and economic sciences. We must investigate the psychological and neurobiological mechanisms of stress, fear and courage; the powerful networks of human social exchange that sustain individuals and families; the special needs and strengths of groups as a function of their history and culture; the principles of economic growth and decline; and the attitudes and beliefs that lead people to vote and sustain a democracy.

The accompanying report describes the resources that the social, behavioral and economic sciences contribute to creating and maintaining effective anti-terrorism strategies. Some of these can help us understand the origins of terrorism, some address how we can prepare for terrorist incidents, and some deal with the effects of an attack and their mitigation. The report describes the powerful tools and strategies these sciences offer as we respond to the threats and actions of terrorists.

Sincerely,

A handwritten signature in black ink that reads "John Marburger". The signature is fluid and cursive, with the first name "John" being particularly prominent.

John H. Marburger, III  
Director

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# Highlights of the Report

The knowledge and tools of the social, behavioral and economic (SBE) sciences are immediately applicable to the construction of strategies that can enhance the Nation's capacity to predict, prevent, prepare for and recover from a terrorist attack.

Our capacity to **predict** future terrorist attacks depends in part on our ability to identify and understand those factors that underlie the formation and maintenance of both domestic and international terrorist groups. Prediction capabilities are enhanced if we understand that terrorist networks and strategies are shaped by the behaviors of both the terrorists and their targeted adversaries, which differ across time, place, and access to resources.

Our ability to **prevent** a domestic terrorist attack will depend, in part, on detecting who threatens us. Behavioral methodology in conjunction with sensor and surveillance technology is being used to anticipate and detect threats during the earliest pre-incident phases. The social and behavioral sciences are helping our law enforcement and intelligence agencies adapt to new roles and responsibilities, and advising policy-makers to ensure that we protect individuals and communities that are vulnerable to isolation and stigmatization.

The social, behavioral and economic sciences are integral to the development of optimal short-term and long-term strategies to **prepare** for a terrorist attack. SBE models of threat, risk and vulnerability

assessments are advising the creation and evaluation of effective response plans. SBE models of risk perception and communication are being used to appropriately modify emergency responder and public behaviors under conditions of attack, threat and uncertainty. SBE models of community stress and resilience, developed on the basis of lessons learned in previous instances of natural and technological disasters in the United States, are being used in the evaluation of emergency preparedness plans.

Our capacity to **recover** from a terrorist attack is enhanced by taking advantage of SBE models of terrorist attacks and other large-scale disasters that incorporate measures of community strengths and weaknesses. The treatment of acute and chronic stress is informed by current views of the fundamental mechanisms of brain and behavior, and how stress and coping reactions are modified by experience and context. We will recover faster and better by understanding human vulnerability and resilience factors.

This report recognizes numerous opportunities for research in the SBE sciences that will further enhance our capacity to ensure that America thrives for all its citizens—not by building walls, but by seeking understanding; not by promoting fear, but by enhancing strengths, and not by closing doors, but by welcoming those who share our pluralistic and democratic values and aspirations.

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# The Challenge

A terrorist attack has enormous impacts even beyond the possible loss of life. These impacts have profound psychological, social, economic, political, and judicial consequences. Recovery from an attack and efforts to prevent or protect from future attacks must address all of these consequences.

This report is organized around how the United States can use the SBE sciences to help predict, prevent, prepare for and recover from a terrorist attack. It recognizes that greater national and homeland

security will not be achieved only by building stronger buildings, smarter airport screening machines or more layers of protective gear. Effective strategies to combat terrorism also will have to harness our understanding of human behavior at the level of the individual and the group. There is an abundance of knowledge within the SBE sciences that is fundamental to such strategies. This report contains examples of these resources, as well as opportunities for research that will further enhance such efforts.

## Background of this Report

In the aftermath of the September 11th attacks and the anthrax letter events, the Director of the Office of Science and Technology Policy (OSTP), through the National Science and Technology Council (NSTC), formed the Task Force on Anti-Terrorism Research and Development. A primary purpose of the Task Force was to map out a research agenda for homeland security that would be conducted over the next several years. In addition, OSTP began to consider how the federal government should organize or re-organize itself to execute this new research agenda. These organizational and research

efforts became important components for the preparation of the President's National Strategy for Homeland Security, and ultimately for the organization of the science and technology component of the new Department of Homeland Security.

The work of the Task Force on Anti-Terrorism Research and Development was assumed by the Social, Behavioral and Economics Sciences (SBES) Subcommittee, formed in November 2003 under the National Science and Technology Council Committees on Science and Homeland and National Security.

**Two hundred fifty-five survivors of the direct blast in the 1995 bombing of the Oklahoma City Murrah Building showed a high incidence of post-disaster psychiatric disorder (45%) and Post-Traumatic Stress Disorder (34%) six months after the bombing (North et al., 1999). Mental health researchers examined the course of recovery among those individuals to acquire a better understanding of the evolving course of disruptive and disabling symptoms of distress, how to identify those at risk of developing a serious mental illness after such an event, and how to offer timely interventions to reduce trauma-related distress, including depression and anxiety disorders.**

**Basic economic research on macroeconomics and how financial markets function was used by economic policy-makers to devise policies to cope with the severe economic shock of September 11, 2001. Their efforts kept the sharp decline in the stock market from**

**spiraling into a broader economic crisis. Economic models and forecasting techniques were crucial tools, including time series analysis of financial data (Engle, 2001; Granger 1986), rational expectations models (Lucas, 1972; 1976), and tools for analyzing economic dynamics (e.g., Sims, 1983).**

**A nation-wide survey of Americans after September 11, 2001, found that the most common coping strategies among Americans on that day and several days after were talking with others (98%), religious thoughts or actions (90%), participating in group activities (60%), or making donations to relief services (36%). The most common single coping behavior was to check on the safety of close family members (75%) (Schuster et al., 2001). Researchers concluded that ensuring ways for people to communicate and to participate in rescue and recovery efforts should be key components of local, State and Federal planning strategies (Silver et al., 2002).**

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# I. How Can We Predict?

Evaluating the likelihood of future terrorist attacks depends in part on our definitions of terrorism and our understanding of its root causes, the nature and magnitude of the terrorist threat, and the factors underlying the formation and maintenance of both domestic and international terrorist groups and networks.

**Contributing characteristics of how the problem is defined.** Consensus as to what actions define terrorism has been difficult to attain. Although the SBE sciences can and should contribute to resolution of this definitional problem, such resolution must also engage historians, military strategists, experts in international diplomacy, and others with expertise outside the SBE sciences. It also must be recognized that investigation of how terrorism takes root and grows in any particular culture and time can be affected by biases that may interfere with sound scientific analyses. For example, the use of the term “terrorism” may over-simplify different types of actors, warfare and motivations, encapsulating them in a single group or act so that critical variables are overlooked. The use of the term “terrorist” denies the perpetrator all claim to legitimacy within Western Culture, even while we cannot come to consensus on the defining characteristics of the actor. Modeling and data collection efforts in the aftermath of a terrorist incident are likely to be different than they would have been in the absence of such attacks. Moreover, definitions that are not cross-culturally acceptable may affect information flows from foreign sources.

Biases introduced by experience with terrorism are likely to skew the application of science to the challenges posed by terrorism. Decision science has taught us that while such biases may not be altogether avoidable, at least we can identify the biasing effects of terrorist incidents on the nature of the science we do, especially on normative and clinical longitudinal studies.

**Terrorism as a cycle, not a discrete event.** Our definition of terrorism should include more than the terrorist attack per se. Systematic analysis needs to be applied to the antecedent and consequent events that are part of both successful and unsuccessful incidents. Such analysis should include details about (i) the blueprints and plans of an attack, whether these are on paper, in computer memory, or in human memory; (ii) why some attacks were aborted; (iii) why and how some attacks were thwarted; and (iv) attack threats, whether real or feigned, that changed the behavior of the target, such as putting it in a readiness or defensive mode that depleted resources or affected public opinion and attitudes.

**Elucidation of the root causes of terrorism** as an individual or group act depends on our understanding of behavior at all levels of analysis, from the basic biological and behavioral mechanisms of emotion, cognition, motivation, and social processes, to the behaviors of groups in small and large cultural and global contexts. The root causes of one terrorist action may have little in common with those of another.

**The nature of the threat: Contributing characteristics of the culture.** We can gain some understanding of the factors that contribute to terrorism through what we have learned about both pro- and anti-social networks and group affiliations, models of social influence and persuasion, and our understanding of how charismatic individuals emerge to lead social movements. We know that ideology, the resiliency of communities, and how strategies are adopted or created to cope with living conditions in which basic needs may or may not be met, are critical in the emergence and success of social movements. We know that education, urbanization, migration (and internal displacement), poverty, opportunities for socioeconomic growth, political development, and political participation are factors in the development and mobilization of social groups. We can gain much understanding of

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SBE sciences can model extremist and socially marginalized group and organizational behaviors, which can help explain why certain people become sympathizers, followers, members, or leaders of terrorist and extremist groups; and how these processes change over time.

terrorism if we seek to understand it in the same ways as we have understood the construction, sustenance, and eventual demise of previous ideologies that mobilized individuals and groups for either good or harm. As with other social movements, the concepts “pro-” and “anti-social” depend on one’s perspective and acts that one group regards as anti-social may be regarded as pro-social by another. Fields such as anthropology, linguistics, sociology, social psychology, and comparative politics can shed light on the self-understanding of terrorists and those who support them. Survey research and media content analyses can help provide information needed to better understand the perspectives of the “other.”

The terrorist threats currently challenging America may have strong extremist components that refer to or exploit religious beliefs. We know that cultural, economic, geographic, social, political, and jurisprudential factors can both foster and inhibit the proliferation of extremism. The SBE sciences can be used to illuminate how the interactions of individuals within cultures and communities contribute to social behaviors such as violent aggression, genocide, prejudice, and stigmatization. In addition, the SBE sciences can help develop interventions and methods for ameliorating violent action that are applicable across cultural boundaries.

**The nature of the threat relating to the characteristics of the individual.** We know that the culture in which people are socialized has a deep and lasting influence on their social behavior and personality. Both pro- and anti-social extreme behaviors often are the result of small group dynamics. The SBE sciences can help us understand specific instances of attitude and belief formation and change, and the interactions of attitudes and beliefs with behaviors. They also can model extremist and socially marginalized group and organizational behaviors, which can help explain why certain people become sympathizers, followers, members,

or leaders of terrorist and extremist groups; and how these behaviors change over time.

The SBE sciences can be used to investigate whether individuals who are part of terrorist groups are more or less likely to exhibit certain personal characteristics, such as particular styles for coping with interpersonal conflict, hostility, humiliation, and aggression or affiliation. It is important to investigate how sources of social identity, such as resident/immigrant, racial, ethnic, or cultural status, may contribute to the likelihood that a person joins a terrorist group. SBE studies can aid the search for commonalities among individuals who engage in suicide/homicide bombing strategies, and investigate the role of ideology, family and community support in promoting such behaviors.

**Nature of the threat: Contributing characteristics of the counter-threat.** Terrorist groups do not emerge in a vacuum but are born, grow, and die in large part depending on how their opponents react. Historical, social and political theory and data indicate that Americans’ response to terrorism will help to determine how terrorism threatens America.

**Terrorists in networks.** Organizational structures of terrorist groups can vary. Over the years, the terrorist groups that most concern the U.S. have evolved from hierarchical to more horizontal and loosely affiliated network formations. In fact, certain groups, such as *al Qaeda* and its affiliates, have become a series of overlapping networks that conduct a range of activities, such as recruit new members, give and receive orders, provide training, secure weapons, and transfer funds.

Social scientists, building on work in mathematics and the physical and biological sciences, have developed a body of theoretical and empirical research on the implications of different network structures for the transfer of information and resources between individuals and within and across boundaries of organizations. Network analyses and models can tell



us how terrorist networks are structured, where their vulnerabilities are, the extent of their dependence on formal and informal institutions for the maintenance and transfer of financial assets, and how affiliations with other networks—either legal, such as charity groups, or illegal, such as organized crime syndicates—affect the growth and resiliency of the target network. SBE scientists can provide data on the circumstances in which networks are situated, how these change over time, points of weaknesses, promising tactics for network disruption, and likely paths of network reconstitution should the disruption of existing networks succeed. Network analyses can be expanded to include not only the terrorists but their targets. The analysis of how terrorist networks operate, thrive or languish as a function of the behaviors of the groups or people that are the targets of their actions will allow for the development of more effective predictive strategies.

**International and domestic arenas.** One of the strengths of the social sciences is their capability to systematically synthesize information about diverse locations in order to understand the links between regions and the manifestation of incident processes at different geographic scales. SBE scientists can monitor stressors and existing areas of regional instability and help to provide continuous assessment of the likelihood of terrorist insurgencies by identifying the underlying circumstances that facilitate (or alternatively, hinder) state-sponsored and extra-state terrorism. The SBE sciences can offer tools of value to those trying to monitor and understand actions in other cultures. The application of linguistic methodologies, such as corpus linguistics and automatic speech recognition technology to the challenges of understanding cultures other than our own is a vital area of evolving research.

SBE science can provide analyses of how a government's political control of geographic space (or lack thereof) may foster terrorism. For example, border functions and policies, differentially depending on the flows of goods and people, may constrain or

enhance trans-jurisdictional responses to issues such as immigration, disaster response, refugee movements, weapons proliferation, narco-terrorism, or environmental degradation.

## Enhancing prediction capabilities

Our ability to understand the causes of terrorism and the nature of the terrorist threat will be facilitated by the creation and maintenance of large-scale data sets that are current and relevant to the terrorist networks and threats of interest. These data sets should include data from both domestic and international populations, and be gathered using trained members of indigenous social science communities (rather than foreign or domestic news services, out-of-country survey teams, or anecdotal sources). They should include data from opinion surveys, specifically gathered with terrorist threats in mind, and trade data, originally gathered for other purposes. Such data collection efforts would be enhanced by:

- ▶ the invigoration of regional and country studies and the fostering of foreign area experience, student exchange programs, and the training of foreign students in American universities among SBE science students and practitioners of social sciences;
- ▶ the promotion of partnerships with universities, community colleges, SBE research organizations and the public workforce investment system that catalyzes and builds the SBE workforce;
- ▶ determining ways in which SBE scientists can effectively interact with the intelligence and law enforcement communities, so that we can put the best scientists together with the best data—whether those data exist in the public domain or not, and
- ▶ the creation of appropriate legal and privacy protections for gathering, fusing and sharing data and information derived from such large-scale data systems.

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**The terrorist threat today is both resilient and diffuse because of...[a] mutually reinforcing, dynamic network structure.**

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National Strategy for  
Combating Terrorism

February 2003

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**Terrorist groups also include domestic organizations... The U.S. government averted seven planned terrorist acts in 1999—two were potentially large-scale, high-casualty attacks being organized by domestic extremist groups... both domestic terrorist groups... and special interest extremist groups continue to pose a threat to the peace and stability of our country.**

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The National Strategy  
for Homeland Security

July 2002

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SBE scientists can provide information on the circumstances in which networks change over time . . . Network analyses can be expanded to include not only the terrorists but their targets.

Such systematic data collection could be used to enhance our understanding of the causes of terrorism and the nature of the terrorist threat by illuminating:

- ▶ the role of extremist ideologies in facilitating the development and maintenance of terrorist movements;
  - ▶ trends in attitudes that contribute to terrorism and how they are affected by personal and social characteristics and world events;
  - ▶ the role of state breakdown and state support in the development and maintenance of terrorist movements;
  - ▶ the different factors affecting the development and maintenance of terrorist sleeper cells, in countries around the globe, including the United States;
- ▶ the role of economic, political, and cultural globalization, including the confrontation of non-Western, transitional societies with Western-dominated “global cultures,” in the development and maintenance of terrorist groups;
  - ▶ the impact of the World Wide Web (Internet) in facilitating new virtual worldwide communications, command and control networks, and the development and maintenance of social movements;
  - ▶ the potential and actual dynamic relationships among domestic and international terrorist-related groups, and among these groups and their presumed target populations; and
  - ▶ the role of the Internet and other mass media in international perceptions of the United States and its role in the world, and how these perceptions affect, positively or negatively, the vulnerability of the United States and its citizens to terrorism.

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## II. How Can We Prevent?

Our ability to prevent a terrorist attack will depend, in part, on detecting who threatens us. Our ability to detect, in turn, will depend on how we adjust to new roles and responsibilities, and on the interactions of American and foreign publics with agents and agencies charged with preventing terrorism.

**Detecting whom among us is a threat.** The behavioral sciences have developed technologies to measure biological and behavioral markers of stress and anxiety—which are likely to correlate with intent to harm—to identify individuals who might pose a threat at critical ports of entry into the U.S., large crowd events, or secure locations. Luggage screeners at the airports are trained with an understanding of human performance factors, such as vigilance and fatigue, that is based on sound behavioral science. The behavioral sciences, including neuroscience, can be used to further develop and evaluate new techniques for the identification and screening of individuals for pre-cursor behaviors or patterns of behavior, including gait and other nonverbal behaviors, that might signal threat and intent to harm. Biobehavioral technologies, such as the use of electroencephalography (EEG), functional Magnetic Resonance Imaging (fMRI), near-infrared spectroscopy, and other bio-imaging techniques, can be further adapted and applied to the detection of deception, threat or intent to harm.

**Adjusting to new roles and rules.** Workers at all levels of local, State and Federal government are being asked to assume new roles and responsibilities, and to work together in new groups in the construction and maintenance of effective terrorist prevention and response strategies. Private industry is being asked to partner with government in infrastructure protection efforts. Private citizens are being asked to be more vigilant and to prepare for possible biological, chemical or radiological attacks both at home and in the workplace. Law enforcement, intelligence agencies and criminal justice systems, via implementation of the USA PATRIOT Act of 2002 and

the integration of a multitude of diverse agencies into the Department of Homeland Security, are assuming new roles and responsibilities. The SBE sciences, especially organizational studies and human factors models and methods, can help us to construct and support the new roles, missions, responsibilities and challenges that are integral to domestic surveillance and detection efforts. These sciences can advise the development of roles and missions that connect resources and infrastructure to antiterrorism efforts without violating the trust and confidence that the public requires of policing in democratic societies.

**Keeping America whole.** The nature of the terrorist acts targeted at the United States, and the people who carry out such attacks, will have differential effects on American communities. It is possible that responses of communities with significant numbers of immigrant and ethnic minority residents will differ from those of majority populations, or that responses in urban areas will differ from those in suburban or rural ones. It also is possible that some communities or people will be made to feel especially vulnerable to security measures with consequent stigmatization, isolation and the possibility of a backlash that could lead to support of terrorist ideologies or movements.

How we respond to terrorist attacks also will have an international impact, which may, in turn, especially affect our immigrant and ethnic minority populations. These may be communities that are likely to be of importance to the prevention of terrorist networks within our own boundaries.

The SBE sciences have a wealth of knowledge and tools for understanding attitude and belief change; how stigmas develop and are sustained; how immigrant groups are isolated and absorbed into mainstream culture; the role of differential access to resources in community vulnerability and resilience; and the short- and long-term effects of racial and ethnic prejudice on political engagement.



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**Because we must not permit the threat of terrorism to alter the American way of life, we have to accept some level of terrorist risk as a permanent condition. We must constantly balance the benefits of mitigating this risk against both the economic costs and infringements on individual liberty that this mitigation entails.**  
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The National Strategy  
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July 2002

## Enhancing prevention capabilities

The implementation of detection capabilities, which is central to many prevention strategies, will be enhanced by:

- understanding the relationships between various measures of brain activity and the psychological processes of cognition, emotion, and motivation;
- further investigation of the relationships among various bio-imaging markers, intentions to behave, and behavior in both individuals and groups;
- investigation of the variance among behavioral and biological measures as a function of gender, socioeconomic status, ethnicity, age, training and experience;
- the development of surveillance technologies along with automated protocols for sorting through masses of information and signaling possible danger signs, and
- advances in data mining, including the collection of new data that can alert authorities to individual or group behaviors that may be cause for alarm.

Prevention capabilities will be enhanced by:

- a better understanding of the impacts of biometric and other detection and tracking methodologies on the privacy rights and sense of vulnerability of the American public;
- a better understanding of the impacts of the development of large-scale information databases on both the American public and on the international community, so as to develop and maintain an awareness of privacy and civil liberties concerns;
- assessing how detection methodologies might impact specific groups of resident or immigrant Americans that may be integral to efforts to prevent the spread of terrorist networks within our own borders;
- the evaluation of tools such as enhanced wiretaps, new money laundering traces, and new trial processes for effectiveness, fairness, and acceptability by domestic and world opinion;
- creating new opportunities for the development of international research collaborations on effective antiterrorism interventions.

# III. How Can We Prepare?

No one can be expected to fully predict or prevent future terrorist attacks on American soil. It is prudent, therefore, to prepare for future attacks. The SBE sciences are integral to the development of optimal short-term and long-term preparation strategies.

SBE scientists have models of threat, risk and vulnerability assessments that can be used in the creation and evaluation of response plans. Data collected in previous instances of natural and technological disasters, as well as data collected after the Oklahoma City bombing and the attacks on 9/11, have led to an understanding of some of the human and societal factors that determine community stress and resilience capabilities. This understanding can be used in the development and evaluation of emergency preparedness and response plans. Studies of building usage and egress, patterns of use of transit systems, and community egress behavior can inform architects, engineers and city planners for how to build and modify our environment in preparation for small-scale and large-scale attack events.

**Risk, threat and vulnerability assessment methods.** Risk, threat and vulnerability assessment methods have been broadened beyond an exposure-response framework to a more holistic view that includes exposure, susceptibility, resistance, resilience, and adaptation. Preparedness efforts can take advantage of improved vulnerability science and hazards research to address the consequences of terrorist attack operations. In particular, modeling both 1) the consequences of terrorism with regard to a particular group, community or operational unit, so that preparation strategies can be implemented that are specific to the needs of that group, and 2) the short- and long-term negative economic consequences of a terrorist attack across variations in the location and nature of the attack, and the community or communities affected, to help guide our national preparedness efforts.

Accurate risk models incorporate measures of surprise, uncertainty, confidence levels, and triggers

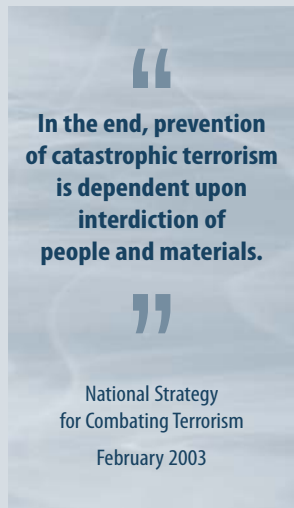
in evaluations of vulnerability. They identify the motivational and targeting factors that cause certain locations, facilities, or individuals to be more susceptible than others to terrorist threats. In addition, indicators of societal or individual values and symbols can be incorporated into vulnerability assessments. By delineating the vulnerability of certain locations, facilities or individuals as a function of type of threat across time, comparative and early warning indicators can be developed.

**Risk communications and shaping responses to warning alerts.** A prepared public is a public more likely to minimize damage and recover quickly. How people assess threats and risk is a strong determinant of what preparation measures they are willing to take and how they will likely react to extreme events. Risk perception and communication strategies are two key areas where the SBE sciences can make a significant contribution to our national preparedness.

Effective risk communication depends on understanding the origins and consequences of differences between expert and lay threat and risk assessments. SBE scientists can assist in the design and evaluation of warning systems and public messages related to possible or actual terrorist attacks. We need to ensure that such systems and messages neither traumatize nor desensitize the public. This will require that those responsible for the development of risk communication plans be educated about the roles of public trust, designated spokespersons, the media, and understand the effects of living with long-term threats and uncertainties. Risk perception and communication factors are contextually dependent and will change across time, so that communication strategies must be continually evaluated and updated.

**Facilitating emergency responders.** Human performance factors scientists know what variables are important to the selection and training of emergency and rescue worker personnel, health care workers, and civil defense personnel who must deal with new threat scenarios, such as the deliberate release of toxic agents. Data and models from human factors research can be used to design biometric

SBE scientists can assist in the design and evaluation of warning systems and public messages related to possible or actual terrorist attacks.



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**The ability to quickly recognize and report biological and chemical attacks will minimize casualties and enable first responders to treat the injured effectively. Local emergency personnel and health providers must first be able to diagnose symptoms.**  
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The National Strategy  
for Homeland Security

July 2002

systems, sensors and screening machines, and protective gear in ways that optimize performance and are sensitive to the needs of the individual who operates these systems as well as to the community in which they function. Human factors science can continue to play an important role in ensuring that the technologies that are created to prevent terrorist attacks or mitigate their impact are designed to be compatible with the capabilities and limitations of the human user. Emergency response systems can be designed with regard to the needs of families and friends of rescue workers, and the social and emotional characteristics of people in conditions of quarantine. Research in this area can help improve our understanding of how interpersonal and mediated communication within and across communities in the event of an attack will affect the impact of an attack.

#### **Facilitating health care in emergencies.**

Experience with SARS has led to some understanding of what happens under conditions of quarantine for health threats and the saturation of health facilities with patients exhibiting physical and psychosomatic symptoms. More than fifty years of research on many kinds of disasters has led to an understanding of crowd collective and convergent behaviors in the face of threatened harm, so that we can begin to predict what people will do in instances of chemical, biological, radiological, or nuclear attacks. Epidemiological models can be used to determine the conditions that affect the diffusion of purposefully introduced diseases among populations of humans, animals, and plants. Ongoing health surveillance data can be used to detect behavioral and other diagnostic trends that could provide early evidence of biological attacks.

#### **Enhancing preparation capabilities**

The development of a robust infrastructure for geospatial, demographic, economic, and health-related longitudinal data and their applications to appropriate models are essential to improving our

Nation's preparedness for a terrorist attack. These data should be collected:

- ▶ from homeland security exercises and other threat scenario exercises;
- ▶ from both national and international sources, in order to capture global financial, labor, and trade impacts;
- ▶ via distributed (and perhaps, redundant) data resources, in order to avoid source-dependent biases, and
- ▶ on a long-term basis in the absence of an attack or any other calamity, in order to have information on a community or group in the absence of stress or disaster (that is, to have baseline measures).

The usefulness of such data and models will depend on the extent to which they are:

- ▶ maintained and distributed across user communities;
- ▶ linked with local, State and Federal public health infrastructure;
- ▶ leveraged for an understanding of other disasters (e.g., a San Andreas or Madrid earthquake; a hurricane strike directly on one of the east coast metropolises, or a medical pandemic);
- ▶ linked with vulnerability and risk assessments of specific locations, facilities, and populations to terrorism or other environmental threats;
- ▶ structured to reflect the interdependence of infrastructure sectors (e.g., electric power grids and communications networks), so as to understand how to minimize contagion of one sector by another as a result of the occurrence of an extreme event, and
- ▶ made an integral part of the education of the next generation of skilled workers, so that the databases can be further developed and evaluated as needs change.

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## IV. How Can We Recover?

A terrorist attack is most successful when its impact is felt well beyond the immediate location of the event. To the extent that a community is able to mitigate the effects of an attack, recover quickly, and isolate the impact of the attack to the attack site, terrorism becomes a less effective strategy. Shoring up our local health and emergency responder networks is, therefore, a strategy not only for recovery, but also can be an effective (although long-term) deterrent against terrorism.

**Planning for the disaster.** The empirical literature on disaster mental health from natural and technological disasters and acts of mass violence tell us about the potential range, magnitude, and duration of a disaster's effects on the stricken community the experiential and demographic factors that influence who within that community is most likely to be adversely affected, and the psychological and social processes that influence the strength or duration of these effects at the community and individual levels. Substantial research links the psychological aspects of traumatic stress reactions to the many neurobiologic systems activated under stress that allow individuals to assess and respond appropriately to potential dangers. These converging lines of research include animal studies of the biological and behavioral effects of unpredictable and uncontrollable stress, descriptive studies of behavioral and biological dysregulation in humans, and clinical studies examining how the severity of Post-Traumatic Stress Disorder (PTSD) symptoms is linked to neural functioning, processing of memories, and interpretations of trauma. This research is informing the development of interventions that may prevent the onset and reduce the severity of posttraumatic disorders.

**Understanding short- and long-term vulnerabilities and strengths.** We know that vulnerability to short- or long-term psychological distress in the case of a terrorist attack or other significant traumatic event is a function of degree of exposure to the event, previous experience with

similar events, mental health status at the time of the event, and social and other post-event support. We know that whereas most individuals recover from such events and exhibit no long-term distress, chronic exposure to stress depletes individual neuroendocrinological and neuroimmunological resources and increases the vulnerability of brain systems that play a primary role in resilient behaviors.

The challenge to isolate the effects of an attack is made greater by the fact that as news information is shared more and more rapidly via television broadcasts and the Internet, media coverage of an attack is one way that an attack may cause nation- or world-wide trauma and affect public opinion and governmental policy. If "there was an attack and no one came," terrorism would be a less effective strategy.

**Enhancing economic robustness.** The SBE sciences can inform us on how to collect the necessary resources for recovery and intervention efforts related to terrorism and other extreme events. Economic interventions require a basic understanding of the trade-offs between security and other forms of government expenditures and the effects of security measures on the economy. More broadly, the SBE sciences can help us understand the appropriate roles of the public and private sectors in pre-attack economic intervention, so that the government is not doing things that can be more effectively addressed by private sector entities, and so that the private sector is not relied on for forms of intervention better suited to the scope and resources of the government.

**Dealing with psychological and social trauma.** Terrorism is not a threat that can be met only by missiles in silos; it is a threat that is met also by people in communities. Psychological impacts of various kinds of attacks must be part of ongoing scenario assessments. It is not sufficient to develop a vaccine or antidote for a biological agent or contaminant: we also need to know whether people

Emergency response systems can be designed with regard to the needs of families and friends of rescue workers, and the social and emotional characteristics of people in conditions of quarantine.

will accept vaccination procedures, what it might mean to vaccinate health workers but not their families or the general public, and how the efficacy of treatments will depend on the behaviors of the people involved.

Victims of terrorism will endure some measure of psychological trauma. In addition, the physical destruction resulting from terrorist acts may lead to an escalation in unemployment, displacement from housing, loss of public transportation and communication facilities, and widespread economic hardship (for individuals, families, organizations, industries, and government). The SBE sciences can help us understand the psychobiological mechanisms by which trauma induces both vulnerability and resilience to adverse outcomes in children and adults and how children are affected by exposure to terrorist attacks and repeated media coverage of such attacks.

Community reactions to a terrorist attack will vary. We know that local community resources—schools, places of worship, community centers, the local library and video store—play a pivotal role in community resilience. Spontaneous and civic memorials and other forms of coming together help to build and sustain responder and citizen resilience. Effective interventions must reflect an understanding of coping strategies and positive response outcomes (e.g., “pulling together,” increased compassion, sensitivity, and helpfulness) following traumatic incidents.

### Enhancing recovery capabilities

With respect to current threats, our capacity to recover from an attack would be facilitated by a better understanding of:

- ▶ the acute and longitudinal effects of traumatic psychological stress, including mental health deterioration and substance abuse, in survivors, family members, unendangered witnesses, and emergency responders involved in disaster mitigation and cleanup efforts;

- ▶ the conditions that make for more effective delivery of psychological first aid, and of those variables that are early markers of individuals who are at risk for the development of long-term mental illness following exposure to a terrorist incident;
- ▶ vulnerabilities in various economic sectors to different types of terrorist attacks, and the potential for negative spillover effects from one sector to another; for example, the economic implications of scenarios such as massive disruptions in the world’s supply of petroleum or the contamination of major city water supplies;
- ▶ monetary policy in times of acute economic disruption;
- ▶ the risk to the economy of loss of confidence in economic institutions, particularly financial markets, but also with respect to a generalized loss of confidence in market mechanisms;
- ▶ the effects of current regulations and security measures on specific industries, and
- ▶ how to design regulatory systems and insurance mechanisms to encourage optimal private sector investment in infrastructure resiliency.

The groups of people tasked with ensuring the safety and security of the national airspace were affected directly by the events of 9/11. Current vulnerability, as well as the massive restructuring and reorganization of the aerospace industry, continues to impact the people who work in the transportation sectors of our society. To understand better how to promote individual and group resilience, the SBE sciences can contribute to recovery efforts by investigation of:

- ▶ the basic neural mechanisms of fear and hope, vulnerability and resilience, and how these are modified by context and experience;
- ▶ the usefulness of presymptomatic markers of exposure to pathogens—that include behavioral

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**The Panel recommends [that we]...establish a research program to help guide public response and policy development, to sustain and augment research into the psychosocial implications of terrorist incidents.**

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The Science and Technology of Combating Terrorism  
President’s Council of Advisors on Science and Technology  
July 2003



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indices—for the rapid classification of individuals into treatment or quarantine, which can be shared with the public in ways that enhance coping strategies;

- how groups best adapt to losses of key personnel;
- features that make labor, supply and distribution networks robust to sudden and extreme shocks;
- the origins of the putative “culture of fear” that may be growing among Americans, and how fear and risk are situation- and group-specific;
- variables that predict full recovery from trauma and resilience, including situations where the long-term positive impact of a traumatic event is greater than its long-term negative impact;
- whether Americans might be made to act vigilantly and be prepared for further attacks by an emphasis on capacity, resilience, and individual and societal strengths, and
- how the mass media affects the quality of people’s responses to traumatic events.

To understand the psychological impacts of various kinds of attacks and allow them to be incorporated into ongoing scenario assessments, SBE sciences must address:

- the clinical assessment and management of short-term anxiety reactions and longer-term vulnerabilities to Post-Traumatic Stress Disorder;
- how behavioral aspects of resilience, anxiety and stress reactions are mediated by social norms, community embeddedness and cultural variables;
- optimization of techniques of early psychological intervention for mitigating adverse consequences, and interventions that hold promise to reduce the risk of long-term disorders and disabilities, and
- identification of the factors that promote resilience at the individual and community level, including family, religion, workplace and other group involvements.

To the extent that a community is able to mitigate the effects of an attack, recover quickly, and isolate the impact of the attack to the attack site, terrorism becomes a less effective strategy.

# Summary of Priorities and Needs

“  
A 2004 Research Project  
at the National  
Institute of Justice  
supports a description  
and assessment of  
Internet-accessible  
databases relevant  
for social science  
research on terrorism.  
”

## Immediate priorities and capabilities

**Infrastructure development.** Central to the development of a robust capability to conduct threat assessment and prepare for terrorism is the creation of a solid social, behavioral and economic science infrastructure that can be used to inform and model preparation strategies. Essential to this enterprise are behavioral, geospatial, demographic, economic, and health-related longitudinal data. These data should be: (1) collected in instances of threat scenario exercises; (2) collected from both national and international sources; (3) collected via distributed (and perhaps, redundant) data resources; (4) include ongoing health surveillance data, and (5) maintained on a long-term basis both pre- and post- event.

These databases should be maintained and distributed across user communities, and (1) linked with local, State and Federal public health infrastructure; (2) leveraged for an understanding of other disasters; (3) linked with vulnerability and risk assessments of specific locations, facilities, and populations to terrorism or other environmental threats; and (4) structured to reflect the interdependence of infrastructure sectors so as to allow for the modeling of the contagion of one sector by another as a result of the occurrence of an extreme event.

This effort would involve acquiring an understanding of the impacts of the development of large-scale databases with information about private citizens on both the American public and on the international community. Whatever is constructed and maintained must protect the individual and privacy rights of all the people included.

Infrastructure development also rests on ensuring the skills and competencies of the SBE workforce and research community.

**Application of modeling methods to complex problems.** Current computational, game theoretic and agent-based modeling capabilities can be

applied to understanding the formation, development, activity, and demise of networks of various sorts and to understanding intersections of terrorists and victims. Modeling can be applied to understanding the interactions, dependencies and vulnerabilities of terrorist networks to other groups and networks, including organized crime, gangs, prison groups, international weapon financiers, NGOs, charities, and international banking and financial groups.

**Enhancement of public health (including mental health) capabilities.** Enhance capabilities regarding (1) early indicators of long-term impairment following exposure to a traumatic event; (2) identification of vulnerable and resilient individuals, groups, and communities; and (3) connection of urban and rural health care facilities for health surveillance.

**Application of decision science methods to risk communication strategies.** This includes assessment of risk perception among the populace in general, among special population groups, and among local, state and federal responders, and how groups and individuals respond to and transmit information regarding prospective and realized threats. It also includes creating mechanisms that ensure that such assessment is ongoing and readily available to those who are responsible for the delivery of risk and vulnerability messages.

**Application of risk, threat and vulnerability assessment and vulnerability models in the creation and evaluation of response plans.**

Preparedness efforts can take advantage of improved vulnerability science and hazards research to address the consequences of terrorist attacks by (1) modeling the consequences of terrorism with regard to a particular group, community or operational unit; (2) modeling the short- and long-term negative economic and environmental consequences of terrorist attacks across variations in the location and nature of the attack, and the community or communities affected; (3) incorporating the notion of

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surprise, uncertainty, confidence levels, and triggers in evaluations of vulnerability; and (4) identifying the motivational and targeting factors that cause certain locations, facilities, or individuals to be more susceptible than others to terrorist threats.

## Capability development and needs

### Development of biometric and bio-imaging technologies for the use of these technologies

to predict behavior with an intent to harm or deceive, and for understanding the relationship between motivation and behavior, and how these measures vary as a function of individual characteristics (including age, gender, ethnicity, and personal history). This also includes the development of noninvasive methods that reliably detect deception and intent to harm, learning how to apply these without threatening privacy and civil rights concerns of both Americans and the international public, and training the next generation of scientists to use these technologies wisely.

**Elucidation of the basic neural mechanisms** of fear and hope, vulnerability and resilience, and how these are modified by context and experience.

**Development of robust, valid models of the psychobiological and psychosocial mechanisms of distress and resilience** across groups, and

better knowledge of links that tie people and organizations together and how these may be disrupted, strengthened, or short-circuited.

**Development of robust, valid, cross-cultural models of social behaviors, social prejudice, and stigmatization**, and application of these models to methods of ameliorating violent actions across borders and groups. These models can be used for many purposes, including evaluation of the likelihood that either isolated or collective suicide terrorism strategies will be used within the U.S.

**Cross-cultural analysis** of the relationships among individual and cultural characteristics that are likely to lead to pro- and anti-social behaviors.

**Further development and integration of major domestic and international databases** that link ongoing and longitudinal survey data with extant repositories of social and economic data and time- and space-linked information about events and activities, that can shape public perceptions and behavior.

**Development, evaluation and application of methods that allow for the sharing of classified data** with scientists without classified status, while still protecting source attributions and other sensitive characteristics.

Terrorism is not a threat that can be met by missiles in silos; it is a threat that is met by people in communities.

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# Conclusion

This report reflects an initial attempt by the NSTC to formulate research priorities for the SBE sciences to address issues related to terrorism and terrorist attacks. Although this report signifies an important first step in this domain, it is by no means comprehensive. This research agenda must evolve as the United States moves forward with efforts to enhance homeland security and as security needs and challenges change.

## **Special challenges for the SBE sciences.**

The SBE sciences investigate the behavior of extremely complex systems. Controlled experiments often are difficult to do. Furthermore, the application of what is learned is appropriately constrained by civic and privacy rights of the American and international publics.

The necessity of substantive research in the social sciences for the creation of effective counter-terrorism strategies cannot be overstated, but it also must be recognized that these sciences face considerable challenges in both practice and application. Ongoing efforts within the SBE sciences on the following issues need to be continued and expanded in order to make the most use of what these sciences have to offer.

**Determining critically important variables of interest.** For example, what is the role of poverty, wealth or access to resources in the recruitment of individuals to terrorist networks? What role do religious ideologies or charismatic leaders play?

## **The definition of key constructs and the determination of how to measure the most meaningful aspects of groups/incidents.**

For example, different academic communities define terrorism differently. While we may not reach consensus on a definition, the role of how we define the problem within the strategies we devise to face the problem must be recognized. If, for example, we view terrorism as attacks only on civilians, and

not military personnel, then our combating-terrorism strategies will reflect that assumption.

## **How to gain access to groups of interest.**

Important information about a terrorist incident can be gained only immediately post-incident. However, for obvious reasons, the collection of data is not of paramount importance in rescue efforts. Providing scientists access to terrorist incident sites remains a challenge that needs creative solutions.

## **How to gain access to data of interest.**

The majority of SBE scientists do not have security clearances that will give them access to terrorist activity data that are collected via our law enforcement and intelligence agencies. In many instances, these data are unique because of the unusual access such agencies have to people of paramount interest. On the other hand, there is some concern that such data—collected for reasons of national security rather than science—might not be useful in the larger SBE sciences context. Communities within each domain need to talk about this problem and find ways to deal with it and have utility concerns evaluated.

**The development of representative and reliable samples.** Terrorism research is notable for the scarcity of data and the challenges it faces in data collection. But it is not only active terrorists that are difficult to access; so also are their victims. Given the low incidence of such attacks, issues of reliability and validity must be addressed using the most sophisticated SBE methodology available.

**The ability to make decisions with imperfect information.** SBE scientists will need to establish confidence intervals for recommendations they may have to make with imperfect or incomplete information. Under certain conditions, time pressures will require scientists to make tradeoffs between analytical purity and the necessity of providing practical and actionable suggestions to policy makers.

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## Looking forward

Terrorism frequently is a tool of groups with access to little military or technological might. The aircraft that were flown into the World Trade Center, Pentagon, and fields of Pennsylvania on September 11, 2001, were a product of American technology. What made them bombs rather than planes was the ideology, individual and group psychology, social engineering and organized behaviors of a

group of men determined to harm America. We will not win against terrorism by military might alone. We will win because we will learn where and when terrorist networks develop and flourish; how to detect threatening individual and group behaviors; how to make our communities thrive so that terrorism cannot, and how to nourish the resilience that always has been our strength.

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## **About this Report**

This report was developed by the Social, Behavioral and Economic Sciences Working group of the National Science and Technology Council (NSTC) Task Force on Anti-Terrorism Research and Development (R&D) and by the NSTC Subcommittee on Social, Behavioral and Economic (SBE) Sciences. The Subcommittee reports to both the NSTC Committee on Science and the NSTC Committee on Homeland and National Security.

The report summarizes some of the critical resources and research opportunities in the SBE sciences related to terrorism and other national or regional crises. The recommendations of this report will be incorporated and further prioritized in the National Strategic Plan for Homeland Security Science and Technology in the Department of Homeland Security. It is recognized, however, that current Federal R&D efforts to combat terrorism are conducted at multiple agencies; thus, these recommendations are intended to provide guidance across the entire Federal R&D enterprise. The emphasis throughout is on catastrophic terrorist events—defined by the method used and impact, including significant loss of life, property, economic vitality, or cultural symbols of the United States.

## **About the National Science and Technology Council**

The National Science and Technology Council (NSTC), a cabinet level council, is the principal means for the President to coordinate science, and technology policies across the Federal Government. NSTC acts as a “virtual” agency for science and technology to coordinate the diverse parts of the Federal research and development enterprise.

An important objective of the NSTC is the establishment of clear national goals for Federal science and technology investments in areas ranging from information technologies and health research to improving transportation systems and strengthening fundamental research. This council prepares research and development strategies that are coordinated across Federal agencies to form an investment package that is aimed at accomplishing multiple national goals.

To obtain additional information regarding the NSTC, contact the NSTC Executive Secretariat at (202) 456-6101.

