Leveraging Neuroscientific and Neurotechnological Developments with a Focus on Influence and Deterrence in a Networked World

Strategic Multi-layer Assessment[1]

Workshop Summary

18 October 2013

Panelists and Speakers: Dr. Jorge Barraza (CGU), Dr. Bill Casebeer (DARPA), Ms. Abigail Desjardins (NSI), Dr. Emily Falk (Univ. of Penn), Dr. James Giordano (Georgetown University Medical Center), Dr. Clark McCauley (Bryn Mawr), Dr. Jerrold Post (George Washington Univ.), Dr. Victoria Romero (Charles River Analytics), Maj Jason Spitaletta (JHU/APL), Dr. Rand Waltzman (DARPA), Dr. Nick Wright (Carnegie Endowment)

Moderators: Dr. Hriar Cabayan (JS/J39), Dr. Bill Casebeer (DARPA), Dr. Diane DiEuliis (HHS), Dr. James Giordano (Georgetown), Amb. David Smith (Georgian Security Analysis Center)

Report Author:
Sarah Canna
(301) 466-2265
scanna@nsiteam.com

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Preface

Our thanks go to Dr. Diane DiEuliis, HHS, and Dr. Allison Astorino-Courtois, NSI, for realizing there was a need to bridge the gap between the neuroscience and social science communities. Thanks also goes to Dr. William Casebeer, DARPA, and Dr. James Giordano, Georgetown University Medical Center, who were interested in expanding the boundary of knowledge to inform the foundation understanding of deterrence theory. Finally, thanks go to Georgetown University Medical Center for hosting the workshop.

Leveraging Neuroscientific & Neurotechnological Developments: A Focus on Influence & Deterrence in a Networked World Workshop

Background

Students of political science, criminal justice, marketing, and psychology have assessed the interactive natures of deterrence and influence for decades. This workshop introduced an added layer of novel scientific insights from neuroscience and neurotechnology to complement and extend earlier assessments. The geopolitical context is guided by four significant trends likely to emerge in the coming decades:

- Demographic change: The population of allied U.S. countries are growing older and increasing the demand for domestic social spending, making it more difficult for these allies to assist the U.S. in joint international ventures. With some exceptions, youth bulges are slowing in the developing world.
- Resource stress: Globally, there is increased urbanization, a growing middle class, and a greater demand for resources and governance effective enough to deliver them. The rapid growth in urbanization, in particular, means that when natural or man-made disasters strike urban areas, they are more likely to be catastrophic in terms of population displacement and loss of life.
- Further diffusion of power: An equalization of power in the international system may make it more difficult to resolve international issues and lead to concerns about the fragmentation of the international system.
- Individual empowerment: Individual empowerment, together with weak government capacity, could fuel grievances by generating an environment in which dramatic and violent individual actions are easier to accomplish. An increased availability of precision strike weapons in the hand of individuals is, therefore, a growing concern.

Introduction

Dr. James Giordano, Georgetown University Medical Center, stated that the key questions for this workshop are whether and in what ways neuroscience is operationalizable. Operationalization becomes a question of talking to users, identifying needs, and applying science to real world problems. The only way to effectively operationalize neuroscience is through workshops like this one; it serves as an incubatory process. Giordano challenged the workshop attendees to take the input and ideas presented at this workshop home to spur innovation. Neuroscience and neurotechnology are not esoteric concepts, but are applicable tools that can be leveraged in influence and deterrence scenarios. Moreover, while it is clear that a number of ethico-legal and social issues–and concerns–arise from the dual use nature of neuroscience research, this workshop focused on the ways that neuroscience and its technologies could be leveraged to influence individual actors toward deterring possible inter-personal aggression and social violence. Giordano presented an overview of current neuroscientific and neurotechnological (so-called neuroS/T) approaches to assessing and engaging neurological structure and function, which could be applied within projects, programs and/or a paradigm of cognitive and

behavioral influence and deterrence. In this way, he provided a working definition of the terms "neuroinfluence" and "neurodeterrence" to represent rapidly maturing operational approaches to assessing, accessing, and affecting identified substrates and mechanisms of the nervous system that have been shown to be instrumental in cognitive/emotional and behavioral dimensions of aggression and violence.

Participants spoke about the intersection of deterrence and neuroscience. Up until the turn of the 20th century and the introduction of rational actor theory, there was no unified theoretical basis for deterrence. However, the last several decades have shown the limitations of rational actor theory in predicting or accounting for emotions, beliefs, desires, and attitudes. In the 1980s, heuristics and biases were layered onto a revised version of rationality in explaining deterrence. Yet the focus remained on the nation-state. The last 15 years have seen a pivot towards other levels of analysis, primarily non-state actors, individuals, and social movements.

Unlike nation-states, social movements have life cycles: gestation, growth, maturity, and eventual death or transformation. This is a dramatic difference. Strategies for dealing with non-state actors and social movements might change as a function of a life cycle. Additionally, there is a difference between deterring generically and deterring acutely (e.g., preventing an attack on the United States versus preventing an attack in NYC tomorrow morning). Strategies for generic deterrence might draw from research on pre-cognition and supra-cognition (affective) states, whereas influencing non-state actors may draw on research regarding environmental shaping. This new concept of deterrence calls for shaping and influence actions as opposed to the traditional denial or punishment actions.

The cognitive revolution, which started in the 1960s, has a flourishing literature on how aspects of the environment interact with the brain to effect behavioral change. Science allows us to find scientific basis of things like communication and transmission of information. Neuroscience can quantitatively assess how social content can influence behavior. Scientists can then marry effective messages with what is going on in the brain and how that affects behavior. Social pressure has utility and, in certain circumstances, you can influence perception of critical information about the environment.[2]

Ultimately, successful deterrence relies on knowing the environment and culture within which decision-makers lives. Cultural analysis should be an essential part of intelligence analysis.

Discussion:

You talked about the punishment stage of deterrence. We think of classic Cold War deterrence as preventing escalation, but with NSAs, punishment is escalatory. For example, drone strikes radicalize the target population. Is that counterproductive?

Punishment for one person is a reward for another. There are individuals in prison populations who, because of accidents of development, take pleasure in other people's pain. It is hard to deter and influence them.

[2] Bond, R. M., Fariss, C. J., Jones, J. J., Kramer, J. D. I., Marlow, C., Settle, J. E., & Fowler, J. H. (2012). A 61-Million-Person Experiment in Social Influence and Political Mobilization. *Nature*, *489*, pp. 295-298.

Schadenfreude exists not only within prison populations. If someone is morally violated, the reward areas of the brain are more active than when they are punished.

Some individuals are willing to take punishment to mete out perceived justice. That is one of the problems with rational actor theory. Some people are willing to accept punishment to achieve a goal.

In classic leadership deterrence, one is taught to look at leadership dynamics—whether in singular or group. The deterrence paradigm is entirely different for each leader. How does that play into neuroscience?

That is the million-dollar question. Deterrence too often focuses on deterring a state: How do we deter North Korea? However, a state is run by individuals. We need to focus on deterring decision-makers, not states. We need to tailor deterrence to the individual decision-makers.

Knowing a leader's neuroscientific propensities could be a vital tool for effective deterrence. For example, one way in which people vary is epigenetics. Approximately 60% of the male population has the MAOA gene, which predisposes one to violence. However, the environment plays a key factor in the activation of the gene. Only abuse during childhood activates the gene. Understanding epigenetics, environment, and personal history of individual leaders could provide valuable insights for deterrence and influence.

Deterrence theory goes back at least to Thucydides. We almost went wrong during the Cold War by relying on rational actor theory. In studying the Russian archive, we determined that we were very wrong. They were willing to go to nuclear war. The jihadis have done us a favor in that it has challenges our reliance on rational actor theory. Let us purge "rational" from discussion because it refers to a western, Judeo-Christian sense of rational.

One other way we got deterrence wrong is that there is no such thing as a nation-state. One cannot deter a state. The Cuban missile crisis was all about small group dynamics. There was a small group in the White House making decisions and Khrushchev was in a room by himself. You can have as many models and cultural intelligence as you want, but you have to know who the decision-makers are—and we do not usually know these things.

Another participant noted the danger of relying too much on neuroscience findings because research is done primarily on western, college student populations. There is only so much we can say that is globally applicable.

Although human nature is universal, it has been cannibalized by culture.

Panel One: Defining the Current Landscape of Neuroscience & Neurotechnology

Panel Moderator: Dr. Diane DiEuliis (HHS)

Panel members: Drs. Bill Casebeer (DARPA) and James Giordano (Georgetown University Medical Center)

Participants emphasized that the current pace and extent of neuroscientific progress has raised hopes that new insights will improve the United States Government's (USG) ability to conduct influence and deterrence operations. Neuroscientific information gained from methodologically rigorous research can provide strong, evidence-based understanding of how individuals' neural functions contribute to various cognitive (and emotional) states that are important to decision-making and behavior. However, neuroscience, while affording great potential, is also limited in current technical capability and, thus, particular applicability and, therefore, does not provide a stand-alone or absolute toolkit for understanding deterrence and influence. Only when used in combination with other disciplines such as political science, anthropology, and psychology could neuroscience provide the type and depth of insight(s) to bio-psychosocial factors that are effectively operationlizable and, therefore, most useful and meaningful in/to programs of influence and deterrence.

In describing the relative role of neurobiology in social and psychological interaction(s), Dr. Giordano provided the term "neuroecology" to define the nature of neural functions in organisms embedded in, and responsive to, various conditions, effects, and cohorts within environment(s) occupied. These neural substrates of human ecology (i.e., the perceptions and activities of environmental interactions) function to influence a person's awareness, responses, decisions, and actions toward others; environmental conditions; and situations that may be regarded as positive, neutral, or negative. In this way, neuroecology affords insights to proto-moral predispositions as well as moral cognitions, emotions, and behaviors as related to the myriad environmental and inter-personal circumstances that arise within individual, group, community, and even population-wide interactions. From this standpoint, it can be seen that neuroS/T offers potential techniques and tools that could be employed in a convergent multidisciplinary approach to study, define, and possibly predict human ecologies as well as to afford methods and technologies that may be viable and, therefore, of potential value in affecting cognitive and behavioral functions within certain ecological conditions.

Dr. Giordano posited that neuroS/T approaches may be developed and operationalized on "synaptic-to-social, and social-to-synaptic" scales that conjoin differing techniques and methods to both afford valid information about, and affect change to, neural systems that are involved in particular cognitive and emotional states that subserve decisions and behaviors relative, and in response to, ecological conditions. This "individual-to-group and group-to-individual" approach may alter traditional ways that we think about deterrence (i.e., in terms of the posture and activities of one state deterring another). States are inanimate objects that do not think or act. Yet their polis is comprised and composed of individuals who interact, exert, and effect influence(s) as well as instrumentalize decisions and activities of groups. Thus, Giordano asserted that the employing (the correct type and extent of) neuroS/T

approaches within a larger framework of bio-psychosocial analyses and interventions will be important to fortifying extant methods and developing new and innovative means to planning and implementing effective influence and deterrence operations.

Participants noted an increasing reliance and use of neuroS/T in agendas of influence and deterrence, which incurs a number of (neuro)ethical as well as legal issues. The use of neuroS/T methods (e.g., various types of neuroimaging, such as positron emission tomography [PET], single photon emission computed tomography [SPECT], functional magnetic resonance imaging [fMR], functional near infrared spectroscopy [fNIRS], and diffusion tensor imaging [DTI] as well as quantitative electro- and magneto-encephalographic techniques [qEEG and MEG, respectively] to assess brain states correlated to particular cognitive, emotional, and behavioral patterns) have potential application in defining structural and functional correlates of aggression and violence and could be viable–and of value–in assessing, if not predicting, such dispositions and actions. As well, neuroS/T interventions (such as cyber-linked informational delivery, brain-machine interfaces, and new and/or novel use and preparations of neuropsychoactive drugs) may all be employed to fortify intelligence operations (and the capacity of intelligence operators) and/or may be used to affect cognition, emotions and behaviors of individuals, groups, and populations (within programs of psychological operations [PSYOPS] and/or military information support operations [MISO]).

Of course, neuroS/T may also be more overtly weaponized in the forms of neuromicrobiologicals and organic neurotoxins. While such trajectories would appear to fall outside extant doctrinal restrictions against chemical-biological weapons, dual-use research programs may provide some level of shielding against such proscriptions and prohibitions. As well, the signatory nature of such international conventional doctrines does not assure absolute compliance, and thus it is likely that neurochem-bio research and development is both likely to occur and is occurring at present (thereby prompting postures of preemptive readiness to counter any nefarious use of these types of agents). While these issues were not explicitly addressed in detail at this conference, their omnipresence and importance were recognized and acknowledged, and will be the focus–at least in part–of subsequent symposia, meetings, and focal group activities in the near future. (For a current review of these issues, see: Giordano J [ed.] *Neurotechnology in National Security: Practical Considerations, Neuroethical Concerns.* Boca Raton, CRC Press, 2014).

Some argue that neuroS/T is not yet sufficiently mature to be operationalized, and/or that the relative novelty—and profound effects—of these approaches foster a host of unanticipated consequences and restrictive ethico-legal concerns. Without doubt, these approaches are new and are novel in their focus, depth, and potential capability. They also are bound by limitations that dictate rigorous review of their practicality and relative constraint(s). Their capabilities and limitations should not be over- or underestimated. But, as Dr. Giordano noted, the reality is that neuroS/T is advancing in scope and pace; the current neuroS/T market is greater than $150 billion worldwide, with estimated industry growth projected in Asia and South America that is predicted to supersede USA and its western allies' by 2020. In this light, failing to initiate and maintain neuroS/T RDTE is not acceptable because the USG will lose scientific, as well as economic and arguably military, advantage upon the 21st century world-stage. Neuroscience and its implications for influence are not restricted to the domain of the government or

even large laboratories. Unlike other potentially weaponizable entities (e.g., nuclear products), neuroS/T is subject to influence of individual agent/actors', venture capitalists', and single and/or conglomerate corporate entities' direction of development and trajectories of use. Such rapid globalization of neuroS/T compels and sustains prompt and ongoing engagement of relevant scientific and government agencies in the technical, as well as ethico-legal, guidance and governance of the ways that neuroS/T can and should be researched and used to effect definable goods on national as well as international scales.

Discussion:

With regard to narratives, how does the in-group/out-group context influence the brain's response?

It speaks to what is real. States may not be real, but they drive behavior. Group-specific context does drive behavior because it influences how we share resources.

Is there any literature of the effect of youth radicalization on the brain's development continuum?

Culture is a medium that shapes biology, and this must be taken into any realistic account. However, critical periods of development are opaque. Returning to the concept of "neuroecology," we can see a bi-directional influence of "ecology"–here as culture–upon the development and activity of the brain (and the organism in which it is embodied), and of the brain (i.e., embodied in organisms) upon their ecology (i.e., culture). How culture shapes the brain and how neurobio-psychosocial activities of individuals and groups establish and shape culture is important to an understanding of the ways that people relate to others, address certain situations, handle various contingencies of resource allocation and use, make decisions, and execute actions. It is important for a clearer view of how and why norms and mores develop, are enacted, and are adhered to or repressed. There is a notable feedback and feedforward dynamic that occurs, and brain research–in concert with sociological and anthropological studies–focused upon these issues constitutes much of the field of neuroeconomics (for a recent review of neuroeconomics, see: Glimcher, P. *Foundations of Neuroeconomic Analysis.* NY: Oxford University Press, 2011).

Europe is trying to increase bandwidth to collect and transmit research data, but the real solution is to decrease bandwidth requirements. It is an engineering problem.

How good are people at recognizing when they are in story mode? For example, the U.S. reliance on rational actor theory during the Cold War reflects our own cultural narrative about the role of reason and science in behavior. Would analysts recognize when they are being transported by a narrative? Can we use this technology to engage in reciprocal activities?

For fiduciary reasons, our research is targeted at specific populations. This research will not be handed off to public affairs. Humans are always in story mode and can turn it up or down.

Sometimes in asymmetric warfare (AW), people can obtain strategic effects coming in at the substrategic level (e.g., belief systems and their role). Can we approach situational awareness so that it has the strategic effect of disabling the enemy? Are there exploitable domains that we have to think

about as we build theory? We are looking at our own weaknesses deliberately. What would neuroforensics entail? Other countries are not sleeping through the cognitive revolution. How do we attribute attacks to the true source?

There is pushback to operationalizing neuroscience because some say it is not mature enough. However, if we do not progress, we are losing the scientific advantage. Threat and perceived threat are just as important in terms of influence as a real event. A terrorist does not have to infect everyone with a bioagent; he just has to have a sentinel case that ramps up inherent psychological fear. The USG does not want to be caught being reactive.

The discussion today was about ways of using neuroscience and neurotechnology to broadcast ideas, traits, etc. to the population. One base premise of advertising is that the more a technique is used, the more resistant the population becomes to it, which generates a need for escalation. Is there a danger of building resistance to U.S. messaging?

The application of new neuro-based communication methods does not mean that soldiers are supposed to become inauthentic; the opposition is true. We want our soldiers to speak the truth. To do so, they need to understand how to transmit it in a way that is understood or that avoids blowback. Advances in neuroscience let us speak more authentically to others.

Panel Two: Application of Neuroscience & Neurotechnology Insights to Key Aspects of Influence and Deterrence

Introduction: Dr. Hriar Cabayan (OSD) on behalf of Dr. Allison Astorino-Courtois (NSI)

Panel moderator: Dr. James Giordano (Georgetown University Medical Center)

Panel members: Drs. Bill Casebeer (DARPA), Victoria Romero (CRA), and Jorge Barraza (Claremont Graduate University)

Decision- and policy-makers need a set of revised influence and deterrence tools and approaches that are applicable to the 21st century security environment. As the USG draws down its nuclear forces, deterrence becomes a key concern. The USG wants to achieve deterrence through volition, not hostility. Assurance of our allies is also very important. Contextualizing neuroscience findings and tools to the deterrence milieu is more important now than ever.

Empirical tests of key deterrence theoretic expectations are inconclusive including the size of the state, military superiority, previous willingness to fight, and threats of destruction. Therefore, the USG needs a clearer understanding of how deterrence works.

- How and when do people decide to forego behaviors they would otherwise engage in? How does this vary by culture and decision setting environment?
- Under what conditions or for which types of people or groups are threats effective/counter-productive?

- Are there indicators that can be observed without direct contact with an individual or group that it has chosen to be deterred?
- How can social norms be formed quickly?

Which messages get through?

- Do people process (understand and respond to) threats or incentives under conditions specific to the possibility of conflict (e.g., fear, fluid v. rigid decision settings, time pressure, high stakes, perceived threats to personal versus collective interests, etc.)?
- How do we design messages for one actor without threatening or missignaling to others?
- How do we know when a message has "gotten through" the way it was intended?
- How can we craft deterrent messages that are credible and likely to stick?

One interesting finding suggests the brains receive information through one of two lenses: story mode or analytic mode. When the brain functions in story mode, which might prove to be its default setting, a person may be more likely to accept new ideas. This receptive state is ideal for "narrative transportation," which can be measured in four ways: behavior measures, physiological correlations, EEG correlations, and fMRI activation patterns. Combined with the existing literature on transportation, these measures improve our ability to forecast which narratives (and which parts of narratives) are more likely to be persuasive.

Other research, focusing on influence, shows that despite the prevalence of rational actor theories during the Cold War, influence is not purely rational. We use social cues to attribute trust/truthiness of a message. Influence is a social process. The danger in influence is that not all people respond to stimuli the same way. Neuroscience could inform the decision-maker about what may work for a specific individual or for people in general.

One social cue relevant to influence is trust. Oxytocin is a hormone active in the brain that is essential in pair-bond formation, child rearing, trust, empathy, and altruism. Experiments have shown that people infused with oxytocin intranasally are more likely to trust stranger. However, oxytocin does not always lead to trust. It may heighten social cues that helps one determine who to trust. Oxytocin may positively influence a person towards their in-group at the same time as negatively predispose one to the out-group. Oxytocin release may correlate with the most salient parts of narratives as identified by heart rate and other physiological indicators.

Discussion:

The word persuasion was used frequently during this panel. What is the difference between persuasion and coercion?

The Military Information Support Operations (MISO) community differentiates between information, persuasion, and coercion. They focus on conveying information in a way people remember. MISO does not do coercion.

Does oxytocin produce the same responses in men and women?

It is not clear because researchers are hesitant to use it on women due to its role in reproduction and potential interference from estrogen.

Competitive narratives produce an interesting dilemma. One can construct the most powerful narrative ever, but if those in the information space are ignoring it, how do we overcome that? We have well practiced adversaries.

We have to understand the narratives we are competing against. Understanding them helps us know which narratives are worth worrying about and why they are effective. That way, we can focus on which one to counter.

Panel Three: Operational Implications & Potential Applications to Influence & Deterrence

Introduction: Dr. Clark McCauley (Bryn Mawr College)

Panel Moderator: Dr. Bill Casebeer (DARPA)

Panelists: Drs. Nick Wright (Carnegie Endowment for International Peace) and Jerrold Post (George Washington University)

The third panel explored the neurobiological underpinnings of terrorism in its various manifestations. Terrorism has gone global with many characteristics of an entrepreneurial, adaptive, and dynamic competition. What does influence or deterrence mean in terms of understanding the decision making of individual leaders and small leadership groups? A lack of context specificity in single-narrative descriptions of terrorism and violent extremism and the resulting misunderstandings can create fertile conditions for misinformed decision-making.

There are many reasons why an individual might join an extremist group—revenge, status, love, fear, and belonging; ideology is not one of them. Attitudes are not a good predictor of behavior. In fact, radicalization is not a single dimension—one should not conflate ideation with behavior. The neuroscience community does not have a good theory explaining why people move from sympathy to violence.

One potential milestone along the transformation from sympathizer to terrorist is disgust and dehumanization of the other. People and groups have essences. When a group's essence is perceived to be bad (when people start talking about the other as vermin, lice, etc.), the only choices left are to avoid or eliminate the contaminant. Narratives can be used to convey the idea of disgust and dehumanization. In a conflict, the "bad essence" of the other becomes part of the narrative. Mitigating disgust sentiments can be a useful neurocyber tool. However, research suggests that bad essence becomes a social norm and that changing that norm often takes generations.

Psychology has shown us that when hatred has been bred in the bone by the parents (i.e., when one has such an early entrance in the path of terrorism), intervention has to be staged early to have an impact. Therefore, parents have to be the primary target of de-radicalization efforts. However, social media and cyber technology have the potential to fundamentally change how people are radicalized. These online forums create a community of hatred; the USG and the scientific community are not focused on this enough.

In thinking about more classic forms of state-level deterrence, a phenomenon known as prediction error is implicated in inadvertent conflict escalation. Prediction error is the difference between actual and expected events. This has two implications for policy-makers: 1) when making actions, they may have greater impact on the adversary than you understand and 2) when receiving actions, they may have greater impact on you than the adversary understands. Therefore, policy-makers should understand prediction errors and use them as a tool to implement and interpret signals.

This panel demonstrates that there are a number of instrument of state power that allow us to insert ourselves in the ecology to stop radicalization.

Knowing how your adversary thinks: Influence in international confrontations

Author: Dr. Nicholas Wright, Carnegie Endowment for International Peace, Washington, DC.

To manage crises and escalation, or to conduct deterrence operations, it is necessary to predict how an adversary will decide to respond to our actions. Effective deterrence and escalation management thus crucially depend on an understanding of psychology. My work seeks to apply new insights from the modern brain sciences to international security.

One core insight from neuroscience is that when we make an action, the impact it has on the adversary's decision-making is crucially modulated by the action's associated "prediction error." This prediction error is simply defined as the difference between what actually occurred, and what the adversary expected. The bigger the associated prediction error, the bigger the psychological impact of the action.

One reason that prediction errors matter is because they can cause inadvertent escalation in a crisis. When we make an action, we largely know when, where and how we will make the action. But the adversary does not have such insider knowledge. So, to the adversary the action is more unexpected, has a larger associated prediction error and so has a stronger psychological impact than we understand ourselves. As this occurs with the actions of both sides, it can lead to a spiral of inadvertent escalation.

There are many historical examples of prediction errors leading to inadvertent escalation, including the Soviet placement of nuclear-armed missiles on Cuba in 1962. Soviet decision-makers believed that this deployment was not markedly out of keeping with previous actions, and they underestimated the impact it would have on the United States. An example of a serious "near miss" caused by a prediction error is the Israeli reaction to the opening of the Yom Kippur war. Egyptian and Syrian forces had limited war aims in 1973. But to Israeli decision-makers the highly unexpected attack engendered a large prediction error, making them fear for the existence of the State of Israel. As a result, they discussed,

and may have ordered, a nuclear alert, which would have been a potentially dangerous escalation of the conflict.

The preceding instance of prediction errors and inadvertent escalation is just one example of the widespread impacts that prediction errors exert throughout military and diplomatic confrontations. However, whilst the impacts of prediction errors are far-reaching, they can be captured by a simple framework. Further, a prediction error framework also subsumes many important existing strategic concepts: for example, the psychological impact of surprise is just an example of prediction error. Together, these features make operationalization attractive and feasible for escalation and deterrence analysis.

I illustrate the potential role of prediction errors using a near-term Sino-U.S. escalation scenario over the Taiwan Strait. Prediction errors are a simple yet powerful tool, which can help U.S. decision-makers manage escalation and influence an adversary's decision-making.

Discussion:

Dr. Wright cited bombing of London in WWII causing a lower prediction error. Was that because the type of attack and scale was expected?

If it is a known domain, it generates less prediction area than an unknown domain—like cyber threats.

Do you think there is a desensitizing effect? The U.S. keeps expecting an attack and it does not happen.

Dr. Wright responded that he grew up in London when there were bombs going off regularly during the 1980s and early 1990s. It did not perturb us unduly, because itwas what we expected. But the 2005 bombings, coming after a prolonged period without such events, did have a large psychological effect.

It can be argued that the slow ratcheting up of bombings in Vietnam was intended to create a low prediction error on behalf of the Chinese and Russians who were observing. The bombings were not aimed at ending the war in Vietnam.

One participant stated that war is fought to achieve military objectives. Surprise is always good in war. The USG has fought limited wars since WWII. If one wants to keep wars limited, one has to consider the signaling aspect of action.

What does hate mean psychologically?

Hate justifies action. It is quite comforting to have a charismatic leader who says that those with empty lives can blame others. It then becomes a moral imperative to kill the other. It takes away inner feelings of worthlessness by projecting it on another group.

What is the psychological effect of removing a charismatic leader?

To understand that, we have to talk about the charismatic leader-follower relationship. When bin Laden joined the mujahideen and predicted the rise of the Islamic state of Afghanistan, it seemed impossible

except by the will of god. That was key to the leader-follower relationship. The success of the 9/11 attacks made his supporters believe he was superior to the U.S. and supported by Allah.

Panelists concluded the panel by noting that there are several instruments of state power that we can and do use to insert ourselves in the ecology to stop radicalization.

Panel Four: Operational Implications & Applications to Influence and Deterrence in the Context of CBCT

Introduction: Maj Jason Spitaletta (JS/J7) and Ms. Abigail Desjardins (NSI)

Panel moderator: Amb. David Smith (Georgian Security Analysis Center)

Panelists: Drs. Clark McCauley (Bryn Mawr College), Emily Falk (University of Pennsylvania)

This panel discussed what deterrence means for understanding the decision making of individual leaders and small leadership groups as well as implications for deterrence in the context of neural factors in Cyber-Based Communication Technology (CBCT). The intersection of emerging cyber-based communication technologies and human biology including both psychological and neurobiological dimensions of behavior has been an area of interest for decision makers. Online communities provide a medium through which individuals establish relationships for financial, spiritual, and social benefit. Those that facilitate anti-social behavior are difficult to detect and interdict, but they represent a viable target not only for computer network operations but also for Military Information Support Operations (MISO), formerly Psychological Operations (PSYOP). One recurrent theme that emerged from this workshop is that neuroscience and technology have the potential to become an interventional tool with great potential to deter and influence online. The gap between the discoveries in the lab and the application to the field is not as vast as we think it is. Nevertheless, additional applied research is still required to make many of the ideas discussed at this conference and operational reality.

Communication technologies are a means, not an end, to shaping social worlds by connecting people in distinct ways. CBCT provide individuals (including lone wolves) an option to either actively or passively access information that is consistently biased toward already expressed preferences and, thus, reinforces and strengthens their existing worldviews and limits the probability of their encountering information that is potentially contradictory or disconfirming. Tailored search algorithms and the psychologically rewarding behavior of participating in digital "echo-chambers" accentuate these tendencies. These phenomena, however, can also be exploited to counter the radicalization process. Synthesizing traditional methods of social influence with recent advances in neuroscience, cyberpsychology, and captology (the study of persuasive technology) can result in an advanced set of personalized persuasion tactics.

The information revolution has progressed to the point where technology can reach into one's home, bedroom, car, public spaces, etc. to discover information about people. Approximately 2.5 billion people are connected to the internet. Some users are well protected, but many are not. Moreover, there are an

estimated 7 billion mobile devices in use. The ubiquitous presence of mobile devices has whetted the appetite for targeted advertising in the commercial sector, which is driving research in behavior tracking and device matching. Algorithms exist today that can determine where an individual lives, works, and travels through his devices even though he has never connected them. This is the future not only of spyware and hackers but also of e-espionage. This kind of device tracking and monitoring has the potential to reveal motives and patterns of thinking or behavior months or years before psychoanalysis can yield results. The ethics of this capability are challenging, but the technology has arrived at a place that is erasing the line between public and private information.

CBCT has served as a remarkable tool in facilitating sociobiological needs of various communities and the internet has provided safe havens for marginalized groups of every type. The internet has also provided the capability for virtual illicit habitats, or dark networks, for maladaptive social and/or criminal behavior. Going back to basics, hate is an extreme negative attitude joined with a perception of negative essence. On the other side, love is positive essence. At the bottom of all intergroup conflict is love for the in-group. Hate is not freestanding—mostly it is a reflection of loved plus a perceived threat to what is loved.

The idea of deterrence emerged from rational choice analysis; that is its limitation. We overestimate what deterrence can do because we do not pay attention to emotions. Anger is strong enough to cause one to lose sight of his or her own best interest. Emotion makes people honest signalers. Emotions serve to get us out of the trap of rational choice where the stronger always rules the weaker with no impediment.

Ideology does not cause radicalization. Radicalization is caused by anger at a perceived grievance, shame for not doing anything about it, and status seeking. That is why jihad videos are so radicalizing; they instigate an emotional response. Chat rooms and other forms of social media act like echo chambers and result in greater polarization. When you put like-minded people together, they get more extreme in one direction. We do not yet know whether the same is true online, but it is an area that deserves attention.

Similarly, the younger generation relies less on traditional, well-established sources for news and seeks sources that align with their worldview. This creates an echo chamber as well. There is some question as to whether the younger generation is losing the ability to think critically about trusted versus untrusted information, which makes people susceptible to misinformation, manipulation, and reinforced perspectives. This kind of behavior risks leading to the Balkanization of society.

Neuroimaging in one tool that may someday help determine a person's responsiveness to radicalizing messages and videos online. Messages come from the cyber domain that influence what we do on an individual and group level. Predicting how a person will respond to them is difficult. Self-report techniques that ask about attitudes and intentions can explain about one-quarter of subsequent behavior. However, how a person's brain responds to a radicalizing stimulus can be more predictive than self-report. Neuroimaging offers a way to get information from the brain that one could not get from other methods. Methodological triangulation (using combinations of self-report questionnaires,

interviews, cognitive/behavioral tests, and/or neuroimaging) provides us a richer contextual understanding of human behavior. Examining this behavior in the context of a human-computer system enables researchers to better understand the human factors of CBCT. For neurodeterrence to be a reality, we must understand not only how humans use CBCT but also how it makes them think and feel. This can only be accomplished through mixed method designs.

In order to craft effective messages, one has to identify what a person is willing to believe. Therefore, one cannot start by crafting a message; one must incrementally prepare a person or an environment to make the communicated message credible. The USG's adversaries craft messages to support their campaigns continuously. Not only do they prepare for different scenarios and how to exploit them, individuals have the authority to exploit opportunities. Their messages gain credibility because they are engaged in a long-term messaging campaign. The USG is not structured to agilely respond to adversaries' weaknesses. Networks are more agile than hierarchies are.

The next generation of social media is going to focus on images, video, and sound. Mobile devices are now reaching millions of people who are illiterate. Technology is adapting to meet the oral-based demands of users across the globe.

War used to imply that soldiers were engaged on a battlefield with certain kinds of weapons. Technology has now enabled these restrictions to go away.

Discussion:

One recent social phenomenon is the mobilization of people into the political conflict sphere who heretofore would not have been able to participate. Radicalization is strong on the internet. Even just 20 years ago, one had to be there on the streets to throw rocks and participate in the intifada. You had to be brave. Today, you can sit in a basement and be part of the conflict.

Several years ago, Ayman Zawahiri (at the time, the deputy emir of al-Qaeda) issued a letter to Abu Musab al-Zarqawi (the emir of al-Qaeda in Iraq) criticizing beheadings. I was struck by the inability of the USG to respond and exploit this. The USG does not move fast enough to respond to these kinds of opportunities.

Since the Arab Spring, the USG has not even begun to understand the implication of every citizen being a photojournalist. The matter of being able to respond rapidly is crucial. We need to assess why the USG is so slow. Any large western government is the same. The problem is that the USG is a large institution. It can become more agile, but will never be agile enough. Networks are more agile than institutions. The USG needs to act more like a network. Before radio, troops were authorized to engage in decentralized execution.

The younger generation relies on social network and news sources deemed credible by the person's social network. This creates an echo chamber. The Balkanization of society is a real threat. It is not clear that the younger generation can think critically about information from trusted versus untrusted sources. Additionally, the accessibility of social media platforms means that anyone can be an expert and

generate a following. There used to be a hierarchy of expertise. Technology further perpetuates in-group vs. out-group delineations. RSS feed allow one to only view trusted sources, shutting oneself off in way that was not possible before.

If we are going to make the case for the authorities to act proactively, we need to build the science that new media does something that is new and different—and that gives us new levers of influence. Have we made that case? New media is categorically different in terms of speed, reach, personalization, and obfuscation.

One problem is insider threat. The division between human resources, finances, and information technology need to be under one roof to be able to identify potential threats.

Conclusion

Dr. Giordano thanked the panelists and participants for contributing to the nascent field of operational neuroscience. As the science matures, the workshop participants will be at the forefront of efforts to harness and apply neuroscience techniques and findings to more clearly communicate intent as well as to assess the intent of others.

Appendix A: Agenda

Friday, 18 October 2013	
0800 - 0830	**Registration**
0830 - 0900	**Introduction:** Dr. Bill Casebeer (DARPA)
PANEL DISCUSSIONS	
0900 - 1015	**Panel One** **Defining the current landscape of neuro S/T** Moderator: Dr. Diane DiEuliis (HHS) Panelists: Drs. Bill Casebeer (DARPA) and Jim Giordano (Georgetown)
1015 - 1030	**BREAK**
1030 – 1230	**Panel Two** **Application of neuro S/T insights to key aspects of influence and deterrence** Introduced by: Dr. Hriar Cabayan (OSD) Moderator: Dr. Jim Giordano (Georgetown) Panelists: Drs. Bill Casebeer (DARPA), Victoria Romero (Charles River Analytics), and Jorge Barraza (CGU)
1230 - 1330	**LUNCH**
1330 - 1500	**Panel Three** **Operational implications and potential application(s) to influence and deterrence** Introduced by: Dr. Clark McCauley (Bryn Mawr) Moderator: Dr. Bill Casebeer (DARPA) Panelists: Nick Wright (Carnegie Endowment) and Jerrold Post (George Washington Univ.)
1500 - 1515	**BREAK**
1515 - 1700	**Panel Four** **Operational implications and applications to influence and deterrence in the context of Cyber- Based Technology (CBCT)** Introduced by: Maj Jason Spitaletta (JHU/APL) and Ms. Abi Desjardins (NSI) Moderator: Amb. David Smith, (Ambassador; Dir, Georgian Security Analysis Center) Panelists: Drs. Clark McCauley (Bryn Mawr College), Emily Falk (Univ. of Penn)
1700 - 1730	**Sum-up and Key Takeaways**