

THE NEUROBIOLOGY OF POLITICAL VIOLENCE:
NEW TOOLS, NEW INSIGHTS

A Strategic Multilayer Assessment Workshop

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This report represents the views and opinions of the workshop participants. The report does not represent official administration policy or position.

EXECUTIVE SUMMARY (MS. ABIGAIL CHAPMAN & LTCOL WILLIAM CASEBEER)

The *Neurobiology of Political Violence: New Tools, New Techniques* workshop hosted by the National Institutes of Health (NIH), United States Strategic Command (STRATCOM), the Joint Staff, and the Strategic Multilayer Assessment Office (OSD) brought together nearly 80 representatives of government, academia, and industry in Bethesda, MD from 1-2 December 2010. The workshop facilitated a broad discussion of the current state of the art within the related fields of neuroscience, neurobiology, and social psychology as it relates to deterring political violence. While most panelists emphasized the prematurity of applying current research to real world problems within the national security and homeland defense space, they all agreed that the tools of neuroscience and related fields would serve to better inform current deterrence and messaging strategies.

The workshop was organized as a series of panel discussions and individual discussion sessions. This executive summary is organized by session for ease of reading and use.

Opening Remarks

Ms. Abigail Chapman, Senior Research Scientist at NSI, welcomed the workshop participants to the *Neurobiology of Political Violence* workshop with a discussion on the design and intent of the workshop. She noted that researchers have always been fascinated by the complexities of the human brain and, in particular, investigating the relationship between mind and body. In order to develop a deeper understanding of individuals who are involved in violent extremist activities, it is essential to use a multi-method, multi-disciplinary approach that specifically focuses on the complex relationships between attitude and intent formation and, ultimately, behavior manifestation. Thus, panelists were purposely selected from diverse disciplines and backgrounds.

Although the conference is entitled, *The Neurobiology of Political Violence: New Tools, New Insights*, the Steering Committee sought to encourage open discussion of pertinent findings and to allow for the cross-pollination of ideas, identification of areas for collaboration, and topics upon which other findings can inform and augment the dialogue. Additionally, she sought to emphasize that the conference served as an invaluable launching point for previously unknown research and proliferation of ideas and concepts beyond their initially intended audience.

Introductory Briefings

Ms. Abigail Chapman moderated the first session, which focused on highlighting the connection between basic research and the topics of counter-terrorism, radicalization, violent extremism, and deterrence. The briefers set the stage for the workshop with a discussion of the historical and potential future application of research findings from the fields of neurobiology, social psychology, and linguistics to further our understanding of political violence. This first session (taken together with the read-ahead material) provided conference participants with sufficient background to not only understand the subsequent research presented, but also turn a critical eye towards understanding the potential implications and limitations of this area of research.

Panel Discussion: Basics of the Science

The first panel discussion on the basics of science was moderated by LtCol William Casebeer, DARPA, with a specific focus on understanding behavior and attitude formation from the disciplines

of social psychology, cognitive neuroscience, and political science. The panelists spoke on a variety of related topics, yet all agreed that it is critical to have a common set of definitions when discussing violence across disciplines to ensure that the same concept is being addressed. Although the field of neuroscience is exciting, it is essential for people to understand that the research is at a relatively nascent stage with some topical areas more developed than others.

Panel Discussion: Research I

The first research panel focused on a discussion on the psychological and neurobiological mechanisms underlying violent behavior and decision-making processes. The research panel discussion was moderated by Dr. Tom Feucht, a science advisor to the National Institute of Justice (NIJ) at the US Department of Justice (DOJ). Panelists discussed the ways in which research findings from the fields of social psychology and neuroscience can inform and enrich our understanding of how political attitudes are formed and how and when people practice deception. Additionally, panelists discussed the various ways in which researchers are able to use advanced technologies, such as simulated environments and functional magnetic resonance imaging, to understand how decisions are made and, more specifically, what components of a message are the most persuasive and “sticky” to a target audience. This discussion culminated in the agreement that further research is required in this area, but that there is great benefit to be gained from pairing research targeted at understanding attitude formation and decision-making processes with the tools employed by neuroscientists and neurobiologists.

Panel Discussion: Research II

The second research panel focused on aggression, fear, and trust with a specific emphasis on fear’s impact on decision making and violent behavior. The panel was moderated by Dr. Amber Story of the National Science Foundation. The panelists discussed several topics, including the psychologically motivating factors of terrorism inherent in the Terror Management Theory--a theory that is founded upon the basic principle that human beings are motivated to adopt and police a cultural belief system in order to allay their concerns over their own mortality. Sets of sacred values underpin strong belief systems; such values include those beliefs that an individual is unlikely to barter away or trade no matter how enticing the offer is. While further research is required, sacred values may prove a pathway towards better understanding the deep underlying motivations behind certain acts of political violence and identifying values that are less resistant to change such that they may be used to alter an individual’s belief system and/or motivational schema. The panel also discussed the interactive effect of the environment, developmental process, and genetic expression reflected in the brain. Additionally, the panel discussed the advancement of science in regards to exploring the association between genes and the outward manifestation of behaviors relevant to actions of political violence.

Panel Discussion: Research III

The final panel, moderated by Dr. Debra Babcock, NIH, explored research regarding the impact of emotions and stress on decision making and decisions to engage in violent behavior. Several panelists discussed the ways in which emotion or emotional responses to negatively-perceived stimuli interact with an individual’s decision-making process, attitude formation, and subsequent behavior. Emotion plays a significant role in an individual’s decision to engage in violent behavior; for instance, it was mentioned that violence is an emotional act between groups that can be influenced through genetics, environment, narratives, and perceived behaviors of others.

Building upon the notion that emotions can be modified and transformed through stories or narratives, it may be possible that once the right trigger mechanisms within a story are identified and altered, emotion, or at least the cognitive or behavioral manifestation of the emotion, may prove to be malleable. Additionally, several panelists noted that it may be possible to identify situations in which actions of political violence are likely to occur through observing identified tendencies. For example, a historical examination of state communications preceding international acts of violence show a diminished amount of cognitive complexity in the time immediately prior to the action of the aggressor, but not for the attacked. It was hypothesized that this occurs because the aggressor has already committed to a decision, is no longer stressed or anxious about the outcome, and is engaging in heuristic (vs. systematic) processing of information. Thus, by studying the cognitive complexity of a state leader's communication, it may be possible to identify times in which they are seemingly engaging in heuristic processing of information and, thus, more likely to already have a set course of action in mind. Additionally, other research has shown that there may be universal facial expressions for the identified emotions of contempt and disgust that are generally displayed on the faces of individuals immediately prior to engaging in acts of violence. If future research builds upon the findings, then this may prove to be useful research for identifying critical intervention moments.

Putting It All Together--What Does This All Mean?

The concluding panel of the conference sought to answer the question "so what?" in an effort to integrate the research discussions and provide the policy and decision makers in attendance with critical takeaways. The final session was moderated by Dr. Diane DiEuliis, Assistant Director for Life Sciences in the President's Office of Science and Technology Policy (OSTP). Dr. DiEuliis mentioned that this is an area of pressing national security need and, if the government begins to sponsor more research in the neurosciences and the social, behavioral, and cultural fields, there will be tremendous, beneficial spillover effects. The field of cognitive neuroscience is not only pioneering, but when paired with social science, it will increasingly inform the United States Government's (USG) understanding of international relations and actions of political violence. It should be noted that it is critical to recognize that, although promising, researchers in the field of cognitive neuroscience must continue to conduct and build upon basic research; additionally, they must open the discourse to other research domains in order to obtain the most comprehensive understanding of this topical area.

Dr. DiEuliis and the panel applauded the research discussed during the workshop and all agreed that the cross-pollination of ideas and research findings will prove beneficial in the long run, but that the neuroscience research is still relatively basic, and there remain areas requiring significant exploration. For example, further research is required to determine whether it may be possible to identify the antecedents of political violence and terrorism prior to an act of violence occurring. Likewise, it is important to determine whether there are specific markers of political violence relative to other, more generic acts of violence. Attendees at the workshop and individuals interested in understanding political violence, motivations of and methods to deter, should feel confident that there exists a comprehensive and diverse set of research findings that can help inform and deepen the understanding of political violence. When taken together, it may be possible to predict acts of political violence from afar (e.g., using facial affective recognition systems, analysis of cognitive complexity of leaders, etc.), to understand a population's proclivity to trust

(accomplished through research on the socio-economic impact on certain brain chemicals in populations) and, finally, to craft targeted deterrence messages using key terms, images, and mode using neuromarketing techniques.

INTRODUCTION

The *Neurobiology of Political Violence: New Tools, New Techniques* workshop hosted by the National Institutes of Health (NIH), United States Strategic Command (STRATCOM), the Joint Staff, and the Strategic Multilayer Assessment Office (OSD) brought together representatives of government, academia, and industry in Bethesda, MD from 1-2 December 2010. In all, approximately 80 representatives from multiple government agencies, including the Department of Homeland Security (DHS), Department of Defense (DOD), Department of State (DOS), the National Institutes of Health (NIH), and the Department of Justice (DOJ) participated, along with more than 40 academics and practitioners from United States, Canadian, and British institutions.

WELCOME AND CONFERENCE INTRODUCTIONS (MS. ABIGAIL CHAPMAN & DR. HRIAR CABAYAN)

Dr. Hriar Cabayan, OSD, welcomed meeting participants and thanked the National Institutes of Health (NIH) for hosting the meeting. He recognized the US government sponsors for their participation, including the Joint Staff, US Strategic Command (STRATCOM), Office of the Secretary of Defense (OSD), Defense Advanced Research Projects Agency (DARPA), the NIH, the National Science Foundation (NSF), and the Department of Justice (DOJ) National Institutes of Justice (NIJ). He also recognized representatives attending from Defence Research & Development Canada (DRDC) and the United Kingdom Ministry of Defence (MOD).

Dr. Cabayan explained that this effort has its roots in the *Defining a Strategic Campaign for Working with Partners to Counter and Delegitimize Violent Extremism* interagency workshop held in May 2010 at Gallup Consulting Headquarters in Washington, DC. The workshop brought together sociologists, anthropologists, political scientists, and others. The proceedings are available for official use only and may be obtained by contacting Mr. Sam Rhem at samuel.rhem@js.pentagon.mil. At the conclusion of the workshop, Ms. Abigail Chapman, NSI, and LtCol William Casebeer, DARPA, discussed the need to tap other communities and researchers who are working on the issue of political violence. This conference seeks to gain and share the knowledge between the neuroscience community and the US Government (USG). Decision makers from the USG attended the meeting and were eager to better understand the neuroscience of political violence in order to better conduct their jobs.

Ms. Chapman also welcomed the participants. She stated that the workshop was designed to present cutting-edge research in political violence, as well as to engage the government and research communities in open dialogue. While the conference title contains the term “neurobiology,” this conference will emphasize the cross-pollination of disciplines.

INTRODUCTORY BRIEFINGS (MS. ABIGAIL CHAPMAN, MODERATOR)

Ms. Abigail Chapman, NSI, opened up the conference with some introductory briefs. The first brief was from Dr. James Olds of George Mason University.

UNDERSTANDING POLITICAL VIOLENCE WITHIN THE CONTEXT OF THE DECADE OF THE MIND PROJECT (DR. JAMES OLDS)

Dr. James Olds, Krasnow Institute for Advanced Study, George Mason University, spoke about the Decade of the Mind project—an international project involving the US, Singapore, and the European Union (EU) aimed at elucidating how various facets that make neurobiology interesting to the public actually happens. Neuroscience gets at the issues of mental health, neurological diseases, consciousness, ability to be creative, and even engagement in violence. The goal is to capture the imagination of the general public, politicians, and the international community. The challenge is that the science has not developed to the point where all of the dots can be connected.

Political violence has been around for a long time but has received renewed prominence in the recent past. It is not a purely human occurrence either. It exists in phylogenetic cousins like chimpanzees. It suggests that there is an evolutionary component to understanding what this phenomenon is all about. Human brains are evolved machines. They are not engineered and have many positive features, as well as bugs.

The US portion of the Decade of the Mind project is quite impressive. Approximately \$4 billion will be invested in understanding the brain over the next ten years. However, in comparison, the NIH spends \$10 billion a year on neuroscience research. The \$4 billion allocated to the Project of the Mind is government-wide. The government of Singapore is about to spend \$16 billion Singapore dollars (over US \$12 billion) in this area of research over the next five years. If the United States does not step up to this challenge, other countries will do so willingly. The next decade will help explore how the human mind emerges from the brain.

Descartes hypothesized that there is an inherent dualism of the mind. He spoke about the notion that the soul was separate from the brain and was responsible for activities, including political violence. That dualism between the mind and the brain is still not well understood.

There are many complex adaptive systems (CAS). Some include war, political violence, and brains. Dr. Olds stated that he believes that the mind is an emergent property of the brain and that violence is an emergent property of the mind.

Violence has changed radically over time. When researchers were trained in neuroscience 20 years ago, they worked on mice, and the issues they studied were not relevant to political violence. The problem with mouse models is that mice and rats do not have complex minds. Today, more work is being done on volunteer college students to query the conscious mind and look at neurobiological responses using fMRI technology.

Stimulating or perturbing the human brain can be done through a Transcranial Magnetic Stimulation (TCMS), which allows researchers to turn parts of the human brain on and off in order to understand the interrelationship between them.

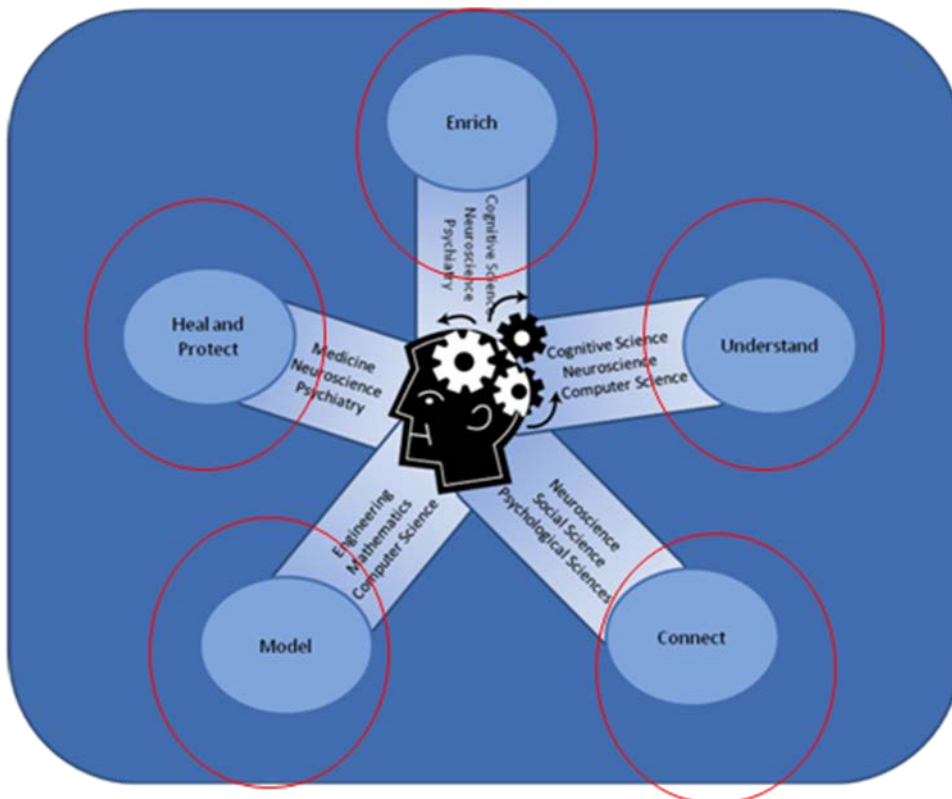
Dr. Olds showed an image of a basic neuron wiring diagram that illustrates the sheer number of neurons and their connections, which is astounding. The neuron is less a computational element than the spine, but the neuron and synapse are relevant computational elements. In fact, the scale of looking at all synapses is so immense that it makes one wonder whether scientists are even ready to look at the problem.

One objective of the Decade of the Mind project is to create a complete wiring diagram of a cubic millimeter of mouse brain. Each cubic millimeter costs approximately 35 million dollars. This may seem preposterous, but many researchers thought the Human Genome project was infeasible as well. However, one complete wiring diagram of a millimeter of mouse brain will tell us nothing, so we need multiple wiring diagrams.

Neurons are structurally complex, but there is an underlying order. One simplifying assumption is that the brains have types of neurons. While each neuron is individually distinct, it can be identified as a member of a class.

Dr. Olds stated that George Mason University just finished leading a grand challenge project with Howard Hughes Medical Institute and the Allen Brain Institute to address the brain wiring problem. They discovered that producing wiring diagrams must be industrialized in order to provide value and understanding. The Diadem World Challenge asked software developers to automate this process. Computers have a difficult time reconstructing a neuron three-dimensionally, because there are a lot of ambiguities. However, there are not enough graduate students or resources to increase the scale of diagram production without industrialization.

Molecular neuroscience is a field that is making great progress. There are roughly 32,000 genes. Only 8,000 are brain specific. Scientists can look at all of them. They have the ability to integrate across multiple layers from molecules to cognition.



The image to the left shows the US model for the Decade of the Mind. Each branch of the model relates to understanding political violence. One benefit of this study may be to better comprehend and ameliorate symptoms of Post-Traumatic Stress Disorder (PTSD).

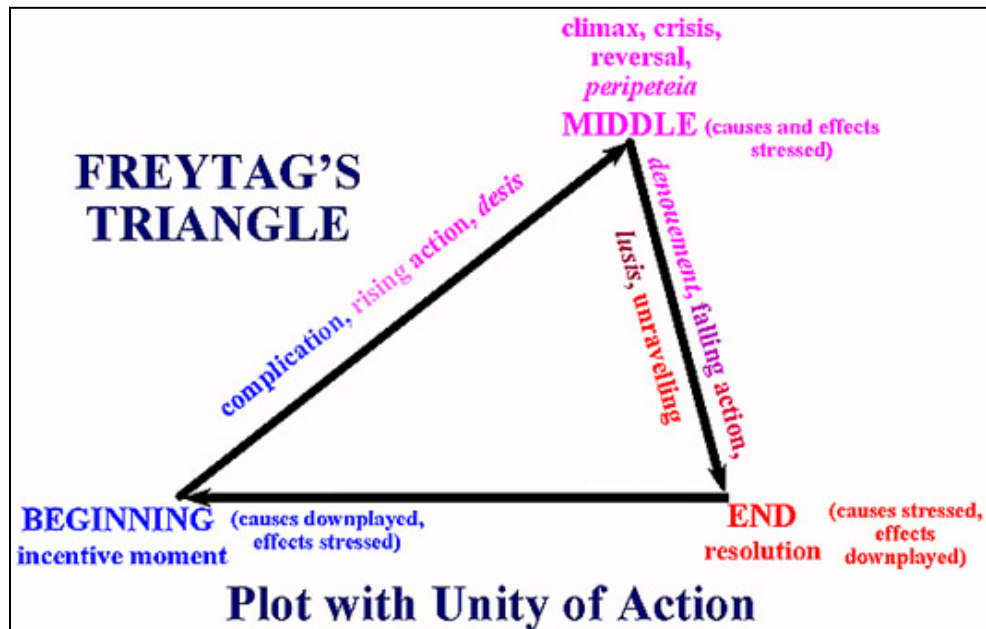
A serious community-wide conversation addressing ethical questions in neuroscience must be held soon for many reasons. First, recent technological and biomedical progress make the present time

ripe for breakthroughs in the study of the mind. Second, success will have broad and dramatic impacts on the economy, global security, and our social well-being. Third, success will require a major investment in research and development.

STORIES, NEUROBIOLOGY AND POLITICAL VIOLENCE: EXPLORING THE NEURAL MECHANISMS OF NARRATIVE PSYCHOLOGY TO DEVELOP WAR FIGHTING TOOLS (LTCOL WILLIAM CASEBEER)

LtCol William Casebeer, DARPA Defense Sciences Office, spoke about the power of narrative in understanding motivations for political violence. He stated that Dr. Olds' brief showed how the Decades of the Mind project and its exploration of neuroscience might be used to understand and reduce political violence. LtCol Casebeer attempted to show how to link the phenomena of political violence to neurobiology and how understanding these links can inform the production of tools (such as simulations and sensors) that the government and military can use to help reduce political violence.

LtCol Casebeer argued that stories are a critical Department of Defense (DoD) resource. Stories and narratives have a powerful influence on human psychology, including memory, reasoning (emotion and cognition), and identity. Additionally, a wide array of behaviors salient to the war fighter are influenced by stories, including radicalization, political violence, support for counter-insurgency by fence-sitting populations, and stakeholder mindset in multiple security situations like negotiations. The study and basic science of stories has reached a tipping point. Scientific disciplines, including the co-evolving fields of psychology and neural mechanisms, are beginning to mature, but are in need of support and integration. Terrorism is a clarion call; depth in our understanding of story ecology is necessary to move forward and put hard science behind our intuitions about how to confront it.



A story is aschematic stimulus, often taking the form of a spoken or written text embodying a Freytag triangle structure. Freytag's triangle involves a beginning, middle (climax, crisis, reversal, etc.), and an end.

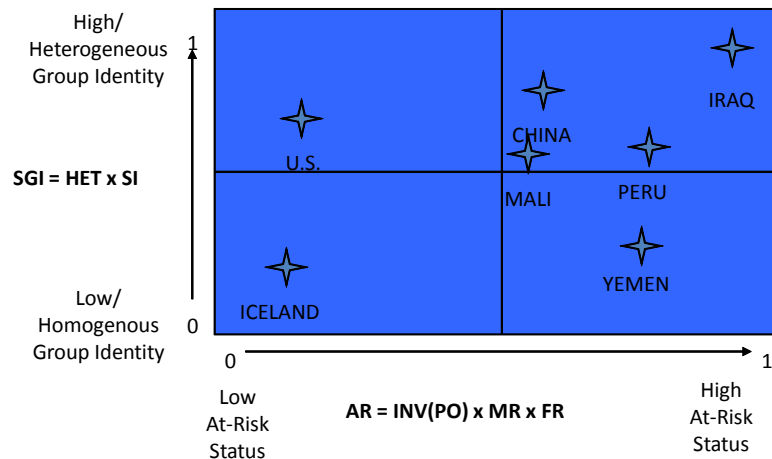
LtCol Casebeer argued that story frames are good at cuing feelings and creating identities. For example, he wakes up each morning and he tells himself something about the purpose of his life with a story. That suggests part of what he ought to do that day and helps define his in-group and out-group members. Harnessing and applying good science and technology can help illuminate this process. Many implications follow from a simple narrative about one's role in the world.

The ecology of political violence is shot through with stories. Counter-insurgency is story driven. The DoD needs to understand the stories vulnerable populations tell about the Taliban and the coalition and how a population responds to groups moving in. LtCol Casebeer stated that what is hampering progress in the Middle East peace process, for example, is story frames, not particulars about the negotiations.

Not all stories follow Freytag’s triangle, but the structure is present in many political stories. If we are going to understand stories using neuroscience, we need to analyze them quantitatively to produce a set of tools that decision makers and strategists can use. Quantitative tools are required to understand how causal factors interact.

If we want to explain why there is a difference in judgment on fundamental moral issues, we need to understand how narratives influence the brain to process that decision. Regions of the brain involved in memory, emotion and anticipating consequences of actions may help us understand decision making, and stories can influence which of these regions is most active in a given circumstance.

Stories & Political Violence: Assessing Vulnerability to a Violent Social Movement



KEY: SGI = Salient Group Identity, HET = Heterogeneity, SI = Salient Identity, AR = At Risk, INV = Inverse, PO = Political Opportunity Measure, MR = Mobilizing Resources, FR = Frame Resonance
...stories influence several of these variables

Theorists have produced tools informed by narrative theory that are useful for strategists. On this chart, the x-axis represents a region’s risk for mobilization of a violent social movement. The Y-axis identifies the role group identities play in the mobilization process. The chart suggests that political violence may be due to lack of political representation. Furthermore, mobilization occurs only once resources are available and a story frame becomes relevant. Without these two elements, the group will not mobilize. This chart shows that Iceland is homogeneous and has a transparent political system. Iraq is the opposite with many ethnic groups and (at least several years ago) no transparent accessible political system. If we can understand how neurobiology contributes to the mobilization of violent groups, we can better the science and improve these tools. A

neurobiological understanding of how identities are formed and become politically salient is needed.

The goal of LtCol Casebeer's research agenda is to spur and co-evolve the basic science of stories to produce neuropsychologically-informed tools for warfighter. Potential outcomes of this research may include

- (1) analysis: advance methods to quantitatively decompose stories systematically,
- (2) neurobiology: quantify the influence of stories on human psychology in neuroscientific terms in
 - a. trust
 - b. reward
 - c. belief fixation domains; and
- (3) tools: exploit that understanding to develop Department of Defense tools useful at tactical-to-strategic level, including hardware (sensors), software (simulations), and suggested doctrinal modifications.

LtCol Casebeer gave some examples of ongoing investigations. One study looks at the role of stories in spurring oxytocin production in the human brain. Oxytocin is an important trust modulator. There is some emerging work being done on how Tweets can create a rise in oxytocin release based on message content. This kind of work could be critically important to understanding how groups form and how we can influence their formation. The hypothesis of many of these studies is that stories differentially modulate endogenous oxytocin production.

LtCol Casebeer also spoke about ongoing research to link narratives to dopamine release. Dopamine may transmit "reward prediction error" and, thus, act as a teaching signal for the part of the brain responsible for learning. One pilot study links Freytag triangle-driven narratives to dopamine release. The initial attempt is to correlate liking reactions to stories with mid-brain endogenous mid-brain dopamine uptake. The hypothesis is that stories differentially modulate dopamine production, and this is linked to liking/disliking reactions.

LtCol Casebeer then spoke about research linking narratives to belief fixation. There is independent behavioral evidence that storytelling modulates "sacred values." The neural correlates of those sacred values could be identified. The hypothesis is that stories can differentially move beliefs along the sacred/non-sacred "indifference" curve.

REMARKS ON THE PREDICTION OF VIOLENCE (DR. MICHAEL GAZZANIGA)

Dr. Michael Gazzaniga, University of California Santa Barbara (UCSB), stated that he would be interested in better understanding the elements of a story. He asked whether stories consist of dispositions based on moral judgments or multiple domains. He stated that a researcher could observe a story, watch the outcome, and build another disposition that feeds back into the storytelling loop. Neurobiology can help understand and inform this process. However, the story elements that triggered the outcome of interest need to be studied.

LtCol Casebeer responded that these are empirical questions. He had some hunches; some are empirically confirmed and some are conjectures. Stories are complicated and have an ecological validity problem. The tool used to understand stories cannot be so complex that there can be no real science behind it. Whatever tools the USG ultimately produces should be simple.

Dr. Gazzaniga stated that an example of one tool that could be used to understand stories is an fMRI machine. Dr. Casebeer responded that fMRI was important in determining independently in a lab that different themes stimulate dopamine release in a way that is subliminal. Behavior may be influenced by the activity of those mechanisms. He stated that he wanted to know what those story elements are so that when a war fighter or decision maker goes into a region to persuade, he does not cue a scheme that triggers a negative reaction.

Dr. Tom Pyszczynski, University of Colorado, stated that stories have a dynamic character; they activate certain cognitive interpretations. In cognition, researchers emphasize knowledge activation; it is the distinction between pressing a lever to divert a train versus pushing someone off a bridge (see bridge scenario below). One's perspective allows him or her to focus on the whole picture. However, if you see the person you are pushing, it interferes with the execution of the act. The dynamic nature of storytelling is important. LtCol Casebeer agreed that the dynamic aspect of stories has to be folded into the research agenda.

Bridge Scenario

You are on a bridge overlooking a railway track with a stranger. You are both looking down, and you can see a group of five people at the end of the railway tracks in the path of the oncoming train. The only way to save the five people is to push the stranger off the bridge. Are you willing to push the stranger to save five people?

Dr. Gazzaniga stated that this is putting the cart before the horse. It seems that the government and the intellectual public have become intensely interested in predicting violence, especially after we experience horrible acts of violence. Psychologists are called into duty after these events to figure out how to stop and anticipate these events.

Dr. Gazzaniga stated that the policy community keeps hoping for absolute solutions for ending political violence. However, it flies in the face of reality. In a court of law, experts are called upon to anticipate whether a criminal is likely to commit another crime (recidivism). These experts are correct only 33% of the time, which is not sufficient, yet an expert's opinion has a tremendous impact on the jury. There are tools that can better predict recidivism (see Monahan), but courts and juries do not like tools.

The hope is that neuroscience is going to add some dimension of understanding or some tool that will further enhance our capacity to predict future danger. It is a question of pooling independent measures and enhancing arguments for reliance on probability.

Dr. Gazzaniga stated that there are examples where genetic expressions can predict whether abused children will grow to be functional adults or whether they will succumb to their situation.

Dr. Gazzaniga spoke about the pixilated brain, which shows functional connectivity based on brain imaging. This method can identify zones or nodes that have a tendency to change and be part of a second network in another learning experience. If there is a dynamic relationship between networks, there is an increased probability that a person will be able to learn and acquire new information the next day. This is a new type of science that is multidisciplinary and will produce a new set of tools.

One participant noted that even if tools could tell that a criminal has a 92% chance of recidivism, what can law enforcement do about it? The values of American society dictate that one cannot be imprisoned for anticipated crime. Essentially, there is a freedom to recidivate. As the neuroscience community gets better at anticipating crime, should law enforcement take any preventative detention action? It is a heated debate in the legal system. The neuroscience, law enforcement, and policy communities have to think about these things as the ability to make predictions improves. The community should be thinking hard about how to use these tools and how they match with society's values.

Dr. Steve Kornguth, University of Texas, stated that in all cases where people committed antisocial behavior, and therefore have a higher rate of recidivism, he was not sure there was any neuro-marker that is a better predictor than the behavior itself. Dr. Gazzaniga agreed that this issue is complicated. The trend may be that science is blindly going forward to predict things. That may happen, but people have to think what to do with these new developments. It requires sophisticated thought.

Dr. Deborah Olster, NIH, stated that you can turn the problem around. You might be able to use the same kind of approach to improve prediction and look at the 8% who do not show recidivism. One could look at what is different about that group to better intervene with the other 92% to prevent recidivism. Dr. Gazzaniga agreed. He stated that researchers will need to report individual data to strategize to solve problems over time. One can imagine a vast database where you would be able to look up where someone stood in a highly normative system to see if they are on the edges.

In response to a question from a participant, Dr. Gazzaniga stated that people who score higher than 30 on the psychopathy scale are more likely to use violence. Additionally, there are low- and high-violence incarcerated populations. Impulsivity control is another way of talking about tendency to use violence. In traditional terms, 1% of the population will commit 40% of the crime.

PANEL DISCUSSION: BASICS OF THE SCIENCE (LTCOL WILLIAM CASEBEER, MODERATOR)

The first panel discussion on the basics of neuroscience and neurobiology was moderated by LtCol William Casebeer, DARPA, with a specific focus on the frameworks for analyzing and understanding behavior and attitude formation from the disciplines of social psychology, cognitive neuroscience, and political science. The panel included:

- Dr. Amy Zalman, SAIC
- Dr. Arie Kruglanski, University of Maryland (UMD)
- Dr. Joan Chiao, Northwestern University
- Dr. Emile Bruneau, Massachusetts Institute of Technology (MIT)

LtCol Casebeer, DARPA, began his session by introducing his panelists and their presentation topics. The presentations were titled as follows:

- Dr. Amy Zalman, “Semiotics and Statecraft”
- Dr. Arie Kruglanski, “Terrorism as Means to an End: How Political Violence Bestows Significance”
- Dr. Joan Chiao, “Cultural Neuroscience of Intergroup Relations”
- Dr. Emile Bruneau, “Identifying, Regulating and Measuring the Psychological Biases that Contribute to Political Violence.”

DR. AMY ZALMAN, SAIC

Dr. Amy Zalman, SAIC, began her talk about semiotics and statecraft by conveying an anecdote that illustrated the power of semiotics and narratives. At the time of the New York Blackout of 2003, Dr. Zalman was living in New York City. At mid-afternoon, her electricity died during an exceedingly hot day. As anyone else would, she went onto her balcony to escape the heat and to find out what was going on. On the balcony of neighboring apartments were others that were palpably concerned that the blackout was an act of terrorism. Indeed, the question of whether the blackout was terrorism or not was never really resolved. In the news media, the event was framed as “not terrorism.” This anecdote illustrates the primary question of how people come to make meaning out of events, something that Dr. Zalman studies. Her area of research includes the study of semiotics or the significance of signs, discourses, narratives, and symbols. The blackout and other similar events, including natural disasters and terrorist attacks, overwhelm individuals’ causal abilities and faculties.

One of the most dominant explanations for the current political violence is that it is precipitated by religion, particularly since 2001. This conception of political terrorism is incomplete and far too simplistic; there is far more involved. For instance, the Iranian Revolution, which is often characterized as a purely religious event, had social and political discourses and languages that were injected into religious rituals and notions of martyrdom, including a lot of Marxism.

A few years ago, a group of several young Somali men in Minneapolis decided that they would participate in the jihad in Somalia and immediately left their community. Dr. Zalman and her team examined the group’s circumstances at that particular moment and their status; they were all immigrants in a marginalized community. The community of which these young Somalis were a part was generally adolescents upon immigrating to the United States; some members of the community assimilated and did well, but a small component of this community did not assimilate so well and were consequently alienated. A small subset of this alienated population turned to a very stringent form of religious orthodoxy becoming the group of men in question. The small proportion of the broader Somali population of Minneapolis chose to go to Somalia as a resolution to a narrative arc of alienation and their personal experiences and need for personal coherence as adolescents.

Dr. Zalman continued by noting that political violence had been mentioned in every presentation so far, but it was yet to be defined. It is very likely that not every panelist had the same sense of what political violence was; particularly, the panelists were likely to disagree on the relevant level of

analysis. Nonetheless, most of the research involves individuals, but political violence itself is often discussed in terms of group dynamics. Likewise, a critical question entailed whether all political violence should be discussed or only the unsanctioned variety.

Additional considerations relevant to the discussion of neuroscience at the intersection with national security are the recognition of rationality and emotionality as it relates to these issues. Within the national security community, there is often a belief that states should act rationally to maximize their utility, provided sufficient and adequate information. The most recent application of a “rational” approach to political violence is Robert Pape's recent research regarding the strategic imperatives of terrorists and violent actors. The primary objective of terrorist groups is to force modern democracies to make serious concessions to national identity groups. In those terms, suicide terrorism maximizes these groups’ coercive power, persuading targets that they are serious and are capable and willing to do it again. Suicide terror groups also allow attackers to ritualize their own deaths and connect them to community values (i.e., to a broader symbolic importance or narrative).

There is a concomitant body of research that suggests that terrorism can be emotionally motivated through symbolic actions. There has been research of this sort relating to ethnic violence. Given the opportunity, individuals will sometimes differentiate themselves more from other groups—reifying the symbols and myths of their own identity group. At that point, the idea of symbolic politics and emotionally-motivated violence is actually quite distinct from rationally-motivated violence.

Another term that requires definition is the term “violence” itself. The Department of Defense does not have a definition of violence, but it does have a dictionary providing terms that implicate violence itself (terrorism, piracy, civil disturbances, etc.). The definition is not clear for either the social sciences or the hard sciences.

The point is, when the move is made toward the application of neurobiological tools to political violence, the definition of these terms matters.

DR. ARIE KRUGLANSKI, UNIVERSITY OF MARYLAND

Dr. Arie Kruglanski, co-director of the Center of Excellence for Research on the Behavioral and Social Aspects of Terrorism and Counterterrorism at the University of Maryland, began his presentation *Terrorism as Means to an End: How Political Violence Bestows Significance* by indicating that he falls distinctly on the “mind” side of the Brain-Mind divide. He expressed a hope that in the course of these discussions, conference attendees will be able to bridge the divide inherent to Cartesian dualism. Dr. Kruglanski’s primary objective for the presentation was to provide a brief sketch of the psychological components of terrorism.

Dr. Kruglanski introduced his presentation by providing a brief description of the history and progress within the social science community vis-à-vis terrorism. He noted that there has been a significant acceleration in research since September 11th.

The initial impulse of psychology is to focus on the individual, because their deviance is the most characteristically unique and frightening (in the realm of psychopathy). There is no unique psychopathological profile for terrorism. If terrorism does not result from personality alone, maybe it is about poverty or political oppression, but here again, there is little correlation between

poverty/wealth and the tendency to commit terrorism. Osama bin Laden is a billionaire, and he has chosen terrorism.

Personality can be important to terrorism. There are distinct characteristics that are connected to terrorism--rigidity, dependency, etc.--but they are by no means the sole factors. In Dr. Kruglanski's research, with regard to the Al-Qaeda (AQ)-affiliated terrorist groups in the Philippines and Sri Lanka, collectivism, a need for closure, and other elements predict violence, but only do so in

The Proximal Focus: Psychological States, Ideologies and Social Networks as Explanations

- Psychological States: Black Widows of Chechnya, Palestinian Suicide Bombers, The Tipping Point Concept
- Ideologies: The sacred values notion (Atran, Ginges), ideological component of deradicalization programs
- Social networks: Sageman's "bunch of guys" notion

particular circumstances. Situation also matters to terrorism. Many of today's terrorists come from countries that have suffered political oppression (oftentimes foreign occupation). In some circumstances, such oppression may count; in others, it may not. So, the question is what are the moderating conditions that determine under what conditions, oppression, poverty, or other types of adverse conditions, will encourage terrorism? Another question is under what moderating conditions specific

personality characteristics, such as rigidity, dependency, narcissism, aggressiveness, or need for cognitive closure, will contribute to the tendency of individuals to engage in terrorism?

The radicalization of a terrorist results from a multifactorial relationship, and the moderating factors matter just as much as the causative contributors. In recent terrorism studies, the proximal approach has been adopted in which researchers have cleaved terrorism along three general categories. These were: (1) psychological states (such as humiliation and trauma), (2) ideological beliefs and sacred values (that could be religious, ethno-nationalist, rightist, or leftist), and (3) the social networks and connections among participants in terrorism (emphasized in Marc Sageman's well-known work).

One issue with this tripartite theoretical system, which explains terrorism as a result of psychology or ideology or social networks, is the implication of exclusivity; each theory group argues for the primacy for their own pet hypothesis. Those who stress personal humiliation and trauma view it as the exclusive cause of terrorism and consider ideological beliefs as mere after-the-fact rationalizations. Dr. Kruglanski noted that all are relevant and correct and that they operate interactively.

One way to look at this is to entertain terrorism as part of a panoply of human behaviors/interactions. Most behavior is goal-driven; the behavior is a means to some goal. Terrorism is goal-oriented in the same way that many other behaviors are. Consistent with each of the three primary theories, terrorism can take a variety of goals. From the psychological aspect, personality states can induce a goal, which precipitates terrorist engagement. Ideologies can,

likewise, suggest a means to pursue that goal, and social networks can persuade an individual of the worthiness of the goal and the effectiveness and legitimacy of the means.

The question is: is there a unique motivational force that compels terrorism? The literature is nonspecific in this regard with multiple hypotheses; but, perhaps it is possible to see what lies beneath these surface goals. Recently, researchers have tried to make the argument that there is a universal motivational construct, the quest for significance, which is an umbrella term for a variety of motivations identified by psychologists since the 1950s. The basic idea here is that everyone wants to matter; people want to view their lives with some significance. Death is the ultimate threat of insignificance.

This significance quest can be instigated in circumstances of significance loss (humiliation of self or one's group by the enemy, for instance) as much as it can be motivated by the mere threat of significance loss, among other scenarios.

The functional gist of terrorism is the means suggestion (i.e., the means of achieving some end);

ideology argues that some behavior/technique will gain you significance. A motivating ideology may not necessarily need to be intricate or complex; a person must not be an expert in the ideology, nor must it be religious in nature, and it can derive from a very simple belief that a very revered leader would love you if you join/commit terrorist acts — the bestowal of significance. The ideology suggests a means that is anchored within the shared reality of the group.

Indeed, the means/ends conception offers an integrative framework for organizing psychological factors in terrorism. The conception allows for relevance as a result of turning to terror emanating from personality variables (e.g., rejection, sensitivity, conformity, and collectivism), while also allowing for the relevance of situational factors. This theoretical framework allows a place for psychological states, ideologies, and social network factors, while also being parsimonious in the use of these factors by confining their application to situations when they are relevant to the formation of a personal goal (significance quest) and the choice of a specific means (terrorism).

Dr. Kruglanski and others have conducted research related to this significance loss paradigm. This research has indicated that significance loss prompts a collectivist shift and an associated adoption of the group's ideology. The collectivist shift affords the individual both the restoration of significance (group identity reduces the fear associated with mortality), and it increases the willingness of the individual to sacrifice themselves for the good of the group. By this chain of events, significance loss increases the readiness of an individual for self-sacrifice.

In several survey-based studies in Egypt, Indonesia, and Pakistan, the relationship between significance loss and collectivism became apparent. Those who identify as individuals support

When is the Significance Quest Goal Aroused?

- In circumstances of *significance Loss* (Humiliation of self or one's group by the enemy, deviation from "the straight and arrow," exclusion, discrimination)
- Under *threat of significance loss* (the Japanese Kamikaze example)
- Presented the opportunity for *significance gain* (earning a place in history as hero and martyr)

violence against Western civilians to a much lesser extent than those who associate with their religion or nation. These findings have been replicated across countries (Middle East vs. Sri Lanka).

Sexual rules and mores tend to be very important across civilizations. Deviations in sexual norms may cause shame and alienation; this may instigate the experience of significance loss and lead to martyrdom as a way of significance restoration. A recent study conducted at the University of Maryland found that the Christian, Muslim, and Jewish participants who are extrinsically religious had a greater propensity to express sexual guilt when presented with sexual images. They also found that they had a greater likelihood/propensity toward martyrdom or self-sacrifice.

Dr. Kruglanski concluded his remarks by suggesting that there is likely some utility to evaluating terrorism in terms of a means/ends analysis. Such an approach allows for integration rather than adopting a piecemeal correlative approach. The idea of terrorism as but an instance of human behavior may have some advantages to it (the banality of evil).

Dr. Cabayan asked whether there had been work done to determine optimal intervention strategies to stop the path into terrorism. Dr. Kruglanski responded that the deradicalization programs in various Middle East countries are a first step to convince radicalized individuals that there are alternative pathways.

DR. JOAN CHIAO, NORTHWESTERN UNIVERSITY

Why study cultural influences on brain function?

- Cultural experience influences behavior and brain function.
- Cultural variation in brain structure and function may exist, even in the absence of cultural differences in behavior.
- Genomic variation across cultures. 70% of genes are expressed in the brain.

(Chiao & Ambady, 2007; Chiao, 2009)

Dr. Joan Chiao, Assistant Professor of Psychology at Northwestern University, continued with panelist presentations by sharing another perspective that she hoped would link the social and cultural conceptions of these ideas. Her presentation was entitled *Cultural Neuroscience of Intergroup Relations*. Most terror and political violence begin with very small steps on the parts of individuals. Continuing from Dr. Kruglanski's discussion, Dr. Chiao chose to talk about the banality of basic social and psychological conceptions. Just as geography plays an important role in defining us as human beings in terms of

who and what we are (e.g., urban vs. rural), religion, ritual, and cultural traditions can define us as well. These ritualized behaviors, inherent to culture, alter the conceptual meaning of things like good/bad and right/wrong, which, in turn, can shape cultural identities and behavior vis-à-vis others who do not ascribe to the same belief systems.

The decade of neuroscience is really about building maps of human neurobiology. It is possible to think about human neurobiology in a similar way to how people centuries ago conceived of the earliest maps; but these maps can be as unpolished as early human maps due to the cultural and population biases inherent to the social sciences. Indeed, it is important to recognize the effect that

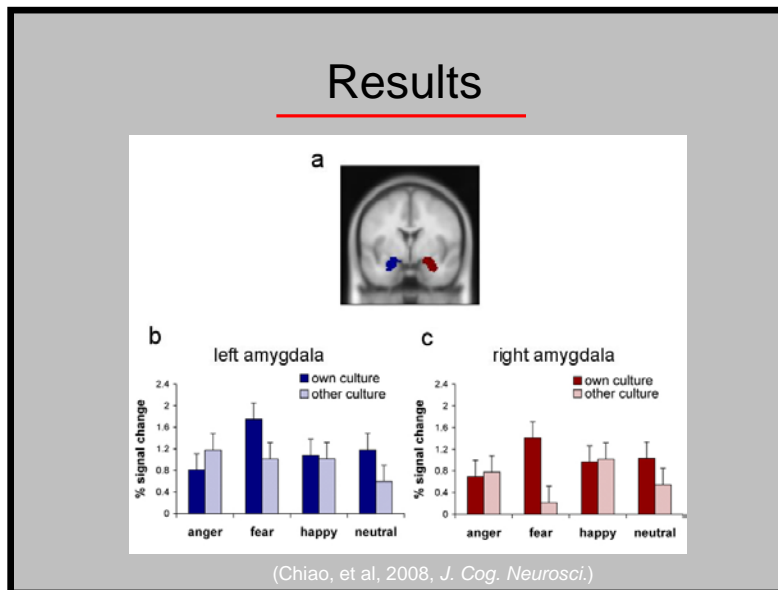
researchers' population biases (in terms of the research subjects they study) and cultural biases have on the generalizability of neuroscientific findings.

The brain does not exist in a vacuum as a world unto itself. Culture influences behavior and brain function. Indeed, there may be variations in brain structure and function across cultures despite the absence of culturally-predicated behavioral differences. Cultural priming can occur at any moment and can be mapped onto biological timescales and ideas.

The data Dr. Chiao presented during her talk resulted from cross-cultural neuroimaging (i.e., neuroimaging studies were conducted on multiple ethnic/cultural populations compared to the general use of largely Caucasian, undergraduate student study populations typical of similar fMRI studies). Dr. Chiao adopted this approach because it is possible to control for the signal-to-noise ratio. Such an approach is vital to understanding the brain in order to help resolve intergroup conflict. Indeed, one of the most basic banalities of this process includes how humans infer the emotions of others.

It is widely known that there are cultural influences on emotion and emotion recognition; individuals are more empathetic to members of their own groups, picking up on the emotions more easily than they would with members of an out-group. There are differences in response states; happiness can cause a high in the United States; whereas, it can cause relaxation/calm in other countries. Most research is in Caucasian populations because Caucasians are more readily available in the developed world where these tools and people are available to conduct research; yet, the

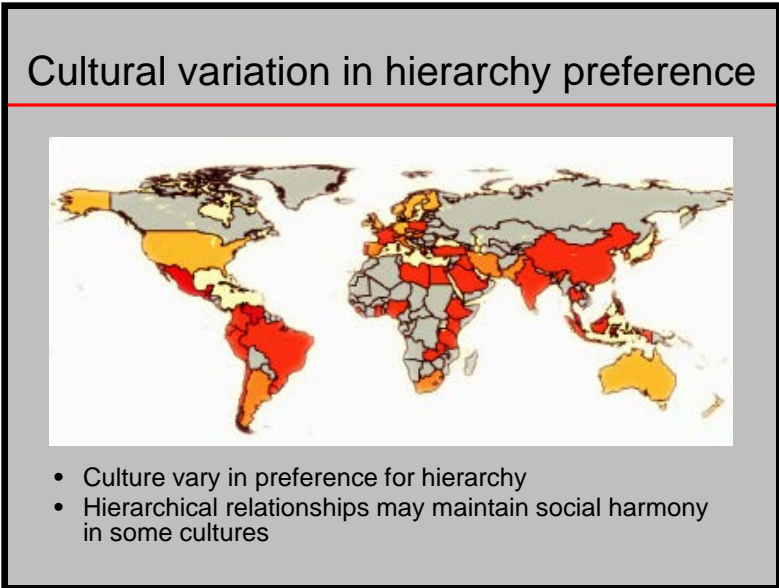
effect of the amygdala can be modulated across culture.



Dr. Chiao and her team compared Japanese individuals with US research subjects and adopted the stimuli model of Matsumoto/Ekman with exaggerated facial expressions of emotions and asked people to identify the emotion that they were seeing. There were significant differences in the response to fear faces in the amygdala across these two population groups. There are core mechanisms that vary as a part of these group memberships.

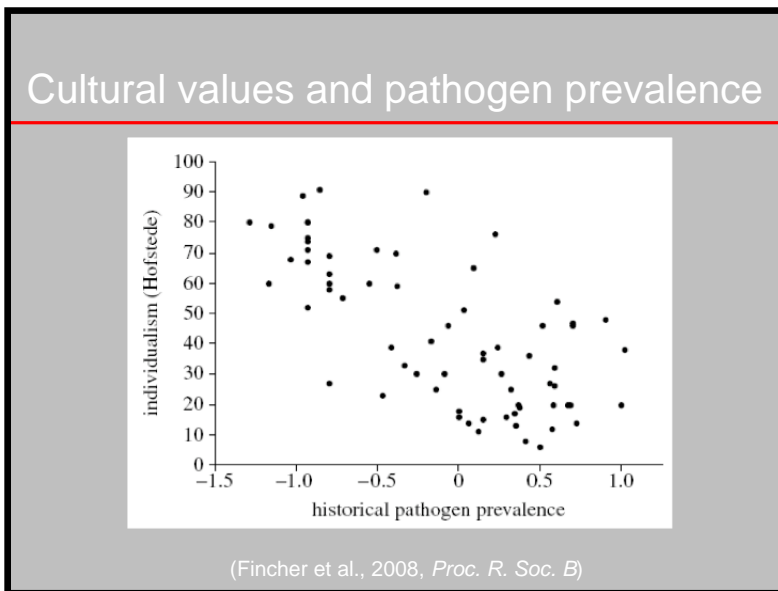
It is very likely that this is mirroring a developmental process that results in these cognitive biases. Such research, as well as other similar studies, indicates that culture and group membership matters even to the very core of our being in the form of the amygdala.

Dr. Chiao conducted another study to understand the state of in-group/out-group empathy between two populations within the United States (blacks/whites). This minority/majority distinction could be very important. As part of the study, research subjects were shown pictures of Hurricane Katrina victims (people in pain vs. neutral images) and were neuroimaged with a special focus on the cultural predictors and neural measures that get at the core of these empathetic responses. Across whites and blacks, people expressed empathy or an affective response. Their self-reported empathy correlates with the biological measures. This research demonstrated something very classic: a lot of intergroup conflict is not about hate but about love. Members of a group exhibit closer affection for other members of their own in-group. Blacks show increased levels of empathy to the members of their own group. The medial prefrontal cortex (MPFC) was very important to this mechanism.



The researchers observed that there was greater activation of this segment of the brain for in-group members, which makes sense, given its relation to the self.

The MPFC is very important to construct creation and self identity. There can be unobservable cultural differences at work within the brain. Some cultures prefer hierarchy more than others (see map above). A dimension of social dominance orientation (SDO) varies closely with empathy. The



SDO scale is a widely-used research scale obtained through survey questions. Only the SDO correlated with empathy relative to other measures tested in Chiao's study. SDO predicts in-group empathy bias. In studies, only one region was related to these variations in SDO, namely the left temporoparietal junction (LTPJ). They found that specific activation of the LTPJ was predictive of this in-group bias across cultures; in other words, social dominance orientation is predicting in-group empathy bias via the LTPJ.

A research subject's social dominance orientation is the only predictor of in-group empathy bias due to neural activity in the LTPJ. Indeed, cultural variation in the LTPJ predicts variations in in-group empathy biases, i.e.,

greater response in the LTPJ among Korean research subjects vis-à-vis Caucasian-American research subjects may represent greater conceptual processing of in-group members' pain (i.e., theory of mind). Egalitarian societies provide individuals with more environmental context, which results in simulation processing; whereas, hierarchy-based cultures rely on conceptual processing. Sometimes cultural differences can be an adaptive process. People create environments that can lead to niche construction and natural selection because of the cultural cultivation. Beyond the coevolution of lactase (an enzyme that breaks down milk-lactose), there are other manifestations of cultural coevolution, including genetic covariants of collectivism. Historical pathogen prevalence correlates with collectivism (i.e., the historical prevalence of diseases like malaria), which motivates the question of what the specific genetic correlate of collectivist social behavior might be.

Collectivists are more likely to carry a short allele on the 5-HTTLPR, a gene associated with serotonin transport. By connecting the gene with the culture, researchers can explore these relationships much more closely. Dr. Chiao concluded her remarks by emphasizing the importance of collaboration.

Dr. Eric Haseltine, DGI, asked Dr. Chiao whether any of her neural measures were more predictive than the established behavioral measures, particularly with regard to epigenetic research and methylation. Dr. Chiao responded that her measures were, in fact, more predictive than the behavioral measures. This research is at the cutting edge, but her lab is looking forward to doing more epigenetic research.

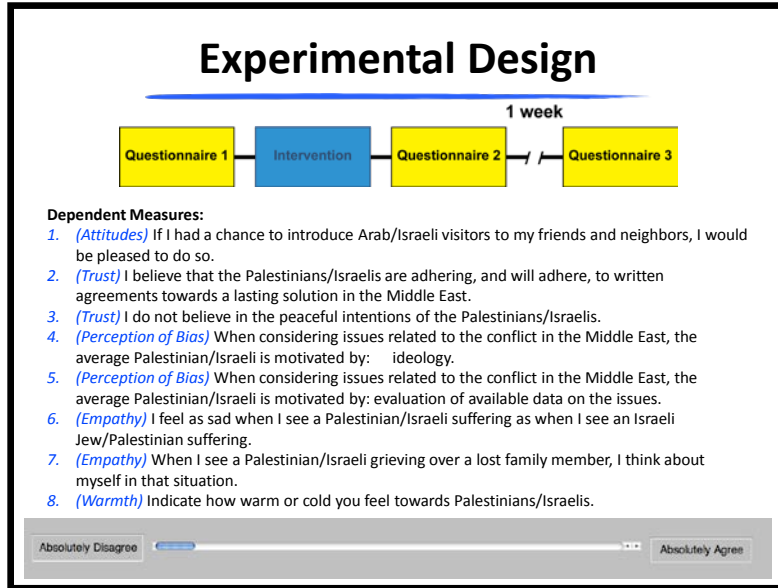
DR. EMILE BRUNEAU, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dr. Bruneau, a postdoctoral fellow in the lab of Rebecca Saxe at MIT, presented a brief entitled *Identifying, Regulating, and Measuring the Psychological Biases that Contribute to Political Violence*. He began by noting that there are some very tangible factors – a history of violence, competition over scarce resources – that can drive people towards political violence. Nonetheless, there are also psychological factors that can motivate involvement in political violence. One of these psychological biases is the “false polarization effect.” The polarization effect alters the way members of one group view members of their opposition or out-group; for instance, pro-choice individuals exaggerate the extent to which they and people who are pro-life disagree. There is an ideological difference between these groups, but the more interesting question is how big the perceived difference between these groups is by members of the adversary group (i.e., what do Democrats think about Republicans and vice-versa). Therefore, people artificially exaggerate the ideological differences between themselves and those of their out-group/opponent, but does disagreement matter all that much? The answer is: yes.

In an undergraduate lab study, researchers manipulated the difference between individuals in order to evaluate how people react to someone with whom they disagree. People who had small disagreements perceived the other to have little bias, and their willingness to negotiate was higher, while their desire to censure was lower; the reverse was true if the disagreement was greater. So the greater the disagreement, the more likely we are to assume that the other person is biased and irrational, and the more likely we are to advocate conflict with the other rather than conciliatory gestures.

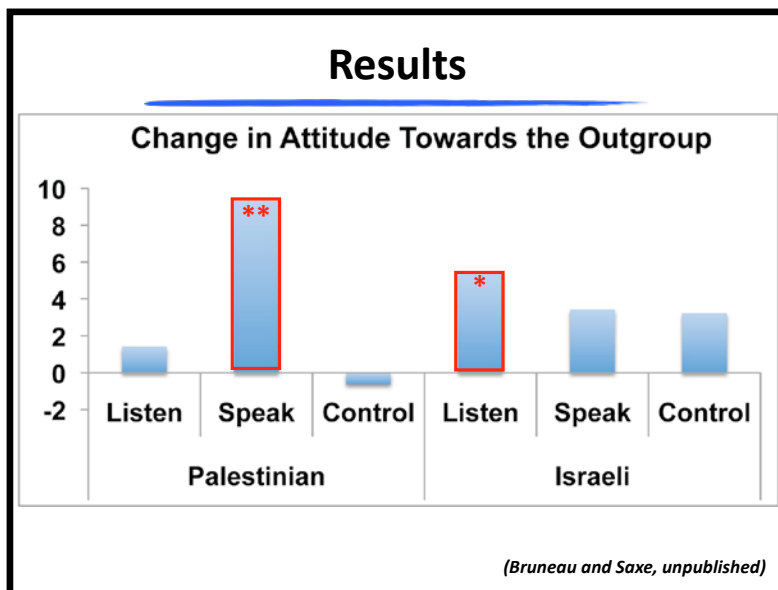
One of the questions for Dr. Bruneau and his research is whether this pattern between irrational and aggressive gestures can be short circuited; i.e., can people disagree without being disagreeable?

Psychological biases have been shown to be regulated. For example, intergroup contact has been shown to be effective if a certain set of characteristics are met. However, this quenching of intergroup biases often seems only to occur for members of dominant groups; for the subordinate groups, interactions either have no effect or a negative effect. The research thus far has focused on the views of dominant groups rather than the subordinate groups. For example, studies on perspective-taking have shown that members of dominant groups change their attitudes towards a subordinate out-group after listening to that out-group member speak about their struggles in life. No study has looked at the attitudes of subordinate group members towards dominant members in the same paradigm.



This dearth of research regarding the subordinate group’s perspective motivated Bruneau’s current research efforts. He has been in Ramallah doing a study with Palestinians; a colleague in Tel Aviv is working with Israelis. The idea of the study was to determine which types of interventions would have positive effects on Palestinian and Israeli participants by measuring their attitudes towards the ‘other’ at three different time points: immediately before interacting with a member of the other group, immediately after interacting, and one week after the interaction.

Eight dependent measures of attitudes towards the out-group (see figure a) were imbedded in 60 other questions and were presented in random order. All of the questions were answered on a sliding scale (at bottom of figure). The intervention Bruneau and his colleagues were interested in was whether a brief online interaction between an Israeli and a Palestinian would alter their opinions towards the other group as a whole. The research design involved having participants come into the lab after completing survey one. Each participant was told that they would interact with someone from a different culture via Skype in a chat window without any voice/audio communication. One individual was the speaker who was asked to write on the question “describe one or two of the most difficult aspects of life in your country and explain the psychological effect these difficulties have on the people



living there.” When faced with a member of the “enemy”, 100% of Palestinians discussed occupation; 100% of Israelis talked about security.

Meanwhile, the other participant read/listened. At the very end, the listener summarized what the speaker wrote without inserting their own thoughts or opinions. The listener role was, therefore, a very classic perspective-taking condition, while the speaker played the role of “perspective-giving.” In addition, there was a control condition where they read an opinion without any Skype interaction and wrote their own summary. Consistent with previous research, we assumed that Israelis (who are perceived in this conflict as the ‘empowered’ or ‘dominant’ group) would respond positively to a perspective-taking. The open question was how the Palestinians would react to each of these situations. Although backed by less empirical evidence, one intriguing possibility with anecdotal and theoretical support was that members of a disempowered group may respond not to perspective-taking, but to speaking and being heard.

Consistent with our prediction, Israelis experienced a significant positive change in attitudes towards Palestinians, only in the listening (perspective-taking) condition. For Palestinians, listening had no effect, but having the opportunity to speak (and be listened to) resulted in a dramatic positive change in attitudes towards Israelis. This research supports the intuition that one size does not fit all in terms of the impact of perspective-taking across dominant/subordinate groups. A week later, attitudes of each group towards the other returned to the baseline, indicating that the positive results of a brief interaction are temporary. It is not known how repeated interactions of this type might affect attitudes in the longer term.

Dr. Bruneau summarized his conclusions emphasizing that these results reflect data that had been unpublished up to this point, and that he is currently working on replicating the results in other groups that differ in power and are divided by ideology. Nonetheless, this study gives an encouragingly demonstrates that, after a very brief interaction, the psychological biases between subordinate/dominant groups can change.

There are other ways to evaluate psychological biases, including the use of fMRI. Neuroimaging has great theoretical potential because it measures a complex signal immune to self-report biases that is immediately proximal to behavior.

Neuroimaging has primarily been used to examine race-face biases in Americans. This methodology is potentially applicable to black-white dynamics in the United States, but has limited utility to conflict groups (in general) for two reasons: 1) members of conflict groups are hard to distinguish by physiognomy alone; 2) higher-level biases based on ideology and perceptions of out-group bias are more likely involved in inter-group conflict. Black and white differences are somewhat anomalous, since most conflict groups are not as phenotypically different (Irish Catholics and Protestants look the same).

To investigate higher-level intergroup biases using neuroimaging, Bruneau and Saxe conducted a study with Arab and Israeli research subjects from the Boston area. The researchers developed a control experiment that would isolate brain regions responsible for processing irrational versus rational statements. The statements that were used were made by real people and were collected from the internet. The research subjects were asked to rate the reasonableness, not whether the research subjects agreed or disagreed with the statement, and fMRI was used to identify the regions of the brain that responded to irrational statements over rational statements. Participants then read statements about the conflict in the Middle East that were either partisan-Israeli or partisan-

Arab. After defining brain regions involved in processing irrational statements with the non-partisan irrational statements, they then asked how Arab and Israeli brains responded to partisan-Israeli and partisan-Arab statements. Brain responses for each participant were then compared to both their explicit and implicit attitudes towards the out-group. They found that in a particular brain region (the precuneus), the amount of brain activity predicted both explicit and implicit attitudes towards the other group. The result of this study is a proof of principle; biases in higher level cognition can be assessed neurally. There are a lot of things that still need to be disentangled, not just rationality, but also emotionality. Nonetheless, this research demands the question whether neuroimaging measures are useful for predicting real-world behaviors.

Discussion:

Dr. Tom Pyszczynski of the University of Colorado stated that for a person with a particular world view, what may be termed as irrational by others might be rational to them from their world view. Dr. Emile Bruneau responded that he is most interested in how people regulate feelings to the in-group/out-group. All Dr. Bruneau is looking for is a tool that can help measure something that he is interested in. The objective for all of this is to find a good and valid measure.

Professor Oliver Goodenough, Gruter Institute at Vermont Law School, asked about the notion of speaking versus having been heard, since they received stimulation in return. Dr. Bruneau responded that the Palestinian perspective change correlated very well with how well they felt that they were heard by the Israeli participant; attitude change in Palestinians did correlate with how sympathetic the Palestinian thought their Israeli interaction partner was.

PANEL DISCUSSION: RESEARCH I (DR. THOMAS FEUCHT, MODERATOR)

Dr. Tom Feucht, Department of Justice—National Institutes of Justice, moderated the first research panel. Dr. Feucht serves as a science advisor at NIJ with a background in sociology. He noted that people frequently hear about crime in the context of political violence, but that scientists and researchers are not often given a venue in which to discuss these interrelationships. He quickly introduced the panelists and noted that there are many pathways from neurobiology to political violence with this group of panelists taking an initial stab at attempting to draw these connections.

The focus of this panel was on the linkage between crime and political violence through the pathway of neurobiology. The panel included:

- Dr. John Hibbing, University of Nebraska, Lincoln
- Dr. Rene Weber, University of California Santa Barbara
- Dr. Oshin Vartanian, Defense Research and Development Canada (DRDC) Toronto
- Dr. Victoria Romero, Defense Research Consultant, Cognitive and Behavioral Sciences
- Dr. Mark Hamm, Indiana State University

DR. JOHN HIBBING, UNIVERSITY OF NEBRASKA-LINCOLN

Dr. John Hibbing, University of Nebraska-Lincoln, spoke about the formation of political attitudes in his presentation entitled *The Physiological Correlates of Political Orientation, Participation, and Violence*. He noted that within the American political discourse, there are some people on the left, and some people are on the right. Likewise, some individuals participate in governance (for example, by voting) and some do not. Dr. Hibbing’s research looks at why there is so much variation. Many argue that participation is influenced by socialization or environment. However, socialization fits the data poorly. One alternative explanation is individual biological difference, which is often modulated by environmental factors.

The science community has been slow to talk openly about individual differences because of political correctness and because the academy is afraid of demonstrating differences between and among groups. Just because one explanation does not fit, one should not give up. It is critical that the science explore individual level differences. Dr. Hibbing is not proposing a fancy technique, but coarse physiological measures. This may be useful before conducting fMRI work. Using such simple observables allows for more focused examinations than whole brain scans.

Dr. Hibbing presented images from his political physiology lab. The equipment used by his team includes skin conductance transducers, heart and blood pressure monitors, and papillary response measures. Skin conductance increases and heart rate declines when research subjects see something disgusting. Part of the research is to determine whether there are variations in such crude physiological measures across individuals, coupled with their own answers to a self-report

Variable	Skin conductance change	Skin conductance change w/ SR	Self-reported disgust sensitivity w/ phys
Gay Marriage	.44**	.45**	.30**
Pre-marital Sex	.28*	.29*	.36**
Abortion Rights	.09	.17	.29*
Free Trade	.07	.06	-.07
Small Govt.	-.12	-.19	-.19
Illegal Immigrants	-.06	-.03	-.00
Military Spending	-.14	-.12	.04
Foreign Aid	.08	-.01	-.16
Police Searches	-.14	-.15	-.11
School Prayer	.05	.09	.01
Gun Control	.10	-.00	-.26
Death Penalty	-.07	-.14	.06
Biblical Truth	.12	.11	.23
Pornography	.10	.11	.05
Tax Cuts	.01	-	

battery that endeavors to measure disgust. Such correlation-based studies have shown that there is a correlation between disgust responses and opposition to gay marriage.

The last two columns of the table at left demonstrate the strong correlation between how an individual reports their disgust and, more importantly, how they respond physiologically, and their concurrence with more ‘conservative’ values on issues such as gay marriage.

Research subjects can talk about how they feel, but they cannot talk about all of the aspects of what they feel. Physiological readings are useful because people’s self-reports do not tell the whole story. Indeed, people sometimes dissemble and, at other times, they are simply terrible at describing themselves.

Another physiological measure is the orbicularis oculi (EMG) startle response, which measures how hard people blink when startled by a disrupting noise. Those respondents with a higher mean blink amplitude demonstrate higher levels of support for the death penalty. In other words, these

individuals blink harder at auditory startle. Likewise, when gaze direction and time is observed, conservatives look at adverse images more than liberals.

In another test involving a caricatured face, respondents were asked to hit their space bar when a dot appeared. The pupils of the face were sometimes directed towards the dot, sometimes pointed in the opposite direction and were sometimes not present. There was a cuing effect when dot appeared where the eyes were looking. ~~Actually, there was a large difference between liberals and conservatives. Liberals slow down dramatically when the eye gaze is in the opposite direction.~~

Dr. Hibbing then moved onto a discussion about involvement in politics rather than ideological leanings. In these instances, the key measure is general physiological responsiveness rather than response to a particular category of images. Research subjects were shown a variety of images; their physiological responses were put in standard equation to explain variation in people's involvement in politics. Even with demographic controls, the mean electrodermal increase predicts political activity. Further research will explore the hypothesis that electrodermal responsiveness is related to, and even predictive, of other things as well, not just involvement in politics.

Dr. Hibbing began to sum up his research and presentation by noting that his primary objective over the course of the presentation was to describe techniques that have been successful in predicting individual-level variations in political left-right orientations and in tendencies to participate in politics and to suggest that these techniques could profitably be applied to variations in proclivity toward political violence. Speculating on the basis of the current data, one possible interpretation is that political violence is not accurately viewed as extreme political participation (i.e., it is not an extension of traditional participation taken to an extreme). Instead, it would seem as though those involved in political violence do not have stronger beliefs than everyone else. Some other factor modulates their strong beliefs to compel or condone violence because, the fact remains, that only some people in a given environment engage in violence, while the vast majority does not.

As people think about how to use research, they must remember that these are probabilistic relationships. Many of these distributions overlap, so it may never be possible to identify specific individuals at risk for political violence.

Dr. Peter Suedfeld, University of British Columbia, noted that there are people who change political positions over their lifetime. He wondered whether Dr. Hibbing had any longitudinal data that might correlate these changes in belief with changes in physiological markers. Dr. Hibbing responded that none of his research would contradict changes over an individual's lifespan. People generally become more conservative as they get older. The environment is clearly still an important factor, as well as other elements, like age and birth order effects.

DR. RENE WEBER, UNIVERSITY OF CALIFORNIA-SANTA BARBARA

Dr. Renee Weber, University of California Santa Barbara, began his presentation entitled *Studying Neural Mechanisms of Violent Behavior in Semi-Natural Environments* by briefly reviewing the title of the workshop. Dr. Weber noted that there had not yet been much discussion of studying complex behaviors with new neuroimaging technology, but he would be presenting an innovative approach during his presentation. Dr. Weber's main argument for his presentation was that trying to understand the neurobiology of violence with standard experimental tasks and brain imaging technology is promising and has resulted in amazing new findings. However, studying brain

function in a semi-natural, story-driven environment that simulates violent behavior not only increases ecological and predictive validity, but also reveals new insights into brain dynamics and brain connectivity of complex behaviors that traditional brain imaging paradigms are unable to provide..

Dr. Weber reminded the audience that research on political violence is based on many assumptions. In general, violence is determined by a combination of innate & biological factors (including temperament), early developmental and environmental influences, cognitive factors (capacity & style), and group dynamics. Politically-motivated violence is a variably determined subtype of human aggression (Victoroff, 2005). One important assumption refers to the recognition that those who engage in political violence are psychologically extremely heterogeneous, although they typically reflect four traits: (1) strong affective response regarding an ideological issue; (2) a personal stake (perceived oppression and humiliation, need for identity, drive for expression of intrinsic aggression); (3) low tolerance for ambiguity and low cognitive flexibility; and (4) a capacity to suppress moral norms against harming others and inhibit affective responses towards victims of violence behaviors.

Much as there are many assumptions that inform this line of inquiry, there are also many theories. Dr. Weber provided an overview on theories that have been used to explain political violence, including Social Learning Theory, the Frustration-Aggression Hypothesis, Relative Deprivation Theory, Oppression Theory, Psychoanalytic Theories, Identity Theory, Narcissism Theory, Paranoia Theory, Absolutist/Apocalyptic Theory, Cognitive Theory, Rational Choice Theory, Novelty-Seeking Theory, Humiliation-Revenge Theory, and others. Dr. Weber generally applies research findings from the area of antisocial personality disorders as the frame to study the neurobiology of violence; but it is not clear that politically-motivated violence is antisocial.

Dr. Weber continued to summarize current research in the area of aggression and violence, which made clear that most research is limited to laboratory settings and artificial experimental tasks. Since political violence is a real-world experience, research paradigms should reflect this reality. Given this context, Dr. Weber has begun to use virtual environments to simulate semi-natural behavior within a brain-imaging environment.

In the first study that Dr. Weber presented, the behaviors of 13 healthy research subjects were studied within a brain imaging scanner while playing a story-driven, first-person shooter simulation. The virtual-reality software used is very flexible and can be used to simulate almost any environment and narrative. The results of the study were subjected to a content analysis with three independent, trained coders defining a complex behavioral model. The content analysis captured all interactions and behaviors (including violent behaviors) second by second. For example, violent (killing a hostage) versus non-violent interactions (helping a hostage) can be compared. The data analysis focused on the dynamics of simulated violence and brain connectivity. For example, one cognitive mechanism revealed that violent interactions inhibit activity in affective (rostral) regions of the anterior cingulate cortex (ACC) and in the amygdala. Dr. Weber observed that this inhibition was anticipated and actively regulated by cognitive (dorsal) regions of the ACC. While this result is in line with prior findings, the dynamics of this brain mechanism as a response to violent interaction was new and has been replicated in various studies (e.g., Strenziok et al., 2010; Hummer et al., 2010).

In a second follow-up study, Dr. Weber and colleagues investigated whether the identified mechanism can be affected by an atypical antipsychotic (Quetiapine). In a double blind, placebo-

controlled brain imaging study of 17 healthy male volunteers, the findings of study 1 were fully replicated in the placebo group, but not in the treatment group.

Dr. Weber suggested that such a simulation-based, low-controlled brain imaging paradigm could be extended to embrace study participants that are different in various aspects that are relevant for violent behaviors. For example, one could look at research participants that are different regarding: (1) sociality (sociopaths v. normal subjects); (2) violence risk (Monahan & Silver, 2003); (3) culture, beliefs, or temperament; (4) dominance (leaders vs. followers); (5) cognitive capacity (impaired impulse control, executive function); and (5) MAOL gene expressions (low vs. high). Moreover, one could investigate different scenarios/narratives; for example, with a (1) political frame, (2) inter-cultural frame; (3) religious frame or (4) with different violations of moral domains (fairness, harm, authority, in-group loyalty, purity) by different actors, for instance.

Another innovative research approach includes allowing research subjects to provide simultaneous (think aloud) self-reports as they are undergoing fMRI scans. Analytically, Dr. Weber suggests new approaches to understand brain imaging data that are collected in semi-natural, low-controlled brain imaging paradigms. For example, traditional analyses that are based on signal amplitude comparisons should be amended by analyses that follow signal reliability logic (e.g., cortical intra- and inter-subject correlation techniques).

A participant in the audience asked whether Dr. Weber had looked at individual differences in datasets with active service members and simulated fighting scenarios. Dr. Weber responded that his research was limited by a sample of student volunteers with extensive experience in playing first-person shooters and a small sample size (n=13). The sample only included men of a similar age, further limiting the demographic variability within the sample group. While Dr. Weber is interested in conducting such research, it would require more funding and the willingness to invest in research using innovative brain imaging paradigms.

Another participant asked whether there had been any studies that look at highly-trained commando operators who confront real threat. Such a research pool would allow for comparisons between those trained to deal with such stressors in real life and those who have only experienced them virtually (i.e., college students). Dr. Weber responded that he knows of such studies conducted a few years ago that address some of these issues, but the results have not been published. At UCSB, Dr. Miller works with active service members and studies both inter- and intra-individual differences with respect to various cognitive performance tasks.

DR. OSHIN VARTANIAN, DEFENSE RESEARCH & DEVELOPMENT CANADA

Dr. Oshin Vartanian, Defense Research and Development Canada Toronto and the University of Toronto-Scarborough, presented his presentation called *Neuroimaging Deception*. His presentation began with a review of findings that have emerged over the past ten years.

He argued for the use of neuroimaging to detect deception for two key reasons: 1) Polygraphs have been shown to be ineffective, yet the federal government conducts 40,000 polygraphs each year; and 2) neuroimaging technology is advancing at a dramatic pace and can potentially fill the void left by polygraph tests.

Since 2001, there has been a gradual increase in the number of fMRI/PET studies of deception. Indeed, since groundbreaking research by Dr. Sean A. Spence from the University of Sheffield, there

has been a special issue of the journal *Social Neuroscience* devoted to this. In 2007, there was a symposium hosted by MIT which brought together researchers doing work with fMRIs on deception to evaluate the efficacy of FMRI. The consensus was that the technology at the moment was not quite ripe for detecting deception in the field. Based on designs employed in lab, the technique is not great in the lab either. It is not a shortcoming of the technology, but the paradigms used to look at deception in the lab.

In order to validate neuroimaging of deception, one must first have a definition of deception. Dr. Vartanian cited a definition (Vrij, 2004), which characterized deception as a “deliberate attempt, without forewarning, to create in another a belief which the communicator considers to be untrue.” If neuroimaging is to be successful at finding deception, researchers must have an operational definition that satisfied the conceptual definition.

Unfortunately, most fMRI/PET deception studies prompted subjects to lie, which is a different kind of deception than a lie told in the real world. By the strict definition of deception (provided above), none of the studies were looking at deception. Instead, the studies were examining dissembling. Abe, et al. (2007) is the one exception. In this study, the subject came into lab and was told about the task by the first experimenter, and then the first experimenter left the room. A second experimenter then encouraged the person to disobey first person. People were given the option to disobey first instructor. But even this study is exploring intentional disobedience rather than deception.

The second question that research must ask about neuroimaging as it relates to deception is whether there is sufficient profile specificity. The good news is that deception reliably activates a consistent neural system in the brain, but this neural system is not specific to deception. Multiple cortical structures in the brain are activated by studies of deception (PET/fMRI). These structures include the ACC, the dorsolateral prefrontal cortex (DLPFC), the medial prefrontal cortex (PFC), and the superior temporal sulcus (STS). All of these regions are also activated during the performance of tasks involving the same cognitive processes in the absence of deception, i.e., there is no deception-specific neural profile.

After reviewing the available literature and highlighting several problems with the available data sources, Dr. Vartanian provided several recommendations, including: 1) deconstructing deception; 2) eschewing arousal-based models of deception for cognitive load models; 3) developing a better understanding of the theory of mind; and 4) clarifying the conditions and context under which data are collected in the lab.

Dr. Paul Zak, Claremont Graduate University, noted that many of the studies referenced by Dr. Vartanian were based on averages. Dr. Zak asked how researchers might resolve the potential ethical conundrum of putting a criminal in a scanner and asking them to do a task and whether a criminal would even complete the requested task.

Dr. Vartanian responded that even those researchers who study incarcerated populations are unsure how they might resolve the potential ethical quandaries. Nonetheless, he noted that if all of this research were conducted with cooperative populations exclusively, it would lack validity.

Dr. Weber noted that telling difficult truths can also increase cognitive loads; for example, telling one’s wife that one has cheated on her.

DR. VICTORIA ROMERO, DEFENSE RESEARCH CONSULTANT, COGNITIVE AND
BEHAVIORAL SCIENCES

Dr. Victoria Romero, Defense Research Consultant, Cognitive and Behavioral Sciences, sought to offer the workshop's participants a slightly different perspective in her presentation entitled *Applied Neuroscience: Combating the Spread of Violent Extremism*. She noted that everyone so far has been a lab researcher, providing workshop attendees with useful information, but she would offer a practitioner's perspective.

For instance, multiple streams of research are identifying parts of the brain associated with compassion. Dr. Romero has been tasked with finding approaches and methodologies to help dissuade a group of 17-year-old boys in Tripoli from joining Hezbollah.

Dr. Romero began her presentation by providing a brief introduction to neuromarketing, which is the application of neuroscience to understand consumer's minds, including a consumer's brand awareness, advertisement affinity, and purchase decisions. Neuromarketers use the same tools as research scientists, including fMRI, electroencephalogram (EEG), galvanic skin response (GSR), and eye-tracking.

In her work, Dr. Romero focuses on issues of engagement and influence. The methodologies she employs include survey and interview methodologies, as well as neuromarketing. This is done in conjunction with other kinds of research.

The tools of neuromarketing help clients, including the US Government, to hone communications for specific targets, condense communication for different platforms, and develop supporting messages and materials. Like any other research pursuit, there are several underlying assumptions, including the correlation between specific neural activity patterns and cognitive processes, as well as the generalizability of basic research. But, the generalizability of such research can sometimes be unclear—there is a differentiation between low-risk messages about consumer products and high-risk messages related to existential threats to a country or people.

Despite some challenges, there are advantages to these approaches, including a relatively small sample size requirement of approximately 20 subjects. The tools help measure subconscious responses, which participants are sometimes unaware of, but are likely to have a significant impact on behavior.

Dr. Romero sought to assuage some ethical concerns regarding neuromarketing research by noting that EEGs are frequently done on babies. She has applied these methodologies in places like Pakistan, in the heart of Pashtunistan, to explore how messages become viral and how they expand beyond the points of initial contact. In Peshawar, the EEG results suggest that the greatest attention and emotion were associated with video clips that depicted villages and local fighters.

Future applications of such approaches might include communication development and testing; probing attitudes on topics of interest beyond messaging, training, and adapting methods to apply other findings from neuroscience.

Dr. Sharri Clark, Department of State, asked whether Dr. Romero considers any of her findings to be cross-culturally generalizable.

Dr. Romero responded that she believed that the results may be, but there is no hard evidence that this may be the case, because these results reflect findings with specific population groups.

DR. MARK HAMM, INDIANA STATE UNIVERSITY

Dr. Mark Hamm, Indiana State University, was the last panelist to present his research in a presentation entitled *Prisoner Radicalization and Sacred Terrorism*. He noted that many panelists had already emphasized the need to define political violence and radicalization, and he had a definition for prisoner radicalization that might be useful. Dr. Hamm defined prisoner radicalization as the “process by which prisoners adopt extreme views, including beliefs that violent measures must be taken for political or religious purposes” (DOJ). Dr. Hamm had conducted a study for NIJ a few years ago interviewing chaplains and gang intelligence officers, as well as 30 prisoners who had converted while incarcerated. Most of the prisoners had been incarcerated for violent crimes. Many were gang members. A portion of the research was conducted at Folsom Prison and the adjoining New Folsom Prison.

While Folsom prison was once an iconic image of modern corrections; it is now an overcrowded corrections facility where inmates are triple-bunked by race to reduce gang violence. California prisons are the most crowded prisons in the world. On average, inmates read at 5th grade level, few work, and there are no rehabilitation programs. Nearly two-fifths of inmates suffer from hepatitis C. Up to half is thought to be HIV-positive or have AIDS. The recidivism rate now hovers around 70%. The suicide rate is highest in the nation. Folsom prison is a failed prison system.

There are neo-Nazis and other gangs roving the yard at such prisons. One prisoner at New Folsom managed to found a “terrorist organization” called ‘Jam’iyyat Ul-Islam Is-Saheed’ (the Assembly of Authentic Islam), which was involved in a plot to bomb Los Angeles synagogues and Army recruiting centers. This effort was orchestrated by an inmate in a high-security prison. The organizer, Kevin James, a member of the 76th Street Crips and a devotee of ‘prison Islam,’ may have waged the plot with a contraband cell phone.

Through his research, Dr. Hamm found that 1) inmate religious conversions happen through friend and kinship networks; 2) the primary motivation for conversion is spiritual searching; and 3) most conversions have positive effect on inmate behavior. Overall, these small-scale religious awakenings in prisons represent a success story.

For many African Americans, the dominant narrative is that of Malcolm X. Another narrative of prison conversion to Islam is that of Eldrige Cleaver, who converted at the age of 23 at San Quentin prison, but ultimately was responsible for a case of domestic terrorism involving a 90-minute gun battle with Oakland police officers.

Contrary to some thoughts, there is no evidence of Wahhabi clerics from Saudi Arabia coming to the United States to foment jihad among American prisoners. People are talking about Osama, but there is no organized attempt for foreign jihadist to radicalize US prisons. Instead, the radicalization is one layer of the existing prison-gang and violence problem.

These religious gangs are like cultural communes. They have their own reading material, their own religion, their own colors, and their own topics of conversation. Since prisons no longer seek to rehabilitate prisoners, they have very little to do and seek recourse through other activities, including religious radicalization and organization.

During Dr. Hamm's research, the head chaplain at Folsom looked at the scene and said 'there is something evil in this prison.' These prisons are petri dishes for terrorism. Part of the problem is that the prisoners have nothing to do.

A workshop participant noted that Dr. Hamm's work represents a great sociological paper, but the participant wondered where the criminology was. The participant asked about the relationship between radicalization and terrorism. Dr. Hamm responded that there are only 46 cases over a 41-year period of inmates radicalized in prison and engaging in terrorism. The likelihood of becoming a terrorist is about the same as winning the lottery or being hit by lightning. Extreme religious devotion is inimical to prison-based terrorism. Al Qaeda is not the real threat; home-grown terrorism is. This is not ubiquitous. Not every prison in US creates terrorists. There are only certain prisons that are considerably more likely to generate terrorism than other prisons. There are similar situations in foreign prisons, like in the United Kingdom. In the United States, no other prison has created more radicalization than Guantanamo.

Dr. Chris Green, Wayne State University, asked whether Dr. Hamm was aware of any systematic study in which either psychological or radiological pathology of any population was associated with recidivism or people in prison. Dr. Hamm indicated that there were not.

Dr. Scott Helfstein, West Point, noted that anecdotal evidence suggests that most inmates show recidivist tendencies, quickly abandoning their new-found religion and returning to patterns consistent with prior criminal activity. He then asked whether there were any markers associated with those who sustain radical views after release. Dr. Hamm responded that this is first study of prison radicalization. There are no markers in a small sample size such as the one he examined.

GENERAL DISCUSSION

Dr. Olds returned to the issue of neuromarketing originally presented by Dr. Victoria Romero. Classic focus groups are replete with the problem of participants playing with the researchers. The tools of neuromarketing are an addition to the toolbox of things researchers are already using. There are tremendous problems in using focus groups, surveys, interviews, etc. The point is that they have different problems. The gaps in knowledge are very different and perhaps complementary with surveys and other tools. These tools have to be used carefully and in conjunction with other tools.

Dr. Hriar Cabayan asked the panel, in general, about whether there have been tests run in the lab at the neurobiological level to look at interventions to deter violent actions in populations prone to violence to see what interventions are more effective than others? Usually, deterrence involves the imposition of a cost, which makes a decision to act too costly to a potential violent actor, but are there alternative deterrence approaches that are yet to be considered and could be tested with some of these tools?

Dr. Weber responded that he has not done such research, but some have done this. For example, Dr. Kent Kiehl conducts clinical neuroscience research of major mental illnesses with special focus on criminal psychopathy, substance abuse, and psychotic disorders (i.e., schizophrenia). He uses non-invasive techniques for measuring brain function, including event-related potentials (ERPs) and functional magnetic resonance imaging. Dr. Kiehl utilizes the MIND Mobile Imaging Laboratory to conduct his neuroscience research in prison populations.

PANEL DISCUSSION: RESEARCH II (DR. AMBER STORY, MODERATOR)

The next research panel focused on aggression, fear, and trust with a specific emphasis on the current research on decision making and violent behavior. The Research II panel was moderated by Dr. Amber Story, National Science Foundation (NSF). The panel included:

- Dr. Greg Berns, Emory University
- Dr. Peter Hatemi, University of Sydney
- Dr. Read Montague, Baylor College of Medicine
- Dr. Tom Pyszczynski, University of Colorado-Colorado Springs
- Dr. Paul Zak, Claremont Graduate University.

Dr. Amber Story began the session by providing introductions for the members of the panel.

DR. GREGORY BERNS, EMORY UNIVERSITY

Dr. Greg Berns, Distinguished Professor of Neuroeconomics at Emory University and Director of the Center for Neuropolicy, was the first panelist to speak on the Research II panel. He began by noting how great it was to be in attendance, along with thanking Dr. Amber Story and Dr. Terry Lyons for their support. The work that Dr. Berns presented is funded jointly by the Air Force, the Navy, and the NSF. It was serendipitous that he began to study sacred values largely due to collaboration with Dr. Scott Atran.

It is easiest to explain sacred values with a little story. Dr. Berns has been at Emory University for 12 years. Shortly after he moved there, he was called for jury duty in Atlanta, GA. Much to his own surprise, given his research areas, he was put on the jury. The details of the case are irrelevant, but it was interesting to observe the interactions between jury members. Dr. Berns sat across the room from a woman, the classic Georgia Peach; she asked Dr. Berns about his occupation. She stopped him mid-sentence and said immediately “you don’t believe in God.” Before Dr. Berns could respond, she said she would pray for him, which provides a simple and anecdotal illustration of the salience and importance of sacred values to many people.

During his presentation, Dr. Berns said that he would talk about a recent study that he and his team had devised which endeavored to address these issues of sacred values, including why we care about things like a belief in God. Historically, there have only been two ways to access these beliefs through research design: researchers either asked subjects what they believe (introducing response bias) or observed what they do. Both of these approaches fall victim to biases like self-reporting and social shaming--people who go to church or make the motions of religious belief because that is what is expected of them. There are clear limitations to rational choice models for behavior. Many human decisions are not based on financial or material incentives, such as social status, religion, etc., and are not easy to assess with the standard tools of neuroeconomics. There is no doubt that abstract beliefs (like religion and ideology) can guide behavior and that rational choice approaches fail to include these elements.

Sacred values are characterized by circumstance and given conditions. Deontic processes would specify a moral value as a logical rule. The alternative is a utilitarian assessment process, which is predicated on cost/benefit analysis. Both approaches are valid frameworks for making decisions;

one is not more right than the other. In fact, people can be compelled to use both decision-making processes when addressing the same problem set. Unfortunately, these things cannot be studied with exactitude, so the alternative is the development of a proxy for sacredness based upon integrity, a consistency of values and actions.

During the experiment conducted by Dr. Berns and his team, an individual is prompted by a series of statements that also has a counterfactual within an fMRI (I am a dog person vs. I am not a dog person). The subject gets to make choices--some are easy, some are mundane (dog person/not dog person) and others engage the sacred (to kill/not to kill; god/no god). The research seeks to determine not whether a subject believes in God or not, but rather, how strongly a research subject feels about that (is there a dollar amount that would make them disavow their belief in God?). So far, all of this is self-report--i.e., the subject is asked the question whether they would disavow some belief for money, but there is no real money involved. In order to address this hypothetical state, the researchers offer real money to get the research subject to state the opposite of what they believe. Individuals are generally unwilling to agree to the opposite of their own sacred value for any amount of money. The mechanism by which the researchers determine the cost for disavowal is a BDM exchange, an automated auction tool.

The researchers give the research subjects the option to opt out of these auctions with the rationale that the things that are most sacred are also associated with the greatest integrity, which individuals will be unwilling to abandon—thus, escaping (somewhat) from the biases inherent to self-reporting. As part of this research effort, Dr. Berns and his team have studied over 40 people in an fMRI and more than 300 in an online survey.

Most bids are either a dollar (the research subjects do not care) (bimodal) or they opt out of the auction entirely. The bid follows something close to a gamma distribution. This provides an operational definition of what people hold sacred (those that they opt out of). With these results, it is possible to begin constructing a behavioral space that spans sacred values by plotting the frequency of people who will hypothetically change their opinion versus those that postulate a specific amount of money. There are a lot of things in between the sacred and the non-sacred.

The researchers repeated the same task 6-12 months later; the sacred items are highly stable; whereas, the non-sacred items are about 80% stable. When asked retrospectively, research subjects' sacred/deontic values tended to be motivated by rights and wrongs; the items that are subsequently bid on tend to fall in all categories.

Based upon the functional localizer of the fMRI scans, the regions associated with cost/benefit rather than right/wrong are in the bilateral caudate regions. Accepting money is, by definition, a utilitarian process, so the hypothetical acceptance of money confirms the regions associated with cost/benefit decision making. The Deontic region is the left temporoparietal junction (LTPJ), which is commonly associated with moral judgment tasks. In the LTPJ, it is just the opt-out items that are being activated; whereas, in the left parietal areas, only the bid items are activating the region.

One final result that can be derived from this research is demographic associations. The activation in the ventral-lateral prefrontal cortex (VLPFC) correlates with how active individuals are within social organizations, i.e., group activism overall, which suggests that these laboratory measures can extend beyond the lab. In the real world, many conflicts are over sacred values and, yet, the usual policy tools are often incentive-based.

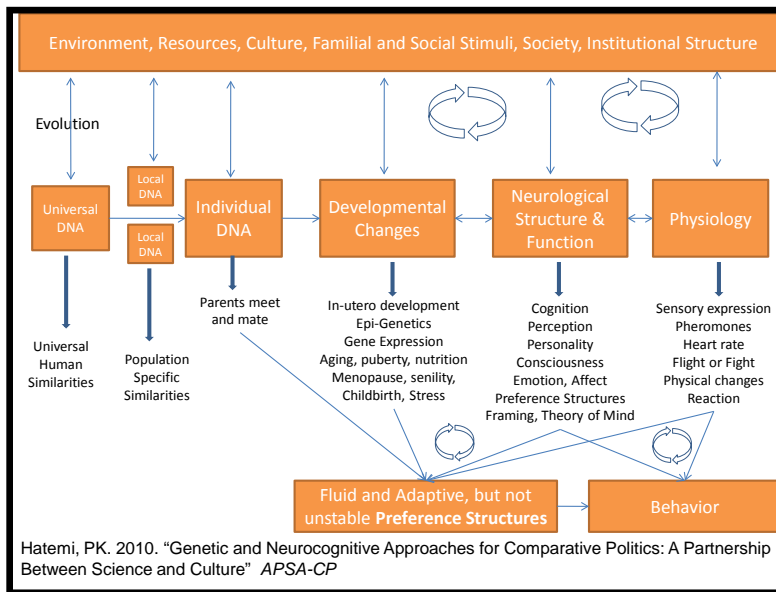
If Socialization is the only reason then

- Why of the 1.3M inhabitants of the Gaza strip, only a very few actually engage in acts of terrorism.
 - Of approximately 9,000 “Arab Terrorists” detained by Israeli security forces in Judea and Samaria, only 396 were deemed to be potential suicide bombers.
 - Of the ~800,000 Catholic residents of Northern Ireland, Sinn Fein commanded 80-100,000 votes among Nationalists but perhaps as few as 750 were active IRA soldiers.
- Why are only a small fraction of individuals residing in an environmental context universally perceived as oppressive by those who experience it prepared to commit acts of terror?

social, developmental factors play a central role.

In response to aggression, oppression, or other provoking stimulus, in every society, there are individuals who will engage in violence. Other individuals may be unable to commit violence in response themselves but will support the violent actors (sympathizers). There are also those who will avoid violence (neutrals), thus illustrating the coexistence of violence and non-violence in the same conflict environments. Not everyone can or is willing to commit acts of political violence (PV), though they have been exposed to the same stimuli and environmental conditions.

Throughout this conference, there has been significant discussion regarding the mechanisms of human behavior and the remarkable within-person variance over time. Even among those actors



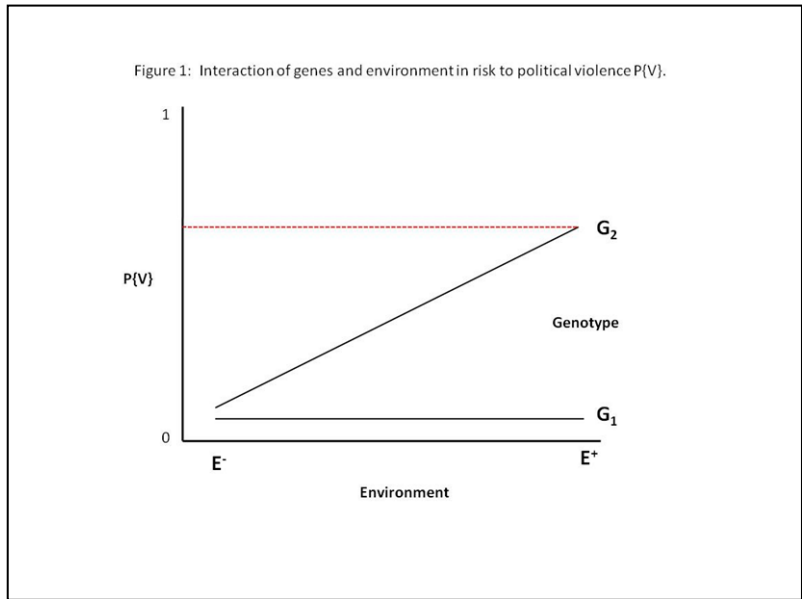
more likely to respond to violence with violence, this is not always the case. Numerous approaches exist to understand complex human behaviors in a changing environment and changing organism (age, puberty, long-term exposure, etc.). All of these models (physiology, neurology, genetic, psychological, etc.) have predictive power; the challenge now is for researchers to couple them together to provide a more complete understanding of behavior.

Here, Dr. Hatemi includes a model of human behavior previously unexplored for political violence.

1. Political violence cannot be understood if we ignore individual differences between people embedded within cultures.
2. The roots of political violence are multifactorial, resulting from interactions between a large number of biological and environmental factors.
3. These interactive effects may differ profoundly within and across populations and contexts, even within individuals.

The figure above is an over-simplification of a very large process, and the panels have mentioned some studies that start to draw the connections between the genetic associations with behaviors. There are many neural systems, based mostly on animal models that seem to influence aggression and violence in humans. In this way, it may prove helpful in conceptualizing how behavior can be better understood by narrowing the mechanisms down to differences in genotype.

The figure to the left summarizes the underlying concept, representing five hypothetical individuals with differing genetic constitution. In the absence of exposure to a specific environmental “trigger” (such as growing up in the Gaza strip) (E-) both individuals (G1 and G2) have a low probability of

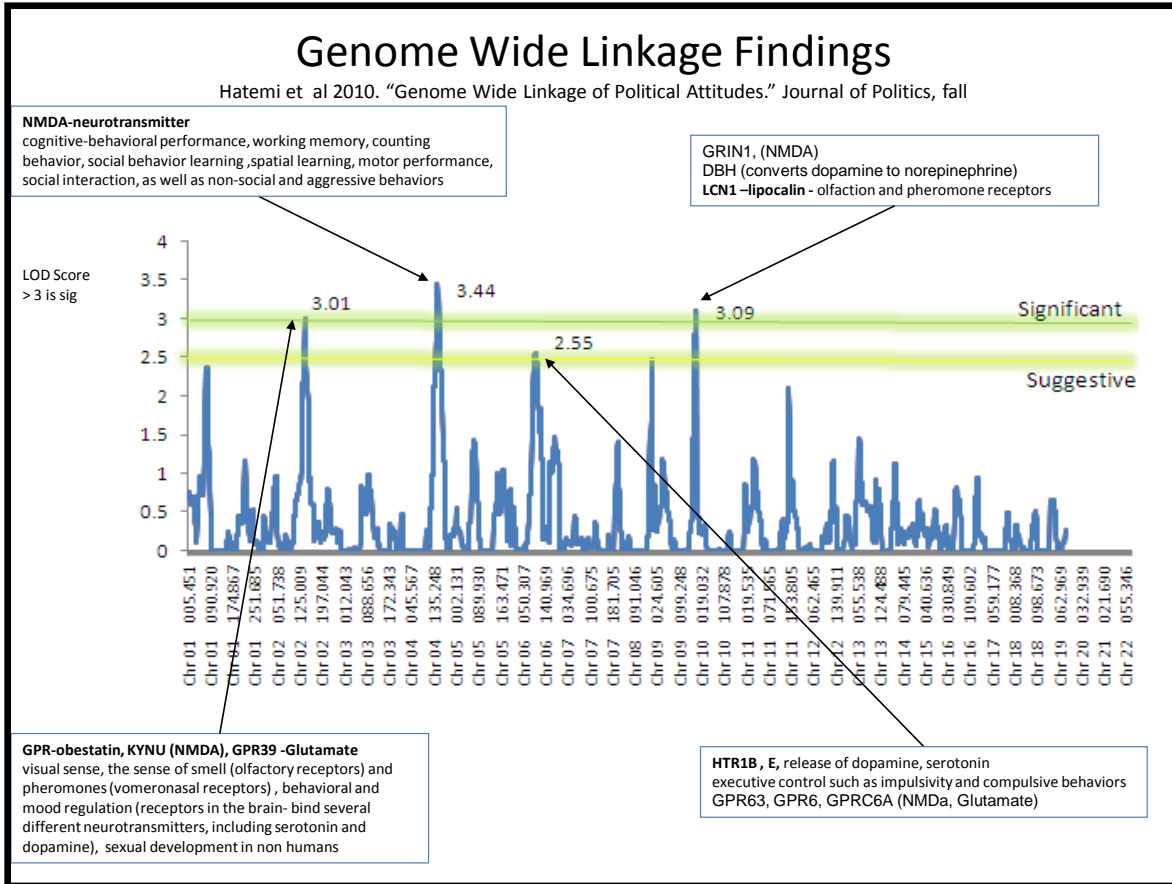


performing an act of terrorism ($P\{T\}$). However, when the environment is changed (E^+), only one of the two “genotypes” (G_2) responds with a high probability of violence. This behavioral genetic paradigm has been widely used for other explorations of violence and may prove useful in exploring political violence. Researchers can pull apart influences from the social family and differentiate them from the dispositional factors. Currently, there are not many studies on political violence, but there are more on general

violence and aggression.

Dr. Hatemi and his colleagues did a study on antisocial behavior, including violence among adolescents, and found that differences in MAOA interacting with traumatic early-life events or conflictual experiences predicted violence response and more violent behavior in adulthood. However, it is not simply that genotypes may lead to more violence reactions; they may also be an avenue to better understand preventative measures. In a previous study of identical and fraternal twins, Boomsma et al, found that being raised in a religiously Calvinist home moderated (down-regulated) the genetic precursors to engage in antisocial behavior. The social reinforcement mechanism of a religious home functioned to diminish the genetic effect. Such research suggests a great possibility for ways to not only identify, but potentially alleviate the probability of engaging in violence.

Dr. Hatemi and his colleagues are endeavoring to address just that issue by using family-based population samples of siblings, parents, cousins, grandparents, and peers (500 so far) that have been exposed to long-term political violence. The objective for this kind of work is to develop family-based populations for study and use in-depth epigenetic studies of the family, environment, experiences, diet, education, and exposure to political violence and other factors to determine the differential consequences of certain genotypic traits to those who ultimately engage in violence. This is currently in the proposal stage, but Dr. Hatemi would appreciate feedback from other participants.



Meanwhile, other research has been conducted by Dr. Hatemi and his colleagues, including a linkage study on 13,000 family members to identify specific genetic loci that may correlate with social behaviors similar to political violence, including pro-military and anti-immigration/out-group attitudes. Several loci in the dopamine, glutamate, and serotonin systems were implicated. In additional research, Dr. Hatemi explored Christian fundamentalism and religious fanaticism and found that vengefulness and faith are highly heritable, whereas, choice of religion was entirely social. Dr. Hatemi proposed a study comprised of a population of families discordant for engaging in violence but uniform in being exposed to violence. In doing so, and in combining paradigms (e.g., twin and family, models, association studies, and in-depth environmental assessment), it will allow researchers to identify the genetic risks for engaging in violence and the mechanism to moderate that risk.

Discussion:

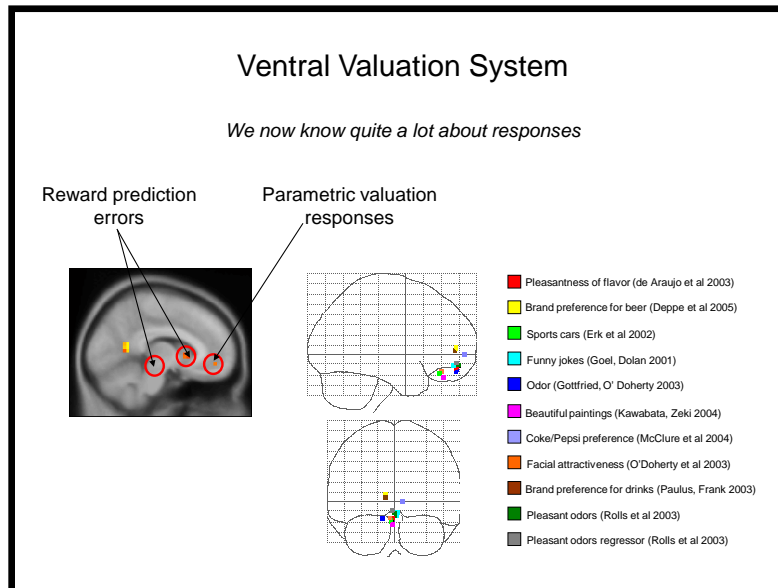
Dr. Eric Haseltine, DGI, noted that Clausewitz said that war is political aims achieved through violence. By this logic, the US military seeks political ends through violence. Thus, people who, in an all-volunteer army, choose to enter the military, might be an interesting study population.

Dr. Hatemi responded that he agrees, and that the genetic variants that may lead to a higher probability to seek out, engage in, or react with violence should be the same across populations. The cultural veneer (being born in the Gaza, or coming from an ardent American patriotic family) lays the groundwork for social development; but within those vastly different cultural experiences, there are likely some genetic similarities, those that respond to violence with violence, and those

that do not. Indeed, genetically, there may be some similarities in a Special Forces soldier, who will knowingly jump from a helicopter to hold to the last with an injured comrade knowing that doing so means his death, and what we label a terrorist, who will knowingly give his life in a suicide attack on a military base. Ideologically those are as far apart as I can imagine, and the idea in many ways is hard to stomach, as I look upon those who sacrifice for our country with reverence, respect, and pride; as all Americans, we are honored by their service. At the same time, I look upon those who kill innocents or commit suicide attacks with revile; however, genes and biological systems are not subject to my moral reasoning. The focus of the study is within-family, within-population, and within-location. The same mechanisms that allow one American to sacrifice for his or her country maybe be somewhat akin to those systems that allow others to do what is perceived the same for their people or country. In order to really understand individual differences in terms of committing violence, researchers have to isolate by condition and be open to the mechanism and not the morality. There is no such thing a gene for terrorism. There may be, however, genetic variants that are concomitant with the ability to commit violence, regardless of the cultural veneer in which they operate.

DR. READ MONTAGUE, BAYLOR COLLEGE OF MEDICINE

Dr. Read Montague, Director of the Human Neuroimaging Lab and Computational Psychiatry Unit at Baylor College of Medicine, was the next to present, noting that people who commit political violence are usurping their deep biological imperatives of survival. There is no other animal on the planet that kills itself for an idea.

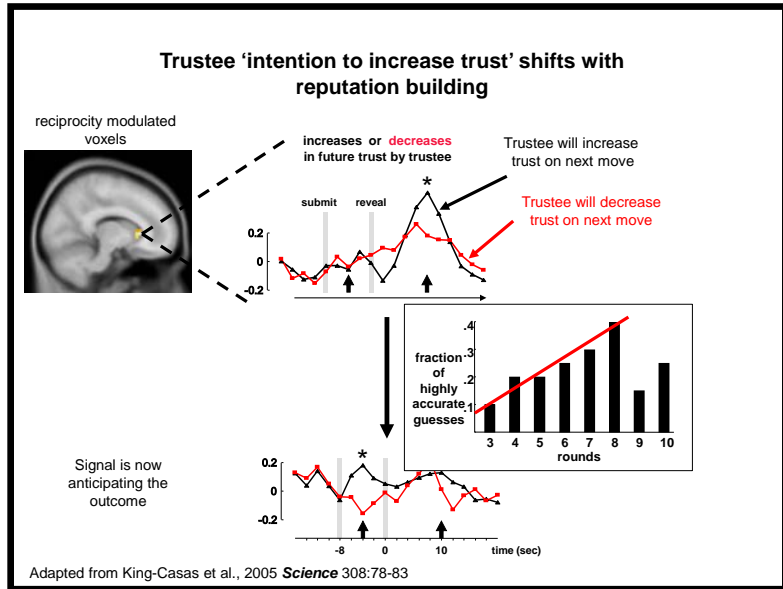


Dr. Montague stated that ideas are taking advantage of valuation mechanisms within our brain that allow us to ignore our biology (the biological imperative for self-preservation) for some amount of time; the extreme of this is problematic.

The reason that valuation mechanisms in the brain in crude imaging studies gain such precedence is because we know a lot about this in animal models. Considerable research has been dedicated to reward-processing

mechanisms. The ventral valuation system (see image to the left for a sagittal view of the brain) is the core primeval center of the brain, the dopamine centers. Projecting into the striatum and the prefrontal cortex (PFC), the ventral valuation system (VVS) is the only source of dopamine to the cortex. The VVS is critically involved in establishing the value of acts before one commits them. If an individual loses the prefrontal cortex (PFC), they lose the ability to make valuation-based decisions and risk-dependent gambles.

After providing a brief introduction to the ventral valuation system, Dr. Montague began to discuss an investor/trustee game conducted in his laboratory. During the game, an investor gets \$20; he can keep or send some portion of it to the “trustee” player, the \$20 trebles in the transmission. Dr. Montague has done this on 850 brains in an fMRI; indeed, he knows of no other experiment where they understand the signals as well. The objective of this sort of large sample size study is to produce normative distributions and compare individuals to that distribution. The only way to answer these questions using brain imaging is to study tens of thousands of people. Researchers, in general, must phenotype research subjects across more axes than is already done.



In order to achieve these results, Dr. Montague and his team used a hyperscan server and database, which allowed multiple research subjects to engage in a simultaneous game with other individuals. According to Dr. Montague, deviations and neural reciprocity is the key to this game. The region of the brain most active for positive reciprocity shifts is highlighted in the slide above. The temporal shift is provocative, because it indicates learning; the trustee anticipates a beneficial response prior to it actually occurring. Montague and his team think this represents a reward-prediction error. Reciprocity is a direct probe with monetary remuneration as the resulting award. But, the real question is what might happen without directed reciprocity.

In order to evaluate this question, Montague and his team executed the same experiment with an abstract art valuation task rather than a reciprocity task. The researchers asked research subjects to look at art on random time boundaries within the fMRI and are then asked to rate the painting. There is no right answer on the art valuation. When an image sits next to a sponsor logo, it changes the valuation of the art. Dr. Montague repeated the same research with art from art students, rather than well-recognized artwork from masters, and continued to find a sponsorship effect. This result suggests that if an individual were to make a gesture in another individual's general direction and some third agent shuts it down, there is neural activity which indicates that you make a positive inclination towards that artwork. This gets at sponsorship effects, but it also gets at valuation. Art experts do not fall victim to the sponsorship effect. A further test of this is the effect of pharmaceutical company inducements on medical doctors and whether that alters their decision making.

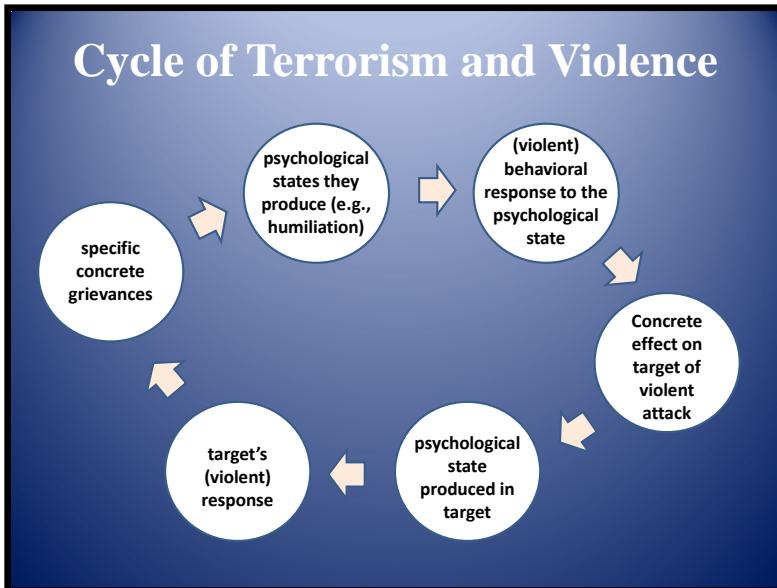
Dr. Olds asked what the postsynaptic effect on the BOLD signal in the neocortex might be when the phasic dopamine signal occurs as a cue that reward is expected. Dr. Montague responded that the dopamine networks in the PFC synapse directly onto the arterioles. The levels of dopamine in the PFC are ten times lower than they are in the striatum. In truth, Dr. Montague was unsure of the

correct answer to Dr. Olds' inquiry. The storage of these time-dependent cues into the future is not held on the dopamine neurons, they are training other systems and networks—PFC, amygdala, and the striatum. The dopaminergic center is not holding onto this information.

DR. TOM PYSZCZYNSKI, UNIVERSITY OF COLORADO AT COLORADO SPRINGS

Dr. Pyszczynski, Professor of Psychology at the University of Colorado at Colorado Springs, was the next to present. He began his presentation by summarizing his objectives, which included providing a broad overview of his work utilizing Terror Management Theory (TMT) to shed light on the psychological factors that contribute to terrorism. Terror Management Theory tries to explain why people need meaning in life and self-esteem and why people are so stressed when there are challenges to their meaning system. Terror Management Theory is an attempt to take ideas from existential, social, and cognitive psychology and put them into a framework that may provide useful ideas about the root causes of terrorism.

Dr. Pyszczynski and his team have been using experimental social psychological methods to test ideas from this theory but also wanted to discuss the potential extensions of these methods to assess the impacts of ongoing major historical events, including Obama's trip to the Middle East and the Administration's outreach to Islam, on the attitudes that Muslims in various countries hold toward radical Islam and the United States. He emphasized that when psychologists talk about cause, they do not talk about a single thing that causes a particular event to happen. Instead, psychologists are talking about identifying a variety of factors that causally contribute to a particular event; the interaction of these causal factors is what usually matter. Dr. Pyszczynski emphasized that when he discusses the psychological factors that are involved, he is by no means separating these things from the concrete issues at stake that other theorists are talking about, like sacred values, etc.



This model (see image at left) suggests that there are variety of points of intervention that may help end the vicious cycle of radicalization and political violence. People who have interviewed terrorists tend to agree that the most common things that come up are issues related to humiliation and justice. In essence, terrorists and those vulnerable to radicalization believe that their beliefs and values are disrespected and that they are perceived as inferior and treated unjustly by their enemies. Terror Management Theory provides an answer as to

why these issues of injustice and justice are so motivating. These feelings of injustice and humiliation do not necessarily result from direct experiences of these events. Typically, in political violence, people are responding to a threat to the collective self-esteem because they identify with their group as a source of identity and self-esteem, whereas, criminals tend to do things for their

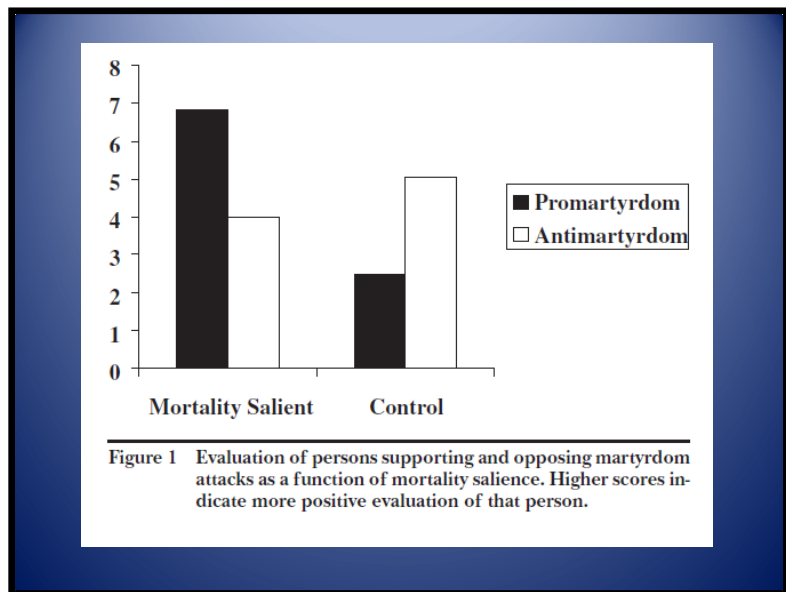
own wellbeing. Terrorists and perpetrators of political violence tend to do things for the good of the group, which is consistent with the collectivist discussions of earlier presenters.

In short, according to Terror Management Theory, people are aware of their own mortality, which is a problem for an organism that is strongly motivated towards self-preservation. Early humans used their intelligence to solve the problem of terror by developing cultures that gave meaning to life and value to themselves. Cultures promote world views to provide us with a sense of value and self-esteem. People deal with their awareness of mortality by maintaining a faith in their particular world view, which may be a religion or political ideology, among many other ways of understanding reality. When a person is treated with disrespect, it undermines the protection from anxiety provided by the world view and of their self-concept. Hundreds of studies have shown that when people are reminded of death, they respond more hostilely to people with different world views.

One of the first studies that Dr. Pyszczynski and his team conducted on these issues involved reminding people of 9/11 or their own deaths and querying their support for the use of extreme military responses in a Middle Eastern context. Thoughts of death increased support for violence and war. Political conservatives, when prompted with mortality-related stimuli, were especially likely to accept extreme force.

Likewise, in a similar study conducted in Iran (through collaboration), support for martyrdom was increased among those that were primed with reminders of death (see graphic below). In this study, Iranians were randomly assigned into two groups and asked to answer questions about death or pain. The subjects then were asked to evaluate an essay that argues either that the use suicide bombings/martyrdom is a necessity or that Islam is a peaceful religion. In the control (with no reminders of pain/death), students had a strong affinity towards the anti-martyrdom essay, but when primed with death, they were much more likely to support the pro-martyrdom approach.

Other studies, conducted in both the U.S. and Iran, showed that fundamentalists, who usually show especially high support for violent solutions to international conflicts, responded to reminders of death with decreased support for war or terrorism when reminded about the compassionate teachings of their religions. When religious values were not primed, the death reminders increased support for violence. Other studies showed that activating a sense of shared humanity or shared fate (created



by thoughts of the global consequences of climate change) are also effective ways of redirecting the effects of fear away from support for violence and toward support for peace-making.

Dr. Pyszczynski has used this method to test the impact of ongoing historical events. His studies show that thoughts of events such as President Obama's outreach to the Muslim world or the repressive response of the Iranian regime after their contested 2007 presidential election can

decrease support for radical Islam and lead to less negative attitudes toward the United States among Muslims in various countries.

Dr. David Matsumoto, San Francisco State University, noted that Dr. Pyszczynski had comparisons between a pain and control group; he asked for further clarification of the research design. Dr. Pyszczynski responded that he consistently found that other aversive events are like other neutral events and that death was the real catalyst for differences.

DR. PAUL ZAK, CLAREMONT GRADUATE UNIVERSITY

Dr. Zak, Director of the Center for Neuroeconomic Studies at Claremont Graduate University, was the final presenter in the last panel of Day 1 of the conference. At the outset, he noted that there is a huge relationship between poverty and many negative outcomes. The difficulty with many interventions is that they may not work with many portions of the population. One of the main factors that contribute to political violence is poverty. There is a 0.9 negative correlation between generalized trust and political violence. There is generally a question of what came first, the diminished trust or political stability. The maintenance of trust is difficult in countries where trust is low. Building environments with reciprocity is helpful in maintaining trust in such environments.

Dr. Zak and his team have done a variety of experiments to evaluate these associations. In particular, Dr. Zak has done considerable work with oxytocin, which is most often associated with maternal care for offspring, to determine whether oxytocin would increase trust when two strangers meet for the first time. When someone trusts an individual, the trusted individual produces oxytocin. The more oxytocin an individual releases, the more likely the individual is to reciprocate. Beyond just conducting this basic research, Dr. Zak and his team looked for a variety of other markers that may interfere with the role of oxytocin.

As part of the research protocol, research subjects receive 40 puffs of nasally-administered oxytocin. After the administration of the drug, the researchers query the subject's levels of social trust, pro-social behaviors, etc., and compare it to earlier, baseline measures. Using this approach, Dr. Zak found that in his research population of undergraduates, there is about 5% of the population for whom oxytocin is highly dysregulated. These 'dysregulated' individuals do not reciprocate trust (oxytocin deficit disorder--ODD) and, thereby, have the characteristics of psychopaths. This small minority of the population is deceptive, as well as self-deceptive, and they have a high number of sexual partners. Individuals with early trauma in childhood have impairment in oxytocin release.

Researchers can inhibit oxytocin in several ways; one way is through testosterone infusion. In another research study, testosterone was administered to men, thereby doubling their serum testosterone. After this administration, they were asked to engage in trust games. Testosterone made men more selfish, but they would burn their own resources to enforce cooperation. Based upon this research, a threat of punishment is a very good tool to enforce cooperation.

Another aspect of this research is to look at what oxytocin looks/feels like in the brain. The researchers developed a 100-second video of a cancer-stricken child that increased oxytocin release. People were more generous after watching the movie. Human brains have not fully evolved the ability to differentiate between a poor child in front of them and an image on the screen.

Likewise, Dr. Zak and his team have looked recently at advertising. As part of their research, they used public service announcement (PSA) advertisements from the United Kingdom on issues like do not drink and drive, just say no drugs, and global warming. After seeing the advertisement, the research subjects answered a simple question about content (they got \$5 as an incentive) and then were asked how they felt subjectively and about how they felt about people in the advertisement. Finally, the research subjects were asked for a donation. Not only did oxytocin increase their affective processing for people in the ads; individuals on oxytocin donated 56% more than those on placebos.

In general, individuals who release more oxytocin on general life stimulus have higher satisfaction with life; they are more resilient in negative situations, and they have more sex with fewer partners. Oxytocin release is trainable; the threshold for release decreases with social settings and exposure conditioning.

The operation of the oxytocin system is fairly complex; it depends on the developmental window of each individual. High stress tends to inhibit oxytocin release; a violent setting diminishes the likelihood that the system will operate properly. Likewise, acute stress raises testosterone levels and inhibits the functioning of the oxytocin system. The operative policy choice is whether we want to maintain a negative feedback loop with an aggressive cycle of zero-sum games or are we in an environment that is more pro-social.

In summary, social and environmental conditions are reflected in chemical levels in the brain. A deeper understanding of the interactive effects of genes, development, and the environment can lead to actionable approaches to reducing poverty and violence.

Discussion:

One participant asked for Dr. Zak's opinion of the studies that suggest oxytocin exacerbates anti-social behavior against the out-group. Dr. Zak responded that the out-group measures in the referenced studies are really rather weak, because these measures are really monetary measures. There is an issue of salience as these groups become more salient, but it is unclear whether oxytocin will increase out-group behavior.

Dr. Kornguth asked whether an experiment had been done when one couples an aversive behavior with stress. Dr. Zak responded that there had been related studies in animals. Nonetheless, a human study that maps out a normal curve of stress responses and oxytocin release is crucial; such a curve is likely to be a hyperbola. Such a study requires a fairly large sample size, but the technology exists. The key question is how these things work for interrogation and identifying the good guys and the bad guys in an applied setting.

If you look at animal models, it is great to be the alpha male. Yet, contrary to popular perception, alphas that stay in power share resources. Alphas can sustain the hierarchy by either punitive force or sharing resources, but sharing is generally more efficient. Effective business leaders are very good at engendering trust. From a policy perspective, we want to deactivate the fear response and activate the desire for a win-win long-range view.

PANEL DISCUSSION: RESEARCH III (DR. DEBRA BABCOCK, MODERATOR)

The third research panel was moderated by Dr. Debra Babcock, NIH. She introduced her panel by noting that workshop participants had been hearing about various cognitive, social, and environmental factors that might predispose an individual to violence and behavior, including biological traits that are risk factors for violent tendencies. The third research panel would focus on emotional states and how they color the decision-making process and set stage for future violence.

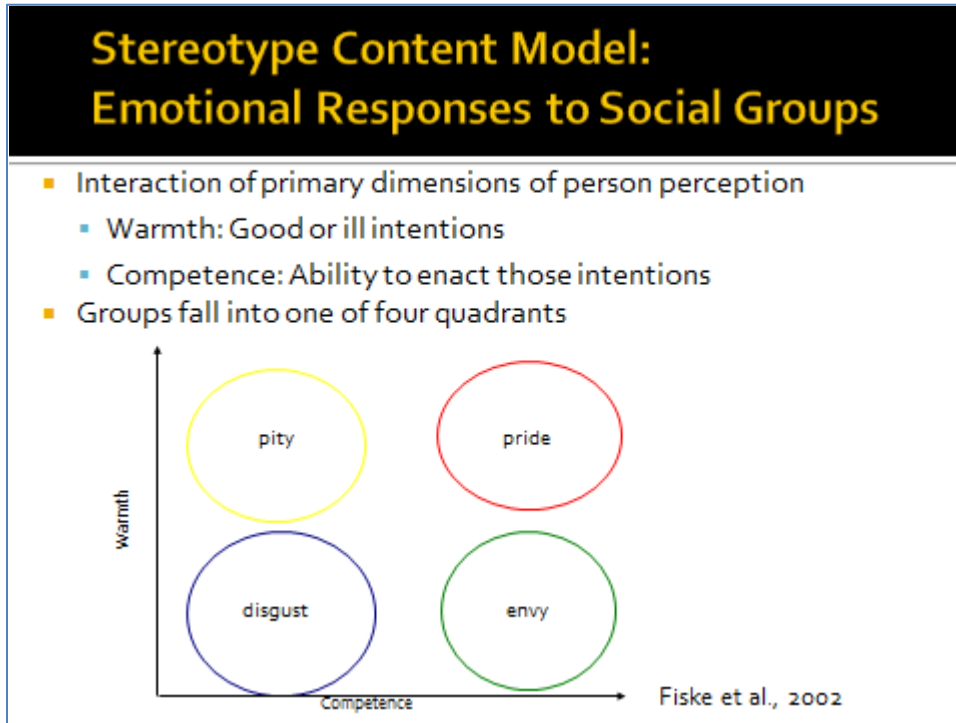
The panel included:

- Dr. Lasana Harris, Duke University
- Dr. David Matsumoto, San Francisco State University
- Dr. Peter Suedfeld, University of British Columbia
- Dr. Rose McDermott, Brown University

DR. LASANA HARRIS, DUKE UNIVERSITY

Dr. Lasana Harris, Duke University, focused his presentation on dehumanization, titling his presentation, *Dehumanized Perception: A Possible Psychological Mechanism for Violence*. Dr. Harris studies social neuroscience, an interdisciplinary field involving primarily social psychology and cognitive neuroscience. This burgeoning wave of interdisciplinary research is providing a number of highly useful perspectives on human behavior.

Possessing a mind involves having an inner life, but it is hard for others to get into the mind of another since the mind creates a private-language problem: no one can know another's mind, because the only mind one has experience with is his or her own. Indeed, if having a mind means feeling like a creature that has a mind, then (other people) culture, society, and the situation dictate what categories of agents have minds like ours. People can extend minds to things that do not possess minds like ours—anthropomorphizing dogs, cats, cars, and computers for instance—and withhold minds from people, eliminating empathy for other humans, leading to dehumanization. If one looks at historical instances of genocide, the propaganda associated with things like the Holocaust included reducing victims to levels below humans, either to the level of animals or objects. This is important because perceiving someone as a human being provides moral protections, such as valuing their life and prohibitions against killing.



Dr. Harris then began to go through some of the available literature in his field. In social psychology, there are two axes that generally define emotional responses to social groups: warmth and competence. These two dimensions thereby create a 2x2 matrix. Pride, which falls in the upper right quadrant of high warmth and high competence, defines most in-groups in the United

States (see chart above).

Disgust and contempt fall to groups perceived as low on both dimensions. In the US, homeless individuals, the poor, and/or drug addicted are extreme out-groups that elicit disgust. This Stereotype Content Model is very reliable across countries and cultures except for Asia where the pride group moves toward center because of modesty norms.

Pity (upper left quadrant—high warmth, low competence), pride (upper right quadrant), and envy (lower right quadrant, low warmth, high competence) cannot be experienced without the actual, imagined, or implied presence of another human being. For instance, people do not envy expensive cars; they envy the person who owns the car. Similarly, the US flag can elicit pride because it reminds Americans about that social group and all the people that comprise it. However, objects, as well as people, elicit disgust.

In one study, research subjects were shown pictures and asked to describe a day in the life of the pictured individual. Participants shown images of individuals typically subject to disgust (like a drug addict) did not spontaneously get into the head of the viewed individual. Because the individual in the image is subject to disgust, they were viewed as less human by the research subjects, which make it difficult for the research subjects to infer what is going on in imaged individual's head. Furthermore, neural activity in neural regions engaged in figuring out what someone else is thinking is decreased for these dehumanized targets.

When the same research design is modified slightly, such that a research subject first sees an image of a vegetable (like a carrot) and then the image of an individual and then is asked whether the imaged individual might like the vegetable, the research subject can more easily get into the head of the imaged individual. Activity increases for dehumanized target in neural regions that support inferring what someone else is thinking.

In another study, Dr. Harris created a scenario in which there is a run-away trolley that can be stopped by sacrificing one person for the benefit of a group of people. The researchers manipulated who was being sacrificed and who was being saved. If one has to sacrifice a homeless person, it is very different from sacrificing someone that is more respected by society; participants more readily endorse this trade-off. Likewise, the willingness of a person to sacrifice someone changed depending on who might be saved by the sacrifice; again, homeless targets were the least likely to be saved. People override the pre-potent impulse not to push a person when he is homeless, and neural regions engaged in resolving conflict are more active during this trade-off, providing corroborating evidence.

In conclusion, Dr. Harris noted that he is working on several projects to find psychological mechanisms involved in the switch. Something cognitive probably happens when dehumanization occurs, leading to affective response like disgust that compromise the mortal protections afforded to human beings.

DR. DAVID MATSUMOTO, SAN FRANCISCO STATE UNIVERSITY

Dr. David Matsumoto, San Francisco State University and Humintell, LLC, was next to present a presentation entitled *The Role of Emotion in Predicting Violence*. Dr. Matsumoto studies emotion mostly through expression of non-verbal behavior. The key points that he sought to emphasize were the fact that 1) violence is inherently an emotional act, 2) studying the role of emotion may give important clues about the psychological and neurobiological factors that contribute to violence, 3) the role of emotions in predicting the escalation of terrorist groups to violence, and 4) facial expressions of emotion can serve as indicators of imminent aggression.

The current literature generally lacks considerations of the roles of emotion in violence, which is surprising, because violence seems to be an emotional act, especially between groups.

He continued onto a discussion of his own research. This work started from anecdotal observation over many years. Every time Dr. Matsumoto sees videos of bad guys, he observes the same few expressions nearly every time. One in particular that these people display is an expression of disgust. Disgust is important to how people ramp up to violence.

There are major differences between anger, contempt, and disgust. Anger is the emotion that fuels aggression, but contempt and disgust justify the aggression. Contempt is the emotion of moral superiority; contempt is often seen in the faces of people intending to do bad. When people are disgusted--emotion of contamination--they want to eliminate the contaminant. Disgust fuels aggression that allows for elimination without thought of who the person is--women, children, etc. Emotions are transformed over time through stories. There is a consistent ramping up of contempt and disgust before violence.

Dr. Matsumoto began discussing a few of his research studies. In the first study, he and his team looked at speeches of leaders of ideologically-motivated groups. They coded their language for emotions they are expressing. The research team hypothesized that as leaders ramped up to identified acts of aggression, they would express disgust before violence.

The final pool of content included 20 acts of aggression and five acts of resistance in 7,800 sentences of content and 191,763 words. The results of this study suggest that as groups are ramping up towards violence, there is a spike in disgust, contempt, and anger between three to six

months before an act of aggression. If one looks at other groups that did not commit aggression, anger went down before they intended to act.

There are many groups out there that are angry, some may even be contemptuous, but Dr. Matsumoto believes that when disgust kicks in, that is when violence happens. For example, Gandhi and the Dalai Lama may have been angry, but they probably were not disgusted.

There was video of the Reagan assassination attempt that showed Hinckley's face—he had a very distinctive facial expression. Dr. Matsumoto looked at other sources to see if there is consistency of face before individuals commit acts of violence; there is a certain face that is consistent among individuals who are going to commit assassination. Dr. Matsumoto asked an actor to portray faces to see if people who have experience with aggression could pick it out. After capturing facial expressions of the actor, Dr. Matsumoto conducted studies with law enforcement officers (LEOs) in five countries, so not specific to one culture's face. They asked the LEOs, who had experience with violence and assault, which face looks like pre-meditated assault, then asked the LEOs to identify the face of the person who has lost control and come at the LEO. If the LEOs had not had the experience, they cannot pick out the right face. Only people in harm's way can pick the same two faces. This is important, because if one can identify these faces, it provides a potential cue 3-5 seconds before an action occurs.

Discussion:

Dr. Pyszczynski asked for further elaboration on what this research tells us about the tendency to dehumanize enemies. Dr. Matsumoto responded that dehumanization is crucial. Part of being disgusted is allowing people to disassociate from their victims. Disgust starts as a biological response towards rotten milk. Nonetheless, people have interpersonal disgust, which helps differentiate in-groups from out-groups.

Dr. Eric Haseltine, DGI, asked Dr. Matsumoto to speak more on contempt. Dr. Matsumoto responded that contempt is the ramp up, but anger fuels the act. Contempt is a justification, so it is observed before disgust. During the act, anger is observed. Over the course of a violent act, one might see anger cycling with disgust.

DR. PETER SUEDFELD, UNIVERSITY OF BRITISH COLUMBIA

Dr. Peter Suedfeld, University of British Columbia, was the next panelist to present, going through his presentation entitled *Assessing Cognitive Processes at a Distance: Reduced Complexity as a Factor in Political Violence*. Like Dr. Matsumoto, Dr. Suedfeld's research involves some content analysis as well. He began by describing thematic content analysis, which he uses to measure integrative complexity. Then he discussed his theoretical model to explain changes in integrative complexity.

Thematic Content Analysis (TCA) is a very flexible tool in analyzing materials that are produced by normal individuals or people anywhere along the decision tree of a nation and in the international community. The texts that are analyzed consist of spoken, written, or recorded materials whose sources are the leaders who give orders to commit violence. Scorers are trained to follow a detailed scoring manual and are not permitted to score for research until they achieve 0.85 inter-coder reliability.

Integrative complexity is a measure of information processing, gathering, perception taking, and decision-making. Integrative complexity is moderately related to tolerance of ambiguity. It is composed of two elements: differentiation and integration. Differentiation is the perception of more than one dimension or aspect of a stimulus or of more than one legitimate attitude about it. Integration is the combination of differentiated precepts in mutual interaction, synthesis, trade-off, or as units within a superordinate schema.

Dr. Suedfeld went through the basis for his scoring schema and then went on to discuss the cognitive manager model, which describes how complexity decreases under stress. Reduction in complexity is not necessarily a function of stress; decision-makers can decide that a problem is not worth expending cognitive resources that integrative complexity at a high level calls for, so they opt for simple solution. High complexity is not inherently more moral or more effective than low; which is superior depends on the particular event and circumstances.

Integrative complexity is a predictor of crisis outcome according to multiple research projects involving scores for leaders in international crisis. Conflict spirals are the classic situation when nations are increasingly ramping up aggressive talk/acts. Every time a nation escalates, the others reciprocate. The first study that Dr. Suedfeld discussed compared messages among leaders of Britain, France, and Germany. As only a few years elapsed between the 1911 Agadir Crisis and WWI, some the leaders were the same, which allowed for significant continuity. As the Agadir Crisis developed and then was resolved, high levels of complexity were maintained by the leaders. However, there was a significant drop in complexity between the beginning of the 1914 crisis and the declarations of war. The findings were replicated with three crises in the middle of the 20th century. The first event was the Soviet Blockade of West Berlin, which was resolved by massive airlifts of food, medicine, and fuel. The second was the Korean War; the Cuban Missile Crisis was the third. The two that were peacefully resolved were associated with higher levels of complexity.

Dr. Suedfeld applied the same research techniques to surprise strategic attacks by exploring nine cases in 20th century. They observed identical patterns in eight of nine cases. There was a significant drop in complex thinking in the texts of the eventual aggressor before each attack. The target of an attack does not show that drop; they show major increases in complexity as a last-ditch effort to reach a peaceful solution.

With persistent rivalries, when two nations are at loggerheads over a long period of time, there are often histories of multiple engagements, which can include guerrilla action and cross border raids with periodic outbreaks of major war. With this in mind, Dr. Suedfeld looked at the Middle East. Every year when major war broke out between Israel and Arab states, there was a significant decrease in complexity in one or both sides three to six months prior to the hostilities. In control years, when there was no war, those changes did not occur; levels of complexity were steady or increased. The last data point, 1976, was curious; there was no war, and this was thought to be either an exception or a disconfirmation of the hypothesis. However, a few months later, Israel invaded Lebanon, so the drop actually was predictive.

Prior to major conflicts between India and Pakistan, Dr. Suedfeld again found a decrease in the complexity of either or both leaderships. No such pattern was found when peace was maintained.

With the recent Russian/Georgian conflict, the changes in the complexity of Georgia's president showed the hypothesized outcomes. He demonstrated the predicted drops and increases as tensions rose and fell more than Medvedev, the leader of the far more powerful country. At the end,

Saakashvili's complexity went down a lot, but Medvedev went up. Judging by previous data, Dr. Suedfeld thought this could have been a precursor of surprise attack of Georgia on Russia, but not a probable outcome, given the disparity of forces.

Dr. Suedfeld applied this methodology to Osama bin Laden as well. There was a significant drop in complexity and an increased need for power a few months before the US embassy attacks in Africa. The same pattern emerged prior to the attack on the USS Cole and the London tube bombings.

Dr. Suedfeld concluded by pointing out that his and other labs have conducted a large number of studies that show the same general patterns: prior to an outbreak of international war, there is a drop in the complexity of texts produced by the leadership. Nonetheless, there is a distinct difference between war outbreak by mutual hostility and strategic surprise attack. He noted that he had not said anything about neurobiology because that is not his area of expertise.

LtCol Casebeer asked whether there has been a chance to manipulate integrative complexity to tease out causal relationship. Dr. Suedfeld responded that there have been such studies, mostly dealing with human simulations. In these studies, people play the role of a decision-making team; the stress they experience is manipulated by changing information they have and feedback. As stress increases, complexity goes down. The study looked not only at the score, but at the complexity of decisions they make.

Dr. Pyszczyński asked about factors that predict or cause increase or decreases in integrative complexity. Dr. Suedfeld responded that there are both internal and external factors. Among the former are fatigue, illness, and loss of hope; among the latter, time pressure, information overload or underload, and competing demands on decision-making. All of these and other influences can produce variations in integrative complexity.

DR. ROSE MCDERMOTT, BROWN UNIVERSITY

Dr. Rose McDermott, Radcliffe Institute for Advanced Study, Harvard University, was the final panelist to present her research entitled, *Exploring the Biological Bases of Leadership*. She began her presentation by noting her interest in the impact of illness on leadership.

Much of her work on leadership has not included a neurobiological element. However, she has recently begun experimental work designed to include a biological component to her work on leaders. While work on leadership and violence may seem like an unlikely relationship, this research relates to political violence insofar as political violence can be spontaneous, but many times it is not, but rather is quite calculated and comes out of concerted actions on the part of leaders. The power of leadership to motivate and inspire actions leads to interesting questions regarding the characteristics of leaders. Some of the characteristics of leaders include: aggression, dominance, protection against out-groups, identity entrepreneurs, and manipulation of emotion. From a research perspective, Dr. McDermott is curious to know whether leaders are in some way different from matched controls and if they are different from one another. Likewise, she would like to know if it is possible to predict various aspects of leadership and see whether leaders are more prone toward violence and how they resolve conflict.

In research with Allan Stam (University of Michigan) and Michael Horowitz (University of Pennsylvania), Dr. McDermott has reviewed the initiation and escalation of violence among leaders who led countries between 1875 and 2004. They collected information about standard

demographic variables to the extent possible and correlated this with data on the initiation and escalation of militarized disputes. They found that prior military service was the most robust indicator of violence and escalation. Interesting, contrary to popular belief, education increases the likelihood of initiating disputes, but makes an individual less likely to escalate.

These historical studies beg the question as to whether leadership qualities can be explored in an experimental setting to answer questions regarding how leaders are different compared to matched controls, how to determine differences among leaders, and how the role and influence of anger on decision-making matters, and how the effect of differentiated emotion-regulation affects abilities.

In order to answer these questions, Dr. McDermott has been working with a leader sample constructed by Dr. Jennifer Lerner (Kennedy School of Government, Harvard), which includes national security fellows in the Executive Leadership Training Program at the Kennedy School of Government at Harvard. These people have generally agreed to participate in their experiments and agreed to give saliva samples. There are two ways to evaluate leadership: objectively (how many people report to that individual) and subjectively (self-perceived position of power within their organization). The researchers attached controls matched on sex, education and age, but not in leadership positions. They hope to follow the research subjects over time to see how things may change.

The experiments involve particular manipulations, which include manipulations in the degree of responsibility, ostracism, and reward/punishment. The research involves several biomeasures derived from the saliva samples, which include tests for testosterone, cortisol, MAOA, COMT, DRD2 and DRD4, as well as 5-HTTPP. Given the limited sample size, Dr. McDermott is wary of drawing conclusions regarding the research pool, but as the sample grows, they hope to produce more generalizable results. In the future, they also hope to get fMRIs of some of the research subjects.

Nonetheless, the leadership research suggests that escalation and initiation is not a spontaneous decision; instead, it reflects a (mostly) calculated decision to order large, mechanized armies to pursue some end.

A workshop participant asked Dr. McDermott to elaborate further on gender differences. She noted that in the existing literature, there appear to be notable sex differences, especially in areas of family background. Males are given early leadership responsibilities for example, captain of football team. They are explicitly given expectations for that and mentorship for their leadership roles. They are groomed for leadership and are typically pushed in that direction. Female leaders generally come out of dysfunctional families and are expected to act in parental roles in their families. They take care of their parents and themselves and siblings. They are active participants in important household decision-making from preadolescence. Leadership is often a role forced on them. In many circumstances, they are actively sanctioned for that, but are still required to do it. Additionally, birth order has a lot to do with it. Firstborns are more likely to be leaders, which is generally true, even more for girls. There are also some situations in which the youngest boys in a family are more likely to become leaders.

Dr. Olds asked how Dr. McDermott operationally defined a leader because, for example, President Wilson is so qualitatively different from a GS-15 leader. Dr. McDermott responded that the categorization of leaders can be viewed both objectively and subjectively. Within the research pool,

it is also possible to do a secondary analysis of military versus political leaders. For Dr. McDermott, the biggest difference is between military and political leaders.

GROUP DISCUSSION

Following the conclusion of Dr. McDermott's talk, Dr. Babcock rose to facilitate further group discussion. She noted that in each of the panelist's talks, there was some focus on prediction, which is obviously an important element of preventing political violence. She asked what researchers still need to know in order to start intervening in the progression to violence and what the researchers would identify as key predictors.

Dr. Matsumoto responded that one thing is to take all of the approaches that seem to do that, throw in mix, and figure out what is a combination of sources that optimizes prediction and develops something that tries to do it. First test a new model with previous data and then move forward.

Dr. Harris added that paying attention to what these potentially dangerous populations think and say is very important. Workshop participants saw that facial expression, language and perceptions enhance that potential for violence. Using these tools as a dimension of a greater focus on populations would be helpful.

Dr. Suedfeld concluded that there is much more that needs to be done. What researchers need is a thorough, focused research on individual cases that fit the averages. There are outliers to understand what variables are involved in determining which way to go. Researchers do not yet know how to prevent violence.

Dr. McDermott noted that one thing that is important is an increase in research focused on discrete emotion and how such emotions predict, in large populations, the propensity to engage and support policy options. Demographic characteristics like age and sex are already relatively good predictors. In terms of political violence, there are some interesting developmental pathways to examine epigenetic features that involve poverty, maternal malnutrition level, etc. At an intergenerational level, it may be possible to prevent engagement in political violence through these things.

Dr. Helfstein, West Point, noted that in work on disgust, there is an apparent contradiction since, historically, terrorist groups kill far more people who belong to in-group than out-group. He wondered how one might account for the in-group violence relative to the discussion of disgust.

Dr. Harris responded that Dr. Helfstein is largely looking at consequences of decisions. If one were to talk to a Taliban fighter, disgust is still there. In their minds, they are not killing a member of their in-group; instead, they are killing people who have deviated from the social norm and were becoming part of an out-group. Everything is created and dependent on the situation and context.

Dr. Helfstein agreed generally with Dr. Harris's points, but al-Qaeda apologizes again and again for their violence.

Tessa Baker, NSI, noted that self-policing measures are an expression of disgust. If a Taliban fighter believes that he is the embodiment of the correct ideation, while someone in another community may still be Pashtun, the fact that they let their wife work violates his precepts of morality and Pashtun identity. Such an individual is thereby usurping the Taliban fighter's power and ideology, which may precipitate a manifestation of disgust. While this may not be a seemingly logical

expression of disgust to a westerner, it remains a form of social shaming consistent with disgust (think about the Salem Witch Trials).

Dr. Suedfeld noted that the boundaries of in-group are very flexible.

Dr. Pyszczynski noted that these findings are consistent with the black sheep effect; members of groups who deviate are the most hated. One is likely to have a higher level of disgust for a defector than a person who one expected to be hostile towards. When someone from one's own culture defects, it is more threatening to one's confidence than an outsider making the same attack. A home-grown terrorist is more hated than external.

Dr. Helfstein noted that this conversation closely ties to sacred values: how does one form disgust around sacred values? Aggregating from the individual level up to broad, population schematics is an important and difficult problem. The individual and organization may not hold the same values or act on them in uniform fashion.

One participant noted that with respect to prediction, there are issues related to false positives and negatives. From discussion on facial appearance, it appears that false negatives are generally taken care of. But considerations of false positives and negatives must be addressed, because political violence is a rare occurrence and noise may interfere with predictive power. Dr. Matsumoto responded that in any speech, emotions are transient, which is part of the problem with dialogue. A person who is angry is not angry all the time; they are only angry when they talk about the out-group. The accuracy has to be grounded in something true to generate false positive and negatives.

One participant noted that the consequence of this for a blue force is the question as to whether the blue force takes preemptive action against a leader perceived to be an adversary based upon his expression. Dr. Matsumoto responds that it depends on the context. If the face is directed toward the blue force, then the emotion may be targeted towards the blue forces as an out-group.

Dr. Harris added that they were all discussing averages. There is always variance around mean. There will always be an outlier.

Prof. Goodenough added that one of the missing pieces is the difference between levels of an actor's psychology. He asked whether the research was considering the leadership phenomenon when looking at profiles and activities, including those of followers and foot soldiers. Returning to the notion of narrative, there may be one piece of glue that sticks all levels together. The shared narratives may help to better determine how the layers integrate then tie back into a foot soldier's emotion.

Dr. McDermott responded that that is a critical point, because a narrative is how leaders manipulate followers. Leaders use strategic manipulation of narratives. Indeed, there is interesting work by Scott Atran on how leaders construct narratives to get followers to do what the leader wants, including killing themselves. Leaders are very calculated and can engage in performance to get people riled up. These are not accidental. They are in the context of narrative.

Dr. Harris added that emotions get people to do things, so there are not actions without emotions.

PANEL DISCUSSION: PUTTING IT ALL TOGETHER—WHAT DOES THIS MEAN? (DR. DIANE DIEULIIS, MODERATOR)

The concluding synthesis panel of the conference sought to answer the question “so what?” in an effort to integrate the prior day’s proceedings and provide the policy and decision makers in attendance with critical takeaways. The final session was moderated by Dr. Diane DiEuliis, Assistant Director for Life Sciences in the President’s Office of Science and Technology Policy (OSTP). The panel included:

- Col Troy Thomas, Joint Staff
- Dr. Jonathan Moreno, University of Pennsylvania
- Dr. Ronald Schouten, Harvard Medical School
- Dr. William Casebeer, DARPA
- Dr. Steve Kornguth, University of Texas
- Dr. Susanna Berry, Foreign and Commonwealth Office (Departed early, notes appended here)

Dr. DiEuliis began by thanking Abigail Chapman, NSI, and the other organizers for planning the conference, because the workshop had been so fruitful. Dr. DiEuliis’ background is neuroscience. When she thinks of the social, behavioral, and cultural sciences, she recalls a sign in her graduate school lab that said, “Under the most controlled circumstances, the organism will do what it damn well pleases.” This conference is great because it brings two fields together and endeavors to apply neuroscience to these social behavioral issues.

Political violence is an area where the USG and others are desperate for solutions, so this workshop has been encouraging in terms of providing particular directions. Yet, it is important to recognize that the field is still at the point of very basic research within the neurosciences. From a ten thousand foot perspective, while this is an area of pressing national security needs, if the government begins to direct the research in the neurosciences and the social, behavioral, and cultural fields, there will be tremendous, beneficial spillover effects.

Each panelist will provide a synopsis of what they heard. After each panelist speaks, the remaining time will be spent discussing their conclusions, as well as those of the audience. Hopefully, the focus will be on deterrence and counterterrorism.

LTCOL WILLIAM CASEBEER, DARPA

LtCol Casebeer noted that the conference had demonstrated just how complicated it is to disentangle these interrelationships. It has only been one century since the discovery of the neuron. It has only been 30 years since neuroscience has recovered from behavioralism. This subject matter is clearly tough. Despite its complexities, however, neuroscience and these neurobiological approaches will be useful for policy makers and decision makers.

The President of the United States and other policy makers should be interested in neurobiological approaches, because they have the potential to

- 1) Increase decision-makers’ situational awareness by providing a better understanding of the causal mechanisms underlying violence of this sort;

- 2) Result in the development of better models and simulations;
- 3) May help cue intelligence collection (in order to make decisions, the intelligence community needs to have information);
- 4) Lead to new and innovative back doors for influence (for example, if oxytocin is as important to trust as the research suggests and having a massage increases endogenous oxytocin production, it would be important to know whether Putin had had a massage before a critical negotiation); and
- 5) To examine large-scale relationships.

Of course, there are countless other reasons why this subject matter might be important for policymakers, but *carte blanche*, it is clear that these issues are of vital importance to our country's leadership.

In addition, LtCol Casebeer made several methodological comments, noting that connections are critical in this realm; connections between the sciences that study these phenomena, in particular, are vital. Therefore, in order to facilitate cross-pollination, participants in the discourse need to work through differences in vocabulary. Additionally, researchers also need to look at connections more broadly. Researchers need to work on the neurobiology of persuasion, of connections, and of vulnerability. Moreover, timescales are very important. Researchers in these fields have to do basic work first before the research can be extended in and through time. Additionally, context counts.

An important question is how do researchers disambiguate the elements of the ecosystem that impact the neurobiology of the target. Finally, there is no need to sweat the definitions at this point. Of course it is good to be reminded of the terms, but definitions fall out of completed science. Right now, a working target is critical, but the vocabulary does not need to be fixed at this point.

DR. JONATHAN MORENO, UNIVERSITY OF PENNSYLVANIA

Dr. Moreno, Professor of Medical Ethics and of the History and Sociology of Science at the University of Pennsylvania, was the next member of the synthesis panel to speak. He recalled the significance of prior restraint, which came up with Dr. Gazzaniga at the very outset of the conference. Dr. Moreno noted that the issues presented by this workshop are very interesting challenges that boil down to the very critical question of how to use data that suggests a potential outcome without crossing ethical boundaries of appropriateness. This data can probably be used, but how do policymakers and researchers integrate the science into the judicial and deterrence process?

The second element that came up during the course of the conference was "propaganda." In a new world order in which neuroscience informs everything, what would the public reaction be to the use of this data to make videos and pamphlets and the like?

Consistent with the issue of propaganda is also the issue of privacy. The publisher of Dr. Moreno's book five years ago was William Safire, a former Nixon speech writer and opinion columnist for the New York Times. Mr. Safire was interested in the questions of privacy that neurotechnology and imaging could create and yet he was also a patriot. He recognized, more than many others, the potential tension between privacy and new technological innovation. The public needs to consider the potential conflict between the values of privacy vis-à-vis our security.

The final theme of the conference's discussion is the matter of public optics. One of Dr. Moreno's interests is the reaction of the polity to science. There is a general sense that there is a disconnect between scientists and the public predicated on scientific hubris; people often wonder what scientists are really doing in their laboratories. Some states have passed criminal laws that ban the creation of human/animal hybrids, including Louisiana.

DR. STEVE KORNGUTH, UNIVERSITY OF TEXAS-AUSTIN

Dr. Kornguth, a former Professor of Neurology and Biomolecular Chemistry at the University of Wisconsin, identified several critical issues from the previous two days' proceedings. First, the identification of biomarkers or markers--whether they are sociological, genetic, biological or otherwise of political terrorism, as distinguished from all other sorts of violence and aggressive behavior--may not be possible. Second, and equally importantly, if the objective is to use these markers of terrorist violence, policymakers and others have to understand the difference of those biomarkers in the terrorists' mind and body as compared to those that are trained to undertake violence (military). Third, research has to be conducted to differentiate suicide bombers from the financiers and organizers of terrorism. Fourth, even if scientists are able to identify precise and accurate biomarkers of political violence, to what end might these markers be used in terms of actually producing a beneficial outcome? For example, if you can identify a potential terrorist, how might they be deradicalized? Finally, what is the risk of a false-positive in terms of enforcement? Will any marker be sufficiently accurate and precise to merit action, and what is the acceptable level of risk in terms of incorrect incarceration? There is the added issue that should be considered thoughtfully of what happens to a terrorist of a different culture in a dominant culture; there is a lack of language and cultural context that might interfere with any of the above processes.

At the core of this discussion is the question of how to translate these tools to an operational user.

DR. RONALD SCHOUTEN, HARVARD MEDICAL SCHOOL

Dr. Ronald Schouten, Harvard Medical School, commented that among his many jobs is teaching Harvard undergraduate students about criminal responsibility and development of the insanity defense, from a moral and legal perspective, which is always an interesting experience. While Dr. Schouten does not identify as a laboratory scientist, he wanted to recognize the incredible value of the science discussed during the conference and of scientific research for its own sake, regardless of whether it ever reaches an operational-use level.

As a forensic psychiatrist, Dr. Schouten spends a good deal of time conducting threat assessments, assessing patients for threat either to themselves or others and, in the last several years, in the context of national security issues. As an assessor of such things, Dr. Schouten, in theory, would be a customer for the neurobiological work in the area of threat assessment, which is how he tailored his feedback. Before providing feedback and commentary, however, Dr. Schouten sought to explore the history of these issues.

Society has turned to science in order to solve hard problems for centuries. In the example of mental illness, multiple theories and rationales have been deployed over millennia, starting with evil spirits as the cause of illness, then witchcraft, then phrenology, more recently psychodynamic theory, and even more recently, a pure neurobiological approach. Such theories, offered with great

certainty as the established “science” of the time, can cause great, if unintended, harm. For example, when psychoanalysis was in its heyday as explaining all abnormalities of human behavior, parents of children with infantile autism found themselves being blamed for their children’s problems, which, as the theory went, arose from their unconscious rejection of the child. Discovery all comes around, which is an argument for not giving up on the pursuit of novel theories or testing these theories to their limits, but rather for humility as we do so and before we offer theories as solutions to real world problems. An example from the world of criminal justice is profiling. Popular among crime writers, television viewers, and some law enforcement personnel, professionals who work in this area refer to it as behavioral analysis and recognize it as an investigatory guide, not a magical and dramatic crime-solving trick. They also recognize the hazards of using such techniques as prospective risk screening tools because of the high rate of false positives. Getting threat assessments wrong can have devastating consequences, which requires an understanding of confidence intervals around these assessments and how to translate theory to an operational environment.

As Amanda Pustilnik² has written regarding criminal law, the efforts to apply neuroscience in criminal justice leave us open to two fallacies of thinking: localization and “otherization.” The former refers to the idea that a given locus, either in the brain or the genome, can be assigned responsibility for a particular type of aberrant behavior. The latter refers to the belief that those who engage in such behaviors are necessarily different from the rest of us in terms of their brains or genetic makeup. I suggest that it is essential that we keep these same problems in mind as we pursue the question of the neurobiology of political violence. To date, there is no evidence that people who engage in political violence have brains that are different from the general public in the West or anywhere else.

Nonetheless, as a potential customer for this research, Dr. Schouten is hopeful that ongoing research can help us address these perplexing problems and do so with tools that possess the following characteristics.

- 1) The markers/biomarkers must be based upon clear and highly specific definitions of the behaviors being analyzed and to which the proposed markers are connected. How are we to define political violence: Lethal vs. non-lethal? Demonstrative vs. Destructive? Impulsive vs. Predatory? Suicidal vs. Non-suicidal? And so on.
- 2) There must be a high degree of sensitivity (ability to detect the vast majority of true positives) and specificity (minimizes the number of false positives) to identify people at greatest risk of these behaviors while minimizing the likelihood that innocent parties might get identified as being at risk or that true positives will be missed.
- 3) They must have proven validity, i.e., measure characteristics that exist in nature as opposed to theoretical constructs, and the statistical significance of these behavioral and biological markers must be demonstrable with special attention to base rates of those phenomena in general and special populations.

² Pustilnik AC. (2008). Violence on the brain: a critique of neuroscience in criminal law. Harvard Law School Faculty Scholarship Series. Paper 14. http://lsr.nellco.org/harvard_faculty/14

- 4) The framework or tool must be flexible and easily manipulated to accommodate the changing needs of the user over time, variations in circumstances and data, and the plasticity of behavior.
- 5) They must be based on behavioral and biological factors that are not merely outcomes of or coincident with the phenomena, but are actually markers or invariants.
- 6) There must be demonstrated reliability, i.e. yield consistent results when applied by different analysts.

COL. TROY THOMAS, OFFICE OF THE CHAIRMAN JOINT CHIEFS OF STAFF

Col. Troy Thomas, USAF and Special Assistant to the Chairman of the Joint Chiefs of Staff, Admiral Michael Mullen, spoke about how cognitive science could impact the field of international relations and armed conflict. His comments have not been approved for public release and are not included in this report.

DR. SUSANNA BERRY, FOREIGN AND COMMONWEALTH OFFICE

Dr. Susanna Berry, United Kingdom Ministry of Defence, was called away from the workshop prior to presenting her thought. She submitted her notes, which are included below.

“Driving to Dulles, the other day, I listened on the radio to neuropsychologist Daniel Tranel talking about his work with SM, a 44-year-old woman with no amygdala, who has no knowledge of what it is like to experience fear. After the interview, an excited listener phoned in to congratulate Dr. Tranel on his work, and to suggest that the US army should consider removing the amygdala of US soldiers going into combat so that they could fight more bravely and return unaffected by PTSD.”

“I grinned ruefully, thinking of a conversation I had had with my colleague from UK as we wandered out of NIH in early December following a presentation about oxytocin and the biology of trust. ‘How would you administer that?’ he had mused. ‘A nasal spray?’ ‘Perhaps you could impregnate someone’s clothing with it?’ I speculated. We stopped short, looked at each other, and laughed with embarrassment. Both he, the scientist, and I, the practitioner, had fallen momentarily into that state of blinding excitement produced by the sense of rapidly expanding scientific possibility.”

“As a Brit (and perhaps, more relevantly, as a European), I should confess to having come to the conference with a number of reservations about how much neurobiology could bring to this field. Among these were:

- That the neurobiological approach would entail an excessive focus on the psychology of the individual and a neglect of group processes in political violence;
- That insufficient effort would be made to define what we mean by political violence and to distinguish between the neurobiology of ‘ordinary’ violence and of ‘political violence;’
- That political violence might be treated definitionally as something that only ‘they’ do;

- That neurobiology would be held up as a tool for predicting politically violent acts;
- That the ability to identify the neural correlates of specific behaviors of interest could undermine the motivation of policy makers and people in the field to make sense of attitudes and behaviors as a coherent cultural whole;
- That the bedazzlement of what is possible might blind people to what is legal, ethical, and desirable.”

“For the most part, these prejudices proved unfounded, and at times were indeed confounded. John Hibbing posed the question of whether biology could do a better job than the social sciences have done in explaining political violence. In the end, I think the message to emerge from the conference was that in this domain, no single discipline or sub-discipline has the explanatory edge. Joan Chiao’s fascinating presentation on the influence of culture on neural processes and Peter Hatemi’s model of the role of genetics and epigenetics within the social and cultural framework both seem to push in the direction of fostering a greater understanding of cultural environments and social processes, rather than a turn away from them. For policy makers looking to emulate past successful interventions against political violence, this work acts as a warning that human biology might stand in the way of our best efforts to make history repeat itself.”

“Practitioners often look to science to provide technologies that will help simplify their lives and remove the complexities that tax human judgment. I think we need to be careful about looking to neurobiology for these sorts of tools. Oshin Vartanian’s presentation on Deception and Neuroimaging illustrated the point that neurological levels of description do not always take us much further than behavioral ones. Just as there is no deception-specific behavioral profile, there is no deception-specific neural profile. Even if I slide suspected bomb-maker Abu Ahmed into an fMRI scanner, I need to understand a multitude of situational, social, and psychological factors about him before I can make much sense of what is going on in his anterior cingulate cortex. Not to mention the fact that having his brain scanned may not increase Abu Ahmed’s readiness to enhance my understanding of those factors!”

“My background as a practitioner tells me that people working among those who are prone to political violence needs insights just as much and perhaps more than they need ‘tools.’ The practitioner on the ground, whether in law enforcement, intelligence, or the military, whether in Iraq, Afghanistan, Luton or New Jersey, needs to understand the social cognitions of the individual and his group and understand them well enough to know how to activate or suppress them as necessary. If easy access to fMRI scanners or gaze-tracking technologies diminishes his motivation to acquire this understanding, then he may be better off without it. Like the obstetrician whose reliance on ultrasound machines impairs his ability to make medical judgments by touch, he will fare moderately well until he loses his access to his technology. In austerity Britain our police, security agencies, and military are unlikely to be issued with mobile fMRI units any time soon. Non-technological means are likely to continue to form the mainstay of our approach in this sphere, a fact driven by economic imperatives, but also by a sense that it is one that has its attendant advantages.”

“On the ‘insight’ side of the equation, the conference raised or reinforced a number of important ideas (not all necessarily from the field of neuroscience) that should be informing the thinking of policy makers and practitioners in the counter terrorism field. Some stood out in particular. Gregory Berns’ findings on the neural processing of sacred values drove home what we most of us

intuitively know but often choose to ignore: that utility-based messaging, when it comes to fundamental moral and religious beliefs, is doomed to failure. The presentations on priming support for violence through reminders of mortality, sexual imagery, etc. (things imaginatively exploited by the propagators of radical extremism) raised questions of how we might identify ways to prime non-violent responses in the same constituencies. Peter Suedfeld's work on integrative complexity in leaders stimulated reflections on whether similar characteristics in the communications of individuals on the brink of a violent political act (e.g., suicide bombing) could be used to predict and avert terrorist attacks. There might also be interesting scope for research into how particular group processes affect the expression of integrative complexity. Work in the UK is looking at how increasing the integrative complexity of youngsters can help inoculate them against the lures of radical thought."

"For social policy-makers, a lone but very chilling demonstration that what we do matters was offered by Mark Hamm. In the UK, radicalization in prisons has become a serious problem and, as in the US, some institutions (the grimmer ones!) seem to be more fertile ground for radicalization than others. Neurobiological analyses in this context seem rather superfluous to the palpable reality that while it is highly challenging for policy makers to find effective ways to counter the effects of radicalization, it is relatively easy to promote conditions in which radicalization can flourish. As Mark Hamm succinctly remarked, 'it only takes one.'"

"Despite early injunctions not to lose sight of the legal and ethical questions raised by our expanding knowledge and capability in the field of neurobiology and behavioral genetics, we touched on them relatively little. This was a pity; however, I dare say we would have needed a couple more days to do it justice. My own brief oxytocin rush aside, it seemed clear that no one was inclined to neglect or under-play the importance of these issues."

"My thanks go to the organizers for bringing together such an interesting, varied, and illustrious set of speakers and for extending the invitation to myself and my UK colleague to participate in the event. We appreciated it and found it extremely valuable."

DISCUSSION

Dr. DiEuliis noted that drawing the links to the current issues of the day sets the tone for the importance of these issues. She then opened the panel to discussion and questions from the audience for the time remaining.

Dr. Haseltine asked whether anyone had heard anything that rises to the level of actionability during the course of the conference. Likewise, he wondered whether there has been anything in terms of situational awareness that would inform or contextualize a decision. Dr. Schouten responded that he had not heard anything that was actionable at the moment, but he commented that the findings were seductive and intriguing. His overall impression is that everything discussed during the conference could help inform and contextualize.

SSA Andrew Bringuel, FBI, said that he teaches a course on understanding the minds of terrorists; as a consequence, he is most interested in manipulating human behavior for source development. During training, FBI operatives do not just discuss radicalization because not all radicals are law breakers. The FBI would be interested in those markers that distinguish actors within those

enterprises, those markers that would lead to radicalization, and then to the criminal behavior. The FBI would like to be able to identify those individuals and the concomitant incentives that provide for individuals who could be sources, those that are part of the organization but are not violent.

Dr. Hatemi contributed that most of the people he works with do not believe that there would be one specific genetic marker for terrorism; for instance, there is no gene for what religion you will be, but how much you invest into the group may have an underlying genotype or a large number of genetic variants concomitant with the trait. The systems that humans work around are fairly universal, but the context varies, and the conditions change. The same systems that cause people to commit violent acts, whether they are terrorism or military actions, are unlikely to be very different.

The context piece that was missing is that none of these interventions are going to work in isolation, but if it can contribute to something else, such measures and approaches would be tremendously effective. It is not possible to genetically profile people as terrorists, but there may be practical applications of these approaches. How can we actually use this in a military setting? This is all basic science; this is in its early days. Instead of worrying about definitions and constraining it, researchers should let the science loose. The human genome, despite being fully sequenced, is still a mystery to science, more or less.

Dr. Diane DiEuliis added that the science is just at the cusp of epigenetics or the study of how protein expression is changing over time.

Dr. Pyszczynski noted that he is a social psychologist with a limited exposure to neuroscience. He offered his own summary of the conference, suggesting that much of what had been discussed endeavored to explain the underlying neurological mechanisms that produce the effects that social psychologists study. The science has not advanced to the point that specific neurological markers could be used and deployed by researchers and policymakers. It may be important to look at how people interpret a new attack or an incursion and draw the connection between the perception, the meaning system, and the underlying neurobiological activities.

Dr. Kornguth responded that the panel had not yet made a statement regarding the “so what” of the conference, a critical oversight. The question is not that we are going to learn more, because we will, but rather what it will add to the current view of the world. In the end, it is incumbent on the scientist to draw the connections.

LtCol Casebeer replied that these are empirical questions whether the causal indicators will be teased out in a sufficient way to be used as a marker. Some of the concerns are predicated on a physics perspective on what a good model is; there will never been a universal proof ($F=ma$). In the human realm, a coevolution of psychology, evolution, genes, environment, etc., will inform a better model, but it will never be a universal proof. The phenomenon writ large of political violence and the affiliated neurobiology will never produce generic/generalizable proofs.

Dr. Feucht concluded that almost everything was relevant during these discussions. As a representative of an affiliated domestic justice/criminal component, there are sheriffs that want to know these things. He suspects that these people are not looking for actionable recipes. They are far more advanced than that; they just want to be involved in a much more sophisticated discussion of evidence, situational awareness, and wisdom about human phenomena.

Dr. Hriar Cabayan concluded the conference by reinforcing LtCol Casebeer's statements. There is a whole family of security needs, particularly in terms of influence and deterrence, that needs to be better understood before action is taken. This community of scholars provided us with additional insights to give decision makers. He then thanked the participants for their contributions and concluded the workshop.

APPENDIX A: AGENDA

December 1-2, 2010
National Institutes of Health
Building 45—Auditorium Balcony C

December 1, 2010

7:30-7:50am	Check-In
7:50-8:00am	Welcome & Conference Introduction
8:00-9:00am	Introductory Briefings Neurobiology, Stories and Political Violence: The Security Upshot of the Cognitive Neuroscience of Narrative <i>William Casebeer, DARPA</i> Leveraging the Decade of the Mind to Reduce Political Violence <i>Jim Olds, GMU</i> Remarks on the Prediction of Violence <i>Michael Gazzaniga, UCSB</i> Moderator: Abigail Chapman, NSI
9:00-9:15am	Break
9:15-11:00am	Panel Discussion: Basics of the Science Social Psychology, Cognitive Neuroscience & Political Science: Frameworks for Analyzing Behavior and Understanding Attitude Formation Panelists: Amy Zalman, Arie Kruglanski, Joan Chiao, Emile Bruneau Moderator: William Casebeer, DARPA
11:00-12:00pm	Lunch Break: Cafeteria
12:00-2:00pm	Panel Discussion: Research I Research into the psychological & neurobiological mechanisms underlying violent behavior and decision-making processes Panelists: John Hibbing, Rene Weber, Oshin Vartanian, Victoria Romero, Mark Hamm Moderator: Thomas Feucht, DOJ
2:00-2:30pm	Group Discussion Opportunity for the audience to interact with the panelists and to answer the question, "How can I use this information/research to inform the questions I have?"
2:30-2:45pm	Break

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2:45-4:45pm Panel Discussion: Research II
Aggression, fear & trust—Research and impact on decision making and violent behavior
Panelists: Greg Berns, Peter Hatemi, Read Montague, Tom Pyszczynski, Paul Zak
Moderator: **Amber Story, NSF**

4:45-5:15pm Group Discussion

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8:30-9:00am Check In

9:00-10:30pm Panel Discussion: Research III
Emotion & Stress—Research and impact on decision making and violent behavior
Panelists: Lasana Harris, David Matsumoto, Peter Suedfeld, Rose McDermott
Moderator: Debra Babcock, NIH

10:30-11:00am Group Discussion

11:00-11:15am Break

11:15-12:30pm Putting it All Together—What Does this All Mean?
Panelists: Troy Thomas, Jonathan Moreno, Ronald Schouten, William Casebeer, Steve Kornguth
Moderator: Diane DiEuliis, Live Sciences Officer of Science and Technology Policy, Executive Office of the President

12:30-1:30pm Networking/Informal Discussion

APPENDIX B: PARTICIPANTS

Allison, Tim	ATAC
Armani, Robin	STRATCOM J922
Astorino-Courtois, Allison	NSI
Babcock, Debra	NIH/NINDS
Baker, Tessa	NSI
Baty, Roger	NORTHCOM
Bennett, Phil	DOE/SNL
Bernard, Mike	DOE/SNL
Berns, Greg	Emory University
Bernstein, Lynne	NSF
Berry, Susanna	UK Foreign and Commonwealth Office
Bhatt, Sujeeta	FBI
Blackwell, Jim	US Air Force
Brawley, Courtney	FBI
Bringuel, Andrew	FBI
Bruneau, Emile	MIT
Cabayan, Hriar	Office of the Secretary of Defense, AT&L
Canna, Sarah	NSI
Casebeer, Lt Col Bill	DARPA
Chapman, Abigail	NSI
Chauvin, Cherie	NAS
Chiao, Joan	Northwestern
Clark, Mark	SAIC
Clark, Sharri	US Department of State
Costa, Barry	MITRE
Cullem, Kimberly	SAIC - USSTRATCOM/J55
DiEuliis, Diane	OSTP
Elder, Robert LTGen	George Masson University
Fenstermacher, Laurie	Air Force Research Laboratory
Feucht, Thom	DOJ/NIJ
Forbes, Chad	NIH
Friend, Dan	University of Washington, Seattle
Gamba, Nidia	FBI
Gates, Kevin	Armed Services Committee
Gazzaniga, Michael	SAGE Center for the Study of Mind, UCSB
Gelfand, Michele	UMD
Goodenough, Oliver	Gruter Institute
Green, Christopher	Wayne State University
Hamm, Mark	Indiana State University
Haseltine, Eric	DGI
Hatemi, Peter	University of Sydney

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Helfstein, Scott	Combatting Terrorism Center
Hennessy, Richard	British Foreign and Commonwealth Office
Herk, Monica	UGOV
Hibbing, John	University of Nebraska, Lincoln
Himelfarb, Sheldon	US Institutes of Peace
Hwang, Hyi Sung	
Jeannotte, Alexis	ODNI
Jones, Laura	UMD- STRATCOM
Klein, Kristen	UMD
Kornguth, Steve	University of Texas
Krex-Brinkmann, Larissa	Marine Corps Fellow
Kruglanski, Dr. Arie	University of Maryland
Leventhal, Todd	US Department of State
Ling, Geoffrey	DARPA
Long, Carla	JSOC
Lyons, Terry	AFOSR
Marchant, Danny	JSOC
Matsumoto, David	San Francisco State University
Maxwell, Jeffrey	USG
McDermott, Rose	Brown University
McKenna, Pat	STRATCOM
Meinshausen, Paul	Army
Meissner, Christian	National Science Foundation
Mershon, Dr. Carol	National Science Foundation
Minacapelli, Lauren	University of Maryland
Montague, Read	Baylor College of Medicine
Moreno, Jonathan	University of Pennsylvania
O'Conner, Jennifer	Department of Homeland Security
Olds, James	George Masson University
Olster, Deborah	NIH
Poore, Josh	NIH
Porter, Wayne CAPT	CJCS
Princit, Ruthie	George Washington University
Pyszczyński, Tom	University of Colorado
Rhem, Sam	SRC
Ritter, Valarie	Centra Technology
Romero, Victoria	Defense Research Consultant, Cognitive and Behavioral Sciences
Russell, Adam	USG
Russell, Anne	SAIC
Samanta Roy, Robie	Armed Services Committee
Schouten, Ronald, MD	Partners.org
Smith, Becca	CSIS
Stanley, Rob	CSIS

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Stern, Karen	DOJ
Story, Amber	National Science Foundation
Suedfeld, Peter	University of British Columbia
Swanson, Traci	OSD-CAPE
Talmage, Daniel	National Academy of Sciences
Taylor, Ron	National Academy of Sciences
Thomas, Troy LtCol	Chairman's Action Group
Vartanian, Oshin	DRDC Toronto
Waggoner, LCDR	Joint Staff
Wall, Joel	Department of Homeland Security
Weaver, Scott	STRATCOM
Weber, Rene	UC Santa Barbara
Wheeler, Schaun	Army
Young, Michael	DIA
Zak, Paul	Claremont Graduate University
Zalman, Amy	SAIC

APPENDIX C: ACRONYMS

ACC	Anterior Cingulate Cortex
AQ	Al Qaeda
CJCS	Chairman Joint Chiefs of Staff
DARPA	Defense Advanced Research Projects Agency
DDGO	Deputy Director for Global Operations
DDRE	Defense Research & Engineering
DOD	Department of Defense
DOJ	Department of Justice
DOS	Department of State
DRDC	Defence Research & Development Canada
EEG	Electroencephalogram
fMRI	Functional Magnetic Resonance Imaging
GSR	Galvanic Skin Response
JIS	Jam'iyyat Ul-Islam Is-Saheed
JS	Joint Staff
LEOs	Law Enforcement Officer(s)
LTPJ	Left Temporal Parietal Junction
MPFC	Medial Prefrontal Cortex
NIH	National Institutes of Health
NIJ	National Institutes of Justice
NSF	National Science Foundation
ODD	Oxytocin Deficit Disorder
OSD	Office of the Secretary of Defense
OSTP	(President's) Office of Science and Technology Policy
PET	Positron Emission Tomography
PFC	Pre-frontal Cortex
PSA	Public Service Announcement
SDO	Social Dominance Orientation
RRTO	Rapid Reaction Technology Office
SMA	Strategic Multilayer Assessment
SNP	Single-nucleotide Polymorphism
STRATCOM	United States Strategic Command
STS	Superior Temporal Sulcus
TCA	Thematic Content Analysis
TCMs	Transcranial Magnetic Stimulation Scan
TMT	Terror Management Theory
UK MOD	United Kingdom Ministry of Defence
US	United States
USG	US Government
VEOs	Violent Extremist Organizations
VLPCF	Ventrolateral Prefrontal Cortex

WWI World War I