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Strategic Multi-layer Assessment
Periodic White Paper

Topics for Operational Considerations: Insights from Neurobiology & Neuropsychology on Influence and Extremism—An Operational Perspective

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This white volume represents the views and opinions of the contributing authors. This report does not represent official USG or Command policy or position.

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Preface

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This is one of the most relevant and important White Papers I have read in some time. I contend that the articles in it set the stage for a seminal advance in understanding how we must adapt our military information support operations (MISO) and inform and influence activities (IIA) to account for a dramatic change in the information environment (IE). While there have been hundreds of substantial studies and reports over the past decade dealing with the impact of social media and new forms of near-instantaneous global communications, there is a paucity of analytical works focusing specifically on the linkages between the new IE and military IIA. To compound the challenges we face in adapting to this new environment, our adversaries and potential adversaries have hardly been idle. They are engaged as never before in a competition for the ideological high ground. While the IE provides incredible opportunities to advance positive ideas and encourage 'crowdsourced' behavior to solve seemingly intractable problems, it is also a Petri dish for violent extremist behavior. Distorted ideas and ideals that were easily brushed aside twenty years ago are finding an unprecedented audience and gaining a dangerous foothold in the ungoverned spaces of the Internet and social media. In many cases, the United States government, to include the military, has ceded the IE to our adversaries. If we want to counter the extremist ideology while also offering realistic, credible alternative narratives, we must engage readily and continuously in the information environment.

The articles in the report begin to bridge the gap between the scientific, policy, and operational communities by providing a deeper, richer contextual understanding of the unique behavioral and neurobiological factors that underlie political extremism, specifically in the cyber realm. They address the ramifications and implications of insights gained from ongoing advances in neurobiology and neuropsychology to the way we plan and execute military operations as part of a comprehensive approach to telling our story while countering the violent extremist message.

Modern information technologies are empowering violent extremist organizations by providing inexpensive, anonymous forums capable of reaching massive audiences globally and instantly. Advances in cyber-based communication technology (CBCT) have the potential to revolutionize how the DOD operates in cyberspace and will heighten the challenges to MISO activities (formerly known as psychological operations, or PSYOP). These impending changes could restrict our ability to influence perceptions across the range of military operations, but they can also offer new, imaginative ways of reaching our intended audiences—such as concepts of "personalized persuasion tactics" (described in Major Spitaletta's paper) or "dynamic targeting" in the IE. There may well be new risks associated with substantially changing the way we operate in the IE, but the risks of inaction are far greater.

The typical instinctive response to the new IE is to view it almost exclusively through technology-colored glasses (I readily confess to have been guilty of this mistake). To more thoroughly

understand and appreciate the impacts, however, we need to look beyond the communication technology and layer upon it the social world to assess social outcomes. In this context, Cyber Based Communication Technology (CBCT) provides unique and isolated individuals an echo chamber with individuals actively or passively reading information that is consistent with their worldview, thus reinforcing and strengthening their existing beliefs rather than allowing them to encounter and absorb information that is potentially contradictory or disconfirming. While it is far too early to understand exactly what led Tamerlan and Dzhokhar Tsarnaev down a path of radicalization, culminating in the fatal bombings at the 2013 Boston Marathon, the early evidence indicates that social media played a substantial role in the transformation from college student to terrorist.

In addition to determining how to best integrate public affairs, information operations, and MISO into a realistic, comprehensive communication strategy to inform and (at least for non-U.S. audiences) influence the desired audiences and tell a positive story, we also must understand how to formulate comprehensive strategies to successfully derail radicalization before violent ideas become violent acts and violence becomes part of the unquestionable core identity of the individual and the group. To this end, concepts derived from the study of complex adaptive systems offer multi-dimensional and multi-domain solutions for robust counter-radicalization strategies. In conjunction with advances in neurobiology and neuropsychology, these new concepts can be integrated with existing MISO and IIA processes to pave the foundation for new and improved ways and means for the U.S. to combat radicalization with greater precision. Ultimately, our goal is to regain the virtual ground we ceded in the IE over the past two decades and formulate new concepts designed to shape both attitudes and behavior.

Thank you for taking the time to read this report. We look forward to your feedback.

Executive Summary

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This report provides the operational and policy communities with a deeper understanding of the unique behavioral and neurobiological factors that underlie political extremism enhanced by interaction in the cyber realm. It addresses the implications of advances in neurobiology and neuropsychology for the way we plan and execute military operations as part of a comprehensive approach to counter violent extremists and the spread of their violent political narratives. The paper focuses on the intersection of emerging cyber technologies and human biology including of both psychological and neurobiological dimensions of behavior. For the purposes of this white paper, we will refer to these two dimensions as cyberpsychology and cyberneurobiology respectively.

Key Insights:

- Modern information technology is empowering violent extremist organizations (VEOs) by providing cheap and anonymous forums to target large audiences. Advances in Cyber-Based Communication Technology (CBCT) will revolutionize how the DOD operates in cyberspace and will heighten challenges to Military Information Support Operations or MISO (formerly psychological operations or PSYOP).
    - o The next twenty years will see a paradigm shift in the fundamental character of the Internet that will revolutionize how people interact globally. Changes include
        - the shift from Internet Protocol version four (IPv4) to Internet Protocol version six (IPv6) and the emergence of the Next Generation Internet;
        - alternative Domain Name Systems;
        - generic top-level and internationalized domain names;
        - Broadband mobility;
        - Cloud computing and big data;
        - Ubiquitous computing; and
        - IPTV (a technology that allows for broadcast of audio-video material).
    - o Bottom line: The impending changes will add additional challenges to the ability of MISO and cyber operations to influence perceptions.

- Communication technologies are means, not ends—they shape social worlds by connecting people in distinct ways, but it is the social world itself that creates outcomes.
    - Deemphasizing the distinction between mass media and social media facilitates more fruitful exploration of the social implications of different means of communication.
    - A four-way communication typology (i.e., speed, directionality, span, and configuration) allows exploration of the human terrain.
  - CBCT can blur the lines between physical reality and cyber-formed reality, which may differ in delivering catalysts for extremist action while potentially removing vital inhibitors.
  - CBCT likely does not contribute to radicalization and mobilization to political extremism in a linear fashion. Rather, the various modes of CBCT interact with shaping factors (i.e., culture, values, genetic background, access to technology, etc...) and transition factors (i.e., activators, catalysts, inhibitors, and interventions) to produce psychological and behavioral outcomes.
  - Only a very small subset of individuals becomes more radical in their thinking or mobilizes due to interactions with CBCT.
  - The impact of CBCT on a person is dependent on the individual's motivation for using the medium.
  - Bottom line: CBCT often provides isolated individuals the informational equivalent of an echo chamber through which they can 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 "echo-chambers" accentuate these tendencies.
- Complex systems concepts provide theoretical frameworks and insights important to designing tailored counter violent extremist organizations (VEO) intervention strategies.
  - Neurobiological underpinnings, processes of socialization, and the constantly changing modern information environment help illuminate the causes for the bottom up emergence of VEOs. In so doing, they help suggest operational approaches to defeat them.
  - Socialization has always required communication. The rapid expansion in digital media dramatically increases the ways that social groups can form, organize, and plan for action.
  - Connectedness in the modern information environment tends to reinforce, not replace, basic human needs to connect with others in person.
  - Real complex systems do not resemble static structures to be collapsed; they are usually much closer to flexible, constantly respun spider webs.

- o Countering strategies should focus on the interaction of the physical, mental, and moral domains instead of physically focused, relatively static center of gravity concepts.
- o Without an understanding of how all three domains relate to one another dynamically, one may miss the right points of leverage and combinations of interventions that will produce the greatest synergetic effect to influence the direction and momentum of constantly evolving social systems.
- o Bottom line: A strategy based on a solid understanding of the dynamic linkages between all three social domains (physical, cognitive, and moral), coupled with solid comprehension of complexity concepts like bottom up emergence, is more likely to help us choose the right combinations of interventions to successfully derail radicalization before violent ideas become violent acts and before violence becomes part of the unquestionable core identity of the individual and the group.
- Emerging research in cyberpsychology and cyberneurobiology can be integrated with existing PSYOP/MISO processes to create both a set of individualized influence tactics and guide their implementation.
  - o Synthesizing traditional methods with recent advances in neuroscience, cyberpsychology, and captology (the study of persuasive technology) can produce an advanced set of personalized persuasion tactics. This would allow PSYOP/MISO planners to rely on firmly established linkages between perception and actions when developing both their intelligence requirements and the desired psychological effects.
  - o Research in cyberpsychology and cyberneurobiology should produce empirically informed processes designed to target underlying neural mechanisms to create specific psychological effects on a target.
  - o Countering VEOs must address target audiences at the macro (population) and micro (individual) levels.
  - o Bottom line: Appending existing processes to include experimental findings in cyberpsychology and cyberneurobiology along with technological advances from captology will allow the U.S. to combat radicalization across domains with greater precision. Currently, however, there is insufficient empirical data to support explicit linkages between triggers and specific behaviors, and thus experimental validation is necessary.

Topics Overview:

Below are brief overviews of contributed articles.

Introduction: In their introductory chapter, Col Marty Reynolds (JS/J-3/DDGO) and Lt Col David Lyle (USAF) state that we are in the midst of two very real revolutions. The first deals with our understanding of how the human brain works, and the second springs from rapid advances in information technology and social media applications. The latter have created innumerable positive

benefits for society, but they have also empowered violent extremist organizations by providing a cheap, anonymous forum that can target large audiences. They argue that in many ways we are losing the so-called 'competition for ideas' in this information environment. They go on to recommend that we must acknowledge this seminal "difference in kind" and engage readily, deliberately, and continuously in this electronic battlespace. By improving our overall awareness of how neural and social networks operate, we should be in better position to build more holistic understanding of the key elements and forces in play in the shaping of extremist thought, behavior, and socialization. They conclude by stating that these insights will give us a more holistic sense of where we might successfully intervene, co-opt, or forcefully act to stop the cycles propagating extremist violence and values.

[Chapter 1](): In a paper entitled "Considerations on Emergent Cyber Trends and Technologies," Dr. Panayotis Yannakogeorgos (Air Force Research Institute) assesses key changes in core technologies that define cyberspace. He outlines challenges such technologies may present to Military Information Support Operations (MISO). Dr. Yannakogeorgos' primary aim is to spur discussion and raise awareness on the issue of how these technological advances will provide the U.S. opportunities to both counter and deter adversaries in cyberspace. He goes on to argue that the next twenty years will represent a paradigm shift in the fundamental character of the Internet that will end up revolutionizing how people interact globally. For example, challenges caused by mobile broadband devices and increasing interpersonal connections point to the need for national security planners and operators to take into account the importance of exploiting the brain to achieve desired effects. Key technological advances may result in shifts within operational paradigms:

- The shift from IPv4 to IPv6 and the Next Generation Internet: This transition will affect U.S. and global commerce and security for the next 20-50 years.
- Alternative Domain Name Systems: These advances enable the cyber underworld to shift the management of its business operations to avoid law enforcement and to add another layer of protection to their personas. Should significant usage of such shadow Internets occur, it could become very challenging for MISO operators to target radical networks who would now operate in dark corners of the open Internet.
- Generic Top-Level and Internationalized Domain Names: There is increasing trends in use of non-Latin character URLs as well as generic-top level domain names in addition to non-Latin script. This will present a significant human capital challenge as the cultural and linguistic challenges facing the MISO profession today will only intensify. Thus finding adversary propaganda to counter will become more challenging in these new domains.
- Broadband Mobility: It will be possible to create *ad hoc* networks that will effectively be shadow Internets on a local level. This presents both opportunities and risks for U.S. military operations. A future with mobile broadband devices and increasing interpersonal connections indicates the need for national security planners and operators to take into account the importance of exploiting neuropsychological factors to achieve desired effects. Such efforts have implications for U.S. operations well beyond the terrorist efforts to radicalize and recruit individuals to their cause.

- Cloud Computing and Big Data: This trend essentially creates a difficult operating environment for the U.S. in that, if effectively deployed by extremist organizations, secure virtualized environments combined with ad hoc pseudo-DNS systems will become hard to penetrate, and possibly be invisible.
- Ubiquitous Computing: Represents a paradigm shift from networked laptop and desktop towards one of networked objects sensing their environments and communicating what they see amongst themselves. Again, as in the other fields, the trend of the Internet becoming a more fragmented closed space exists here.
- IPTV: is a technology that allows for broadcast of audio-video material. It will present new opportunities for the U.S. to broadcast messages worldwide. These opportunities will exist on the open Internet. However, it is conceivable that with IPTV embedded into the closed networks described above, it will serve as another secure platform for violent extremist organizations to maintain a grip on the minds of their followers.

Dr. Yannakogeorgos concludes by stating that because of these impending changes, the ability to influence perceptions across the range of military operations will become more restricted. Because much of digital communication in the 21st century will not be done in either English, or in a Western cultural context, using cyberspace to influence perceptions will require recruiting multilingual service members. These trends will revolutionize how the DOD operates in cyberspace.

Chapter 2: In an article entitled "Back to the Future: Understanding Radicalization through a Social Typology of Media, Past and Present", Maj Dave Blair (Georgetown University) focuses on establishing the link between cyberneurobiology and cyberpsychology and the social outcomes of humans interacting in the contemporary information environment. Key to his argument is that communication technologies are means, not ends—they shape social worlds by connecting people in distinct ways, but it is the social world itself that creates outcomes. Instead of focusing on the dichotomy between 'old' and 'new' media, he describes media in terms of the depth of ties it creates and the breadth of possible communication. He goes on to argue that by deemphasizing the distinction between mass media and social media, one can better explore the social implications of different means of communication. By doing so, he identifies insights into 'new' media from some very old sources. He advances four variables, which are not entirely independent of each other, to describe a communications medium, namely speed, directionality, span, and configuration. This four-way typology is technology agnostic and allows Maj Blair to explore the human terrain created by these tradeoffs. In addition, this typology allows him to rediscover parallels with very old media and our own agency in shaping these technologies. He then discusses in detail the sixteen ideal-type social worlds that these four variables uncover. He goes on to demonstrates the utility of this framework to provide insights for radicalization by discussing the Nadal Hasan episode. He highlights the three media mediated stages in Hasan's radicalization process. He states that in contrast to the tragic story of Hasan, social embeddedness can prove an effective counter-radicalization strategy, especially amongst tribal groups. He concludes by pointing out that reinforcing embeddedness hardens local social structures against being coopted into master VEO narratives.

Chapter 3: In a paper entitled "Cyber on the Brain: The Effects of cyberneurobiology & cyberpsychology on Political Extremism", Ms. Abigail Desjardins et. al. focus on addressing the following key question: What are the implications of cyber-based communications for theories of political mobilization and mass radicalization? The authors point out that advances in cyber-based communication technology (CBCT) raise important questions about the lines between physical-based reality and cyber-formed reality and how they may differ in delivering catalysts for extremist action while potentially removing vital inhibitors. In order to contextualize and discuss the emerging findings from the fields of cyberneurobiology and cyberpsychology, they use a two-pyramid radicalization-mobilization framework consisting of opinion and action states to characterize individuals relative to a particular cause. Within this framework, radicalization is a process that affects movement between opinion states, while mobilization is a process that affects movement between action states. They describe the various phases within each pyramid and discuss "transition factors" (i.e., activators, catalysts, inhibitors, and interventions) that account for movement up and down within and between the two pyramids. In the process, they also describe key "shaping factors" (i.e., cultural values, genetic background, access to technology, etc.) that condition whether and how "transition factors" function. Using this framework, they discuss in detail the implications of CBCT for shaping and transition factors. They conclude with several key observations:

- The Internet and other forms of cyber-based communication technology do not likely contribute to radicalization and mobilization to political extremism in a linear fashion. Rather, the various modes of CBCT interact with shaping factors and transition factors to produce psychological and behavioral outcomes.
- Only a very small subset of individuals become more radical in their thinking or mobilizes due to interactions with CBCT.
- The impact of a given mode of communication on a person is dependent on that individual's motivation for using the medium.
  - For some individuals, the Internet provides the opportunity to construct new identities, test out new personalities, and experiment with modes of self-presentation and representation to others. In this regard, the Internet can be an escape from an inhospitable offline world.
  - A radical's negative social beliefs can be reinforced by the positive feedback and encouragement of other like-minded individuals. This feeling of social support for atypical and radical beliefs is only further encouraged by a reasoning fallacy sometimes called the "illusion of large numbers: i.e., radicals on the Internet may believe that the few hundred or thousand members of their website represent the tip of the iceberg of support, when in fact they represent a ceiling on total support for the movement or ideology.

Their bottom line is that the Internet provides increasingly unique and isolated individuals an echo chamber with individuals actively or passively reading information that is consistent with, and thus reinforces and strengthens, their existing worldview rather than encountering information that is

potentially contradictory or disconfirming. Tailored search algorithms and the psychologically rewarding behavior of participating in "echo-chambers" accentuate these tendencies.

Chapter 4: In an article entitled "Complexity, Neuroscience, Networks, and Violent Extremism: Foundations for an Operational Approach," Lt Col Dave Lyle (USAF) posits that complex systems concepts provide theoretical frameworks and insights to design tailored intervention strategies that attack not just the symptoms of violent extremism, but the driving forces behind it as well. He advances a multi-tier conceptual framework: namely neurobiological underpinnings, processes of socialization, and finally the constantly changing modern information environment. These factors combine dynamically and adaptively as they respond to their local and global environments. He goes on to state in the case of violent extremist groups, they provide explanations for the emergence of such groups and thus help design operational approaches to defeat them. This emergence results with the creation at the macro level of properties that cannot be predicted or described in terms of the components that combine to create them. He refers to the forces that drive these changes as "attractors." Lt Col Lyle goes on to state that if these forces can be discerned, interdependence between key variables in the system can be better understood, thus allowing a degree of prediction at the macro even when it might not be possible at the micro level.

Lt Col Lyle then discusses complexity at multiple levels. At the neurobiological level, he focuses primarily on mental models and decision-making. In the process, he introduces the concept of "heuristics" and points out that complex systems theories can help us understand how these form and adapt. He then turns his attention to complexity in the domains of socialization and the information environment. He reminds the reader that socialization has always required communication and the rapid expansion in digital media dramatically increases the ways that social groups can form, organize, and plan for action. As such, connectedness in the modern information environment tends to reinforce, not replace, our basic human motivation to connect with others in person. In this context, to know something about any highly connected complex system, one has to understand which nodes in the network have the most influence over changes in the others, and what processes have the greatest relative effect on desired system changes. He goes on to state that emergence applies to the growth of both social connections and the information environment.

Lt Col Lyle turns his attention next to the entire cycle of violent extremism and describes the emergence of extremism from the bottom up starting with the neurobiological processes of individuals. He points out that violent extremists are social within their identity groups, and form their self-identities by relating their personal story to group narratives and social structures. He offers various countering strategies from attacking extremist narratives, to influencing the linkages of these groups to the supporting subsystems, and finally to removing them from the battlefield. He turns his attention next to developing operational approaches that leverage these insights. He sets the stage by pointing out that real complex systems do not resemble static structures to be collapsed; they are much closer to flexible, constantly respun spider webs. He assesses countering strategies by focusing on the physical, cognitive, and moral domains instead of the more static center of gravity concept. He points out that there are many points of leverage throughout the domains all connected to one another through visible and invisible chains of influence. These also

span many different kinds of networks; thus, there is no centrality. For each domain, he discusses the key questions to be addressed and points of leverage and possible interventions. He admits that none of the recommendations he offers are new and novel in themselves. However, without the understanding of how they all relate simultaneously in all three domains, one may miss the right combinations of simultaneous interventions in all three domains that will produce the greatest synergetic effect over constantly evolving systems. He concludes by stating that what complexity science offers is more precise definitions, concepts, and theoretical frameworks that describe how dynamic change occurs in all kinds of complex systems. A strategy based on a solid understanding of the dynamic linkages between all three social domains (physical, cognitive, and moral), coupled with solid comprehension of complexity concepts, like bottom up emergence, is more likely to help us choose the right combinations of interventions to successfully derail radicalization before violent ideas become violent acts and before violence becomes part of the unquestionable core identity of the individual and the group.

Chapter 5: The main focus of "Neuropsychological Operations: A Concept for Counter-Radicalization" by Maj Jason Spitaletta (USMCR) is the incorporation of modern scientific methods into the Military Information Support Operations or MISO (formerly psychological operations or PSYOP) process in support of counter-radicalization. Maj Spitaletta contends that cyber-based communication technology (CBCT) is an enabler of radicalization; VEOs have employed these technologies to facilitate strategic communication, command and control, recruitment, training, fundraising, and targeting. CBCT serves as a platform to facilitate the spread of emotionally evocative messages and creates a digital echo chamber that reinforces preexisting and/or acquired biases. In this context, radicalization is the process by which an individual, group, or mass of people move from legal participation in the political process toward violent political action while counter-radicalization is the set of operations planned and executed to deter, disrupt, and/or defeat that process. He points out that MISO/PSYOP traditionally have relied on methods employed in social and behavioral science. However to exploit an asymmetric advantage, counter-radicalizations operations must utilize every relevant scientific and technological advantage available. He posits that to be effective, countering VEOs must address target audiences at the macro (population) and micro (individual) level. Engagement with those who seek to affiliate with or support VEOs is most likely to occur in cyberspace.

Maj Spitaletta posits that emerging research in cyberpsychology and cyberneurobiology can be integrated with existing PSYOP/MISO processes to both create a set of individualized influence tactics and guide their implementation. These approaches will use knowledge of individual psychology, neurobiology, and online behavior to influence the consciousness of prospective extremists. He points out there is currently insufficient empirical data to support explicit linkages between triggers and specific behaviors, and thus experimental validation is necessary. He proposes that synthesizing traditional methods with recent advances in neuroscience, cyberpsychology, and captology (the study of persuasive technology) can result in an advanced set of personalized persuasion tactics. The combination of laboratory and naturalistic methods employed in those disciplines could be readily applied to the challenge of countering online extremism. This synthesis is not necessarily a new concept but rather, much like the field of

neuroeconomics, an attempt to integrate neuroscience research into a discipline that has long relied upon research and analytical methods from the social sciences. He posits that this type of research will allow PSYOP/MISO planners to rely upon firmly established linkages between perception and actions when developing both their intelligence requirements and the desired psychological effects. In this context, Maj Spitaletta discusses Target Audience Analysis (TAA), which is the systematic research and analysis of relevant information within a selected population that may be exploited to achieve desired objectives. If the appropriate unit of analysis in counter-radicalization operations is indeed the individual, TAA should include not only the group, but also the individual. This will necessitates approaches from disciplines that study individual behavior. Traditional approaches can be augmented, for example, by neuroscientific methods. He points out that designing technologies with the explicit intent to change behavior is relatively young; however, it is not a radical departure from traditional PSYOP/MISO. Research in decision neuroscience has contributed much to the scientific understanding of consumer behavior; the combination of laboratory and naturalistic methods employed in those disciplines could be readily applied to the challenge of countering online extremism. However, measuring the effectiveness of such interventions remains a scientific and operational challenge. These interdisciplinary approaches may benefit from applied neuroscience research as well as advances in technical intelligence collection and analysis since online feedback mechanisms are limited. The result will be an empirically informed process designed to target underlying neural mechanisms to create specific psychological effects on a target. The U.S. must identify the areas where the basic tenants are best understood and develop an operationally relevant applied research strategy. He concludes by stating that appending existing processes to include experimental findings in cyberpsychology and cyberneurobiology along with technological advances from captology will allow the U.S. to combat radicalization across domains with greater precision. By employing its considerable resources, the U.S. can invest in applied research to identify, refine, and ultimately apply some of the tactics discussed to achieve future PSYOP/MISO objectives to counter-radicalization.

Introduction

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Sometimes the most challenging part of living through a genuine revolution is realizing that one is in the midst of it. This is partly because the term "revolution" itself is overused and misapplied, describing everything from large social movements like the Arab Spring, to the new formulas of laundry detergent or diet soda. The traditional way to inoculate oneself from criticism for ignoring the lessons of history has always been to claim that a revolution has occurred, changing the rules of the game entirely. Thus, it is easy to hear someone talking about revolutions and assume that something is new, but not essentially all that different than it was yesterday. But we are indeed in the midst of two very real revolutions, both driven by the rapid advances in our information technology. The first revolution deals with our understandings of how the human brain works: modern neuroscience has yielded more insights about what drives human behavior in the last few decades than we had gained in centuries before that, and we are finding that many of the assumptions behind our social theories do not match reality. The second revolution springs from using modern information technology to connect and form social groups in ways that were not even possible before the rise of the current information environment. These new networks have created innumerable positive benefits for society, as they have helped to spread positive ideas, encourage innovation, and made creative synergies possible. But they have also increased our risks, as those with malign interests adopt these technologies for their own purposes.

Extremists want to hurt our society, and the current information environment is reducing the price for recruiting and admission to the extremist club. Using these two premises, this white paper will provide insights from the field of neurobiology on what causes people to plan for and commit violent acts, and how the current Information Technology (IT) environment influences the formation of mental models and social structures that encourage support for, or actively participate in, acts of violent extremism. This paper will also discuss how the very structure of the information environment influences, and is influenced by, social interactions, giving us insights as to how we might use findings from both understandings to prevent, detect, and design successful intervention strategies to defeat violent extremist networks.

Since its inception, this growing, complex domain is influencing societies in interesting and hard to predict ways. The number of devices, users, and usage of cyberspace has expanded exponentially, while it is also becoming more portable, wireless, interoperable, application driven, and widely

available to all social and economic classes. In 1984, there were 1,000 Internet devices, in 1992, 1 million, and by 2008, 1 billion.[1] In 2009, only 2 percent of U.S. adults owned a tablet, by 2012, 29 percent owned tablets.[2] In the developing world, many countries are bypassing traditional landline communications infrastructure and going straight to cellphones/cell towers. India is a prime example where mobile Internet usage surpassed desktop internet usage last year.[3]

Additionally, the staggering amount of data created is a reflection of how people communicate and acquire information. This year, 4 Exabytes of unique information was produced, more than the last 5,000 years combined.[4] Much of this driven by the usage and importance of social media sites. For example, in 2004, Facebook had 1 million active users and, within five years, it was 300 million.[5] This year it will pass 1 billion.[6] Though Facebook is a leader in the social media sector, it is only one segment of a much larger space. Email, Tweets, YouTube, content-provided sites such as CNN, Netflix, and others provide users access to vast amounts of tailor-ready information. This also includes groups and individuals who have compelling stories and messages. While past innovations in information technology have always had an effect on modes of socialization, the changes associated with the digital revolution arguably have no historical precedent, as described by Mark Shirky in his book *Here Comes Everybody*: *the Power of Organizing without Organizations*:

> We are living in the middle of the largest increase in expressive capability in the history of the human race. More people can communicate more things to more people than has ever been possible in the past, and the size and the speed of this increase, from under one million participants to over one billion in a generation, makes the change unprecedented, even considered against the background of previous revolutions in communications tools…Philosophers sometimes make a distinction between a difference in degree (more of the same) and a difference in kind (something new). What we are witnessing today is a difference in the degree of sharing so large that it becomes a difference in kind. (pp. 106, 149)

Shirky further details some of the most significant changes that the current information has made possible.

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[3] Musil, Steven. *"Mobile Internet traffic gaining fast on desktop Internet traffic."* CNET, 3 Dec 12. http://news.cnet.com/8301-1023_3-57556943-93/mobile-internet-traffic-gaining-fast-on-desktop-internet-traffic/

[4] Wies, Jim. "Digital Media and the Gospe.," 2 May 12. http://www.xpmedia.com/article/280/digital-media-and-the-gospel

[5] Associated Press. "*Number of active users at Facebook over the years."* 23 Oct 12. http://finance.yahoo.com/news/number-active-users-facebook-over-years-214600186--finance.html

[6] Ibid.

- IT has removed former geographic and social barriers to forming groups, and the cost of finding like-minded people has been lowered.
- The distinction between communication media and broadcast media has been shattered when anyone can publish to the entire world.
- The power to publish has shifted from professionals to amateurs, and editing of material is now done after publishing, not before.
- Formal organizations have lost their grip on the control of information as informal ones increase in influence.
- The "former audience" is more likely to react to, participate in, and even alter a story as it is unfolding.
- Information technology is making entirely new types of groups possible.

All of these trends have tremendous implications for investment, economic growth, education, stability, and the way people communicate. But for extremist organizations, the internet provides a cheap, anonymous forum that can target large audiences, specific groups or individuals, in ways that were not available even within the last 10 years. Cyberspace makes local recruitment on a global scale possible.

Activities by American-born cleric Anwar al-Awlaki are a case in point. He is perhaps the most well known extremist who used the Internet to recruit like-minded individuals. According to the New York Times: "His online lectures and sermons had been linked to more than a dozen terrorist investigations in the United States, Britain, and Canada. These include Maj. Nidal Malik Hasan, the Army psychiatrist accused of shooting 13 people at Fort Hood, Tex., in November 2009; Umar Farouk Abdulmutallab who attempted blow up an airplane with a bomb hidden in his underwear in December 2009; and Faisal Shahzad, who tried to set off a car bomb in Times Square in May 2010."[7] Without the Internet, extremists like Awlaki could not influence individuals as far away as the United States, Britain, and Canada. But the Internet not only provides a vehicle to spread ideological messages, it has become the medium of choice for radicalization.

In fact, a nine-month inquiry conducted by a British cross-party Ministers of Parliament (MP) group "found that the internet played a greater role in violent radicalization than prisons, universities, or places of worship and was now 'one of the few unregulated spaces where radicalization is able to take place'."[8] "Keith Vaz (MP), the committee's Labor chairman, said: 'The conviction last week of four men from London and Cardiff radicalized over the internet, for a plot to bomb the London stock exchange and launch a Mumbai-style atrocity on the streets of London, shows that we cannot let our vigilance slip. More resources need to be directed to these threats and to preventing

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[7] New York Times. *Anwar al-Awlaki.* January 28, 2013.

[8] Travis, Alan. The Guardian. *Internet biggest breeding ground for violent extremism, ministers warn.* 5 February 2012.

radicalization through the internet and in private spaces. These are the fertile breeding grounds for terrorism."[9]

In many ways, we are losing the so-called 'competition for ideas' in the information environment. Our adversaries and potential adversaries are engaged as never before in a competition for the ideological high ground. Distorted ideas and ideals that were easily brushed aside 20 years ago are finding an unprecedented audience and gaining a dangerous foothold in the ungoverned spaces of the Internet and social media. In many cases, we have already ceded the information environment to those who wish to harm us. We must acknowledge this seminal "difference in kind" and engage readily and continuously in this electronic battlespace. Otherwise, we will lose the clash of ideas

Although cyberspace is enabling extremist recruiting in ways that were not previously available, the field of neurobiology offers new insights on what causes people to plan for and commit violent acts, and how current Information Technology (IT) environment influences mental models that lead to support for or participation in active violent extremism. As the number of devices, users, usage, and availability of cyberspace continues to expanded, restricting Internet access to potential extremists and their recruits is exceeding difficult if not impractical. However, neurobiology may provide a new way of thinking about the problem and help operational and policy planners reduce extremists' ability to use the information environment to recruit. Furthermore, a better understanding of how the brain influences behavior may give us increased ability to predict which mental models—translated into motivations—are more likely to predict human and group behavior in certain circumstances. By improving our overall awareness of how neural networks operate, how social networks operate, and how the new information environment both shapes and is shaped by the human networks, we should be able to build much more holistic understandings of the key elements and forces in play in the shaping of extremist thought, behavior, and socialization, thus giving us a more holistic sense of where we might successfully intervene, co-opt, or forcefully act to stop the cycles propagating extremist violence and values.

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[9] Ibid.

Considerations on Emergent Cyber Trends and Technologies

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Introduction

The scope of this white paper is to provide a broad strategic level assessment of new technologies. Although the piece focuses on an overview of technological trends that may shape what the cyber environment may look like by 2035 given current technological trends, it is a fool's errand to try to predict what even the next five years of cyberspace will look like. Thus, this piece aims to focus on certain changes of core technologies that define cyberspace and their impact on peripheral technologies. Core technologies include the protocols, such as the Internet protocols and Domain Name System (DNS) on which peripheral applications, such as Facebook or Google run. The white paper then discusses challenges that such core and peripheral technologies may present to MISO operators conducting operations in the cyber domain. My purpose here is not to provide a comprehensive overview of the technologies, rather this thought piece aims to spur discussion and raise awareness on the issue of how technological advances will provide the U.S. opportunities to both counter and deter adversaries in cyberspace. The Department of Defense (DOD) may prepare for the next generation of cyber operations, rather than find itself conducting operations with models optimized for today.

The Evolving Cyber Landscape

The next twenty years will represent a paradigm shift in the fundamental character of the Internet, cyberspace's most potent manifestation. The evolution of the underlying protocols, hardware, and software applications will continue to revolutionize how people interact globally if they are on the developed side of the digital divide. Below, a listing of key core and peripheral technologies that will affect U.S. national security and military operations in the cyber domain are presented to inform U.S. military planners and operators on how technological changes may shift their operational paradigms.

IPv6 and the Next Generation Internet First deployed in the spring of 1978, Internet Protocol version four (IPv4) has been the underlying protocol that allows computers to internetwork. The growth of the Internet from a small DOD project into a global phenomenon has resulted in IP address space consumption. Realizing that the future of the Internet was at stake in the mid-1990s, the Internet Engineering Task Force (IETF) undertook an effort to engineer a new version of the Internet Protocol to assure that IP addresses would not be outpaced by the rapid explosion of Internet growth.

Today's Internet, cyberspace's most potent and global manifestation, is on the cusp of shifting from IPv4 to IPv6. Once the shift is completed, it will be the first time in the Internet's history that the underlying protocol will have changed. The impact of this transition will affect U.S. and global

commerce and security for the next 20-50 years. The transition from IPv4 to IPv6 is not hypothetical since the global supply of Internet protocol addresses in IPv4 space is quickly being exhausted. Indeed, in August of 2012, the European Internet registry exhausted its supply addresses, resulting in the European Internet registry only giving carriers IPv6 addresses.[10] In April 2011, the Asia-Pacific region was no longer able to meet IPv4 demand, and IPv6 became mandatory for building new Internet networks and services as the final IPv4 spaces are rationed out to Asia Pacific Network Information Centre (APNIC).[11]

The U.S. is at a disadvantage for transition. Because we pioneered the Internet, we own legacy technology that is IPv4. Thus, the cost of transitioning is higher than for most countries that do not have this legacy infrastructure and can migrate directly to IPv6 compatible infrastructure without dual-stacking during the transition period and then shutting off IPv4. IPv6 transition is strongest in the Asia Pacific region given that its IPv4 allocation expired in 2012. Indeed, the China Education and Research Network is the largest IPv6 network in the world. Thus, the Asia-Pacific region effectively became the first IPv6 enabled region. Hence, there is a greater operational understanding of how IPv6 implementations operate in the wild outside of the U.S.

Alternative Domain Name Systems The Internet protocol is a critical Internet resource that allows for universally resolvable URLs as a result of the domain name system (DNS) root system that is managed by the Internet Corporation for Assigned Names and Numbers (ICANN). Although this allows for a free and open Internet to function, the standards and protocols that the ICANN uses to maintain the domain name registries can be used by individuals, ad hoc networks, and nation-states to design and deploy an alternative domain name systems (altDNS) that can either be independent of, or "ride on top" of, the Internet. A corporate LAN, such as ".company name" for internal company use, is an example of the first. When a group wishes to ride over the global DNS root but incorporate its own pseudo top-level domain, core operators of the pseudo domains can use specific software resources to resolve domains that are globally accessible within their alternative DNS system. American audiences can experience what it is like to enter an alternative DNS universe via The Onion Router (TOR) network. Downloading the Onion Router package and navigating to websites one would prefer to visit anonymously (the typical use of TOR), one may point the TOR browser to websites on the ".onion" domain and mingle where the cyber underworld has started

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[10] Marsan, C.D. (2012). Europe's supply of IPv4 addresses could be exhausted this month. Network World US. http://news.techworld.com/mobile-wireless/3373483/europes-supply-of-ipv4-addresses-could-be-exhausted-this-month/

[11] Shukla, A. (2011). Asia Pacific Internet registry unable to meet IPv4 address demand. MIS Asia. http://news.techworld.com/networking/3275330/asia-pacific-internet-registry-unable-to-meet-ipv4-address-demand/

shifting the management of its business operations these days to avoid law enforcement and to add another layer of protection to their personas.[12]

Should significant usage of such shadow Internets occur, it could become very challenging for MISO operators to target radical networks who now operate on darks corners of the open Internet. The greatest risk comes when nation-states develop and deploy their own alternate-DNS systems for internal use, thereby separating themselves from the global Internet. This is different from controlling access points and actually developing country-level intranets that may or may not be connected to the global Internet.[13]

Generic Top-Level and Internationalized Domain Names In addition to the rise of altDNS, there is also a trend of non-Latin character URLs as well as generic-top level domain names (gTLDs). Top-level domain names extensions such as .com or .org have been limited by ICANN. In 2011, ICANN opened up a process for applicants to create their own domain name extensions, such as .culture. If organizations run their own top level domain names, they may operate them as they wish, thus making the gTLD either as open or closed to the public as the organization wishes.

In addition to the gTLDs, non-Latin script is increasingly prevalent. Whereas today, Latin characters from A-Z are used to resolve URLs, ICANN has launched an effort to introduce non-Latin scripts, such as Arabic, Chinese, or Greek, into the domain name system. This will allow more users to access the Internet in their own language.[14]

The Internet will thus be open to masses of new users who may not have entered the space because of the English language barrier. This presents a significant human capital challenge as the cultural and linguistic challenges facing the MISO profession today will only intensify. Thus, even finding adversary propaganda to counter will become more challenging on this new domain

Broadband Mobility The deployment of IPv6, and its massive address space, in conjunction with the convergence of industrial sensing systems with the Internet are two trends that will drive the third major change in the cyber landscape: the intensification in the use of broadband mobile devices. In the developing world, the trend is for countries to skip over the plain old telephone system (POTS) and install wireless communications infrastructures, including broadband Internet and cellular communications. Standards such as WiMAX need IPv6 to support large numbers of

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[12] Disclaimer: This is for informational use only. Any action undertaken by the reader of this article on the .onion domain is at his/her own risk, and this author is not liable for any harm caused by or to the reader.

[13] This is different from what Chris Demchak points to in "Rise of a Cybered Westphalian Age," *Strategic Studies Quarterly* 5, no. 1 (Spring 2011): 32–61, where the focus on sovereignty of the Internet is on access points of incoming Tier 1 ISP connections into the country and maintaining government control of those.

[14] Internet Corporation for Assigned Names and Number "Internationalized Domain Names" http://www.icann.org/en/resources/idn

customers. It will be possible to create *ad hoc* networks that will effectively be shadow Internets on a local level. This presents both opportunities and risks for U.S. military operations.

A future with mobile broadband devices and increasing interpersonal connections is indicative of the need for national security planners and operators to take into account the importance of exploiting the brain to achieve effects in the real world and to mitigate potential adversary operations that aim to exploit the human mind. Such efforts extend well beyond the terrorist efforts to radicalize and recruit individuals to their cause and have broader implications for U.S. operations. Take for example the events transpiring within India in August of 2012. After SMS and social media messages falsely warning of impending Muslim attacks against migrants in across Northeastern India, including major cities such as Bangalore, mass panic and exodus of targeted populations ensued. Indian Prime Minister Manmohan Singh warned, "What is at stake is the unity and integrity of our country."[15] It is clear that what occurs in cyberspace can have a very real impact on large number of people's perceptions of the world around them, leading them to actions with consequences for national security. So, the issue that should be addressed within the Pentagon today should focus on identifying and articulating the military's roles and missions in the areas where cyber and neuroscience overlap to provide the U.S. with opportunities to counter and deter possible adversarial actions in the domain.

Peripheral Technologies that Will Benefit from Core Technology Trends

Cloud Computing and Big Data The National Institute of Standards and Technology (NIST) has defined cloud computing as a model for "enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."[16] There is an increasing trend today within the commercial sector of locating many independent services on one physical host. This paradigm, from an operational perspective, allows for a greater ability to operate resiliently in a contested environment. The system allows an organization to transparently operate in the face of one or more faults that would otherwise cause a system to fail. Highly resilient systems are ones that could restart quickly and restore data. In a virtual environment, a sensor will be able to detect a virtualized machine failure and conduct a replacement of the virtual machine with a duplicate backup based on the snapshot of a trusted virtualized environment. All of the data that had not been backed up within the trust configuration would be lost, however, but the system functionality would be restored.

One might argue that centralizing management of virtual assets may lead to an increased risk of a single point of failure that would not have existed before. The virtualized environment will also

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[15] Yardley, J. "Panic Seizes India as a Region's Strife Radiates" *The New York Times* (17 August 2012) p. A1.

[16] Mell, P., & Grance, T., *The NIST Definition of Cloud Computing*, (Washington, DC: National Institute of Standards and Technology) 2011, 2.

enable a protected environment for deploying security services. This would enhance efforts to mitigate the risk of rootkits and social engineering attacks. However, there are still problems of the virtual machine understanding how to detect whether or not a guest application is behaving in an anomalous manner and, thus, the potential for false positives will persist.

Virtualization also makes installing and managing instances of a specific operating system configuration under one authority easier. This lends itself to automating the installation of the same operating system (OS) across several virtual machines. Such massive deployments create software monocultures that could facilitate that spread of malicious software, but also create a uniform ecosystem that would make deploying patches to vulnerabilities more efficient and effective.

This trend essentially creates a difficult operating environment for the U.S. in that, if effectively deployed by extremist organizations, these secure virtualized environments combined with ad hoc pseudo-DNS systems will become hard to penetrate, and may possibly be invisible unless one is invited to the network. Countering this should be a top technical priority for the computer scientist.

Ubiquitous Computing In common parlance, this is known as ubiquitous computing or the Internet of Things, which has been used to describe the full universe of devices, that, when combined together, in the near future will drastically modify the way our societies function. It represents a paradigm shift from networked laptops and desktops towards a paradigm of networked objects sensing their environments and communicating what they see amongst themselves.

Beyond the fundamental changes to the structure of the Internet's network topology, there is also the shifting into the next generation of web applications. We are currently on the cusp of entering Web 3.0, or the semantic web. Web 1.0 was the static web, where people would go and read information without interacting with the media. Web 2.0 is the interactive and social web. The trend towards this started circa 2000, but did not fully take off until later in the decade with the popularization of services such as YouTube and Facebook. Web 3.0, or the semantic web, is the next evolution of the web, which we are already seeing in 2012 and will only intensify by 2020. The semantic web is about machines connecting data, which was not previously linked.[17] Machines will be able to understand data in a way that a human can via the metadata.[18]

This is more than an extension of the Internet to mobile and other devices as it could include independent systems that operate on their own infrastructure and have only partial reliance on the Internet. These objects, from books to cars, from electrical appliances to food, create the Internet of things. These objects may have their own IPv6 addresses or be embedded in complex systems and use sensors to obtain information from their environments (such as food products that record the temperature along the supply chain). Again, as in the other fields, the trend of the Internet becoming a more fragmented closed space exists here.

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[17] Tim Berners-Lee, *Linked Data.* http://www.w3.org/DesignIssues/LinkedData
[18] Nigel Shadbolt, Wendy Hall, & Tim Berners-Lee. "The Semantic Web Revisited" *IEEE Intelligent Systems* (May/June 2006) 96-101.

IPTV is a technology that allows for the broadcasting of audio-video material over a packet-switch IP network. Currently, there is a shift towards this mode of programming with the rise of video-on-demand online service. However, IPv4 networks limit the transmission to a unicast model. That is, in terms of use experience, if someone wants to change a program, pressing "next channel" will require the device to establish a new connection and lead to lag in load time of the next channel or program being requested. IPv6 allows for multicasting. Standards today over which IPTV services will run are emerging, such as the ITU's G.hn standard, which American companies such as AT&T support.[19] This will allow for current and new services to evolve into a format that will resemble the seamlessness of how we watch television today. It is highly like that this will result in a paradigm shift similar to the one experienced when the television model shifted from local broadcast to satellite broadcast. As such, it will present new opportunities for the U.S. to broadcast messages worldwide, following paradigms from broad broadcasts to targeting an individual's screen. These opportunities will exist on the open Internet; however, it is conceivable that with IPTV embedded into the closed networks described above, it will serve as another secure platform for violent extremist organizations to maintain a grip on the minds of their followers within self-referential environments.

Conclusions

While the operating environment today contains social media platforms on the Internet, the ability to influence and manage cognitive process to influence perceptions across the range of military operations to benefit U.S. national security interests will become more restricted. Examining the expertise of each service in order to assign roles and missions to apply their expertise would enhance our ability to organize, train, and equip for operations targeting cognitive processes on a range of actors.

This will require capabilities that are not solely confined within the service core areas expertise. As much digital communication in the 21st century will not be done in either English, or a Western cultural context, using cyberspace to influence perceptions will require either recruiting multilingual service members who know any language other than English or investing in language training in languages of key national security interest.

Today cyber criminals, terrorists, and clandestine networks create psychological effects globally via the Internet. The focus on cyber has largely been on catastrophic digital attacks against critical infrastructure. Consequences of cyber on the cognitive domain are just as consequential. As has been observed in recent protest movements, such as in Iran (2009) the Pittsburg Summit (2009) and Athens (2008), Thailand (2010), London (2011) and the August 2012 incident in India. Individuals using converged Internet and broadband mobile technologies, such as Twitter and Facebook, to spontaneously organize themselves into groups that began with non-violent principles,

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[19] Sean Buckley, "AT&T Officially Endorses G.hn home networking standards" on *Fierce Telecom* (2 June 2011) http://www.fiercetelecom.com/story/att-officially-endorses-ghn-home-networking-standard/2011-06-02

but in some cases turned to violent protest. While cyber capabilities are not the reason for either the protests or the violence, they certainly catalyzed the events and their effects.

The convergence of broadband Internet with mobile platforms will significantly shift the computing paradigm similar to the shift from mainframe/micro computing to desktop computing. This shift will be much more rapid as a result of broadband mobile devices working within an increased IP address spaces. These trends highlight a significant shift in the kinds of devices used to access services in cyberspace, how people interact with the information on the Internet, and with their industrial devices. Usage trends in cloud computing paradigms (Software as a Service, Platform as a Service, Infrastructure as a Service) and the power that applications of these within the way content and information spread (social networking, voice over IP, big data computation, and streamlined business processes) will revolutionize not only how the DOD operates in cyberspace, but also how the people connect and are influenced.

Back to the Future: Understanding Radicalization through a Social Typology of Media, Past and Present

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"All media is social because human beings are social. The only difference is that it happens much, much, much faster now."

Derek Powazek, Internet Entrepreneur, 2010.

The social world provides the essential link between the neurobiology of new media and the mechanics of radicalization. The information environment, like all communication media, prefers certain social configurations and discourages others. These resultant social structures change the human terrain for both radicals and counter-radicalization efforts. This essay is intended as a link between the rigorous discussion of 'cyber on the brain' and the social outcomes of humans interacting in the contemporary information environment.

Toward that end, I seek to sharpen the resolution of our discussion of social media. Rather than a dichotomy between 'old' and 'new' media, I describe media in terms of the communication depth of tie it creates, and the breadth of possible communication. Changing these variables results in different ideal-type social worlds. Presenting each of these types as a plausibility probe, I briefly consider the implications for radicalization within each. I conclude with a parallel between tribal models of social embeddedness and online anti-radicalization strategies, demonstrating the utility of the typology in devising strategies through analogy.

Describing Media

Media is by definition something 'in between,' the connective tissue within a larger social structure. Therefore, all media—from a tribal oral history, through the newspaper, to Twitter and its kin—are inherently social. By destabilizing the distinction between mass media and social media, we can better explore the social implications of different means of communication; platforms such as Facebook easily reach the span of 'mass' media, and mass-produced media are no less dependent on social structures. By doing so, we find insights into 'new' media from some very old sources—for instance, re-tweeting is similar in many ways to an oral history, so tribal models of communication can help us understand the new information environment.

Toward this end, four variables describe a communications medium. The first two variables, speed and directionality, describe the dyadic nature of communication between a sender and a receiver. The last two variables, span and configuration, are triadic, describing the implications that communication between two parties has for a third party. For instance, if two people are having a

conversation across a telegraph, it is relatively difficult to include a third person, whereas if two people are chatting around a table, a third friend could easily interject into the conversation.

- **Speed (High-Speed v. Low-Speed)** is the amount of information flow the medium is capable of supporting. A high-speed medium is typically less context-dependent, which in turn dictates how deeply socially embedded the sender and receiver must be in order to understand each other. Conversely, a low-speed medium is much more reliant on context in order to gain maximum communications purchase per unit data. (This is similar in concept to file compression schemes, where adjacency and consistency are used to reduce file size.) For instance, an IMAX movie's tremendous bandwidth provides high-speed communication, whereas a pictogram relies on imagination and inference to flesh out its message.[20]
- **Directionality (One-Way v. Interactive)** depicts whether one player remains in the sender role or whether both players routinely swap between sending and receiving roles. Collaborative, interactive communications are associated with low social power distance; one-way communication is indicative of formal roles and hierarchy.[21] All communication includes a feedback loop—a book is highly directional, but would-be readers can vote with their feet. Directionality describes whether the medium itself can accommodate interaction between sender and receiver. For example, a conversation is interactive, whereas a speech is one-way—were the speech to become interactive, it would break down.
- **Span (Wide-Span v. Narrow-Span)** describes the additional communicative capacity inherent in the medium before it bogs down—a medium with wide span can include massive numbers of additional members in the conversation before it becomes saturated. This holds implications in the size of the social structure that can be sustained by the medium. Wide-span communications can bind a much larger social network together.[22] For example, a hand-written note is a narrow-span communication, whereas flyers produced on

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[20] As an operational consideration, consider the interpersonal conflicts on mIRC when shared context breaks down and words are misinterpreted, in contrast to the much less fractious face-to-face communication where non-verbal cues flesh out intent. Providing permanent VTCs for dispersed crew communications, such as in the Predator, provide for more robust social ties.

[21] Geert Hofstede, Gert Jan Hofstede, and Michael Minkov, *Cultures and Organizations: Software for the Mind, Third Edition* (McGraw Hill Professional, 2010); Geert Hofstede and Robert R McCrae, "Personality and Culture Revisited: Linking Traits and Dimensions of Culture," *Cross-Cultural Research* 38, no. 1 (February 2004): 52–88.

[22] The Soviet preoccupation in the 1920s and 1930s with controlling the presses and connecting the villages via telegraph and radio speak to the societal implications of these technologies—the centralized production of information supported the centralization of power in Moscow. For further reading, see Kristin Roth-Ey, *Moscow Prime Time: How the Soviet Union Built the Media Empire That Lost the Cultural Cold War* (Cornell University Press, 2011); Joshua First, "Moscow Prime Time: How the Soviet Union Built the Media Empire That Lost the Cold War (review)," *Technology and Culture* 53, no. 3 (2012): 731–733.

a high volume printer is wide-span communication. For the former, one communications tie 'locks out' the medium, while the latter can build many ties before reaching capacity.

- **Configuration (Centralized v. Decentralized)** describes the types of social ties the medium prefers. Mark Granovetter describes weak ties, acquaintanceships that provide a social search function, and strong ties, deep relationships that foster social support and identity.[23] Any effective communications network requires some combination of strong and weak ties, but the cost of weak ties influences the layout of the medium's social structure. If weak ties are expensive, one can expect to see a centralized hub-and-spoke network, where a few central actors achieve economies of scale and drive information production and dissemination. Conversely, if weak ties are cheap, the resultant structure should yield the more organic decentralized pattern of a flat network. This configuration directly impacts influence strategy – a centralized configuration lends itself to professionalized information operations and effective message control, whereas in an organic flat network, one must enlist a myriad of actors at much lower levels of commitment in order to shape messages. The circulation of rumors typically follows a decentralized pattern, whereas official pronouncements proceed from the center outwards.

These four variables are not entirely independent of each other. Print-based technologies expand span through production economies of scale, which leads to centralized configurations; Internet-based technologies expand span by democratizing the production of information, which leads to decentralized configurations. Technological advances expand the *pareto*-frontier of communications and this, on the whole, trends toward high-speed and high-span communications. Still, communicators must make tradeoffs between depth and breadth, between control and resilience, and between richness and refresh rate along that *pareto*-frontier. This four-way typology explores the human terrain created by these tradeoffs.

Stanford Professor Larry Diamond expounds two key points along these lines in "Liberation Technology."[24] First, different implementations of technology advantage or disadvantage particular expressions of society and humanity. Roman technologies strengthened centralized governance, often at the expense of local autonomy—"all roads lead to Rome" advantages Rome far more than Lusitania. Conversely, Internet-based technologies structurally tend to democratize governance and suffer reduced efficiency when forced into a centralized model.[25] Second, technology is highly

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[23] M Granovetter, "The Strength of Weak Ties: A Network Theory Revisited," *Sociological Theory* (1983); D Krackhardt, "The Strength of Strong Ties: The Importance of Philos in Organizations," *Networks and Organizations: Structure* (1992).

[24] Larry Diamond, "Liberation Technology," *Journal of Democracy* 21, no. 3 (2010): 69–83.

[25] Print runs largely the other direction. The Soviet underground *Samizdat* and *Magnetizdat* publications used print and magnetic media respectively to distribute works such as Solzhenitsyn's *Gulag Archipelago,* though in sheer mass of communication could not compete with the state presses. The difference in demand for *samizdat* vice state media fueled its continued existence

contingent—the architects of DARPANet decided to route data in a specific way that had critical implications as their construct grew into the modern Internet. The four-way typology explores the contingency of technology; by challenging the deterministic arc from 'old' media to 'new' media, we both rediscover parallels with very old media, and our own agency in shaping these technologies.

			Triadic Measures *(Breadth of Comm)*			
			Wide Span		Narrow Span	
			Central	Decentralized	Central	Decentralized
Dyadic Measures *(Depth of Comm)*	High Speed	1-Way	'Hollywood' (Movies, TV)	'Blogosphere' (YouTube, Blog)	'Soapbox' (Speeches)	'Oral Tradition' (& Rumors)
		Interact	'Aggregators' (Drudge, Huff Po, Reddit)	'SocNet Site' (Facebook)	'Town Hall' (Public Mtg)	'Happy Hour' (Conversation)
	Low Speed	1-Way	'Print Press' (Book, Mags)	'Billboards' (Posters)	'Gallery' (Graphic Art)	'Postcards' (& Letters)
		Interact	'Classified Ad' (Letters to Ed)	'Fax & Copy' (& Samizdat)	'Corkboard' (& 'Found Dog')	'Scratchpads' (& Sign-up Sheets)

Figure 1: Media Types and Social Worlds

Social Worlds

These four variables result in sixteen ideal-type social worlds. The technologies associated with these worlds can be used in other ways than these preferred configurations, though with an efficiency penalty. A nation can centralize control of their Internet through a labyrinthine system of routers and firewalls, but it pays a cost to do so. Similarly, the underground *samizdat* publications in the Soviet Union used the technology of printing presses in decentralized small batches, but could not achieve the economies of scale of the centralized state presses.[26] Exploring these worlds reveals the preferred human terrain of these technologies.

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despite these disadvantages. F. J. M. (Ferdinand Joseph Maria) Feldbrugge, *Samizdat & Political Dissent in the Soviet Union* (BRILL, 1975).

[26] Gordon Johnston, "What Is the History of Samizdat?" *Social History* 24, no. 2 (1999): 115–133; Hyung Min Joo, "Voices of Freedom: Samizdat," *Europe-Asia Studies* 56, no. 4 (2004): 571–594.

Internet- and Radio Frequency-based technologies share the domain of High-speed, Wide-span social worlds. These, as a whole, tend toward globalization but vary on advantaging moderate or extreme voices—centralization moves toward moderation on the whole, whereas radical voices are often the ones best able to be heard above the din in a decentralized world. The focus in this set of worlds is to be first with the truth, as under the extremely high refresh rate and short attention span of these worlds, speed trumps precision.

- *'Hollywood' (High-Speed, One-Way, Wide-Span, Centralized.)* Characterized by massively centralized and expensive production of information, this social world uses high communications bandwidth to overcome social fissures by creating synthetic shared context. The world of globalized entertainment and 24-hour high volume news serves as exemplars of this structure. The economies of scale inherent in this system leads to a relatively small number of firms in monopolistic competition.[27] The strategic imperative in this world is to influence the high ground of these key players and meticulously manage message control.

- *'Blogosphere' (H, O, W, Decentralized.)* The democratizing of audiovisual production, along with the proliferation of self-publishing platforms results in a more diffuse social world than that of 'Hollywood.' YouTube and blogs inhabit this world, and Twitter straddles the space between the blogosphere and a social networking site. Dynamics in the 'blogosphere' are similar to oral histories, in that events are socially re-interpreted through repetition, though with much higher span; they are similar to printed flyers, in their short half-life and wide variations in quality, though at much higher speed. Strategies in this world accept more risk in messaging, as one viral meme (even amidst a number of duds) is far more powerful than a well-groomed milquetoast message, and focus on influencing a broader community of opinion makers.

- *'Aggregator' (H, Interactive, W, C.)* Aggregators synthesize democratized information production with the advantages of central sources of information. Rather than relying on a journalistic epistemic community[28] to gather an interpret information, the world of the aggregators compiles information gathered by a community. This results in propinquity, the tendency of individuals to associate with like-minded others, encountering ubiquity, where each individual is connected to many others.[29] Polarizing topics favor the former, as with the Huffington Post and Drudge Report; neutral topics move toward the latter, as with Reddit and Tumblr. In this world, influence is best spent by producing messages with viral

[27] For further reading, see Avinash K. Dixit and Joseph E. Stiglitz, "Monopolistic Competition and Optimum Product Diversity," *The American Economic Review* 67, no. 3 (June 1, 1977): 297–308; Paul R. Krugman, "Increasing Returns, Monopolistic Competition, and International Trade," *Journal of International Economics* 9, no. 4 (November 1979): 469–479.

[28] P. M. Haas, "Do Regimes Matter? Epistemic Communities and Mediterranean Pollution Control," *International Organization* 43, no. 03 (1989): 377–403.

[29] L. Festinger, S. Schachter, and K. Back, "The Spatial Ecology of Group Formation," *Social Pressure in Informal Groups* (1950): 33–60. Personal Communication, Dr. William Casebeer.

potential focused on the communities represented by the aggregators. Clay Shirkey's work on crowd-sourcing describes the emerging dynamics of this world.[30]

- **'Social Networking Site' (H, I, W, D.)** Rather than logging on to a site and receiving the same feed as all other members, these media function as real-time-oral-histories as well as personal aggregators, where information is collected and interpreted through an individual's social network. Facebook is the present dominant application. As with the aggregator, ubiquity and propinquity are in tension; however, as most individuals are socially embedded in a number of non-overlapping worlds,[31] diverse social networks can accommodate a variety of views. In this world, broad, diffuse influence is paramount, as there are few individual influencers who are able to shape the entirety of the medium. Similar to the blogosphere, delegation of messaging to individuals and accepting higher risk is more likely to yield a successful viral outcome than tight messaging control.

Focusing on radicalization, the ability of social network sites to keep an individual embedded in multiple non-overlapping social networks reduces the leverage of any one view over an individual – organizing low-commitment movements such as Occupy Wall Street are far easier, but demanding total commitment to one cause becomes more difficult.

Wide-span and low-speed social worlds largely belong to print-based technologies. Mass production allows printed works to reach wide audiences, but a low refresh rate means that messages must be well sculpted in order to endure. The lower the refresh rate, the more this is true—managing influence in the newspaper medium emphasizes a timing element that is relatively less crucial in book publishing. The imperative in this set of worlds is to reach the most people with the best message, even if that message takes longer to sculpt.

- **'Printing Press' (Low-Speed, O, W, C.)** This social world involves extensive curation of information—only a small subset of information produced is selected for publication, and the information that is produced extends to a very wide audience. Literary publishing and magazines occupy center stage here, while newspapers gravitate more toward the interactive side of this world. While this world aggregates tastes into a few categories, messages must be fine-tuned to each of these. For instance, pulp fiction reaches a much different market than high culture literature. Message is king in the world of the Printing Press, while gaining access to the power centers of the publishing world (or creating new ones) comes in a close second.
- **'Billboards' (L, O, W, D.)** The world of billboards provides voice opportunities, at cost, to a diversity of individuals in order to communicate messages to broad audiences. Posters and

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[30] Clay Shirky, *Here Comes Everybody: The Power of Organizing Without Organizations*, Reprint. (Penguin Books, 2009).

[31] Mark Granovetter, "Economic Action and Social Structure: The Problem of Embeddedness," *American Journal of Sociology* 91, no. 3 (November 1985): 481–510.

mass advertising constitute this world, where the imperative is to advance engaging messages in a cost-constrained space.

- *'Classified Ad' (L, I, W, C.)* Large-scale print media, especially newspapers, often include an interactive component. Letters to the editor, OpEd columns and classified advertisements provide avenues for community voices in mass produced publications. These media focus on messages viewed as authentic and trustworthy, as well as those who make the best use of the scarce space available.

- *'Faxes & Copiers' (L, I, W, D.)* The advent of affordable personal printing provided for both decentralized production of information and interaction with that information. Fax machines enabled the 1989 demonstrations in Tiananmen Square[32] in a hard-copy analog to Twitter. Copy machines and personal printers provide the foundations for this world. Dominant strategies reflect the social networking world, where social legitimacy and messages with viral potential are key.

The third quadrant, narrow-span and high-speed, is the province of speech. Inter-personal direct communication has a wide bandwidth, but is limited in scope. Radio Frequency and Print communications technologies amplify the potential span of speech, though these come at a cost of trust; speech in its native form provides an immersive experience that is inherently limited to those present. This set of worlds rewards those who master creating and shaping context with words and non-verbal cues.

- *'Soapbox' (H, O, Narrow-Span, C.)* The world of oratory lends itself to hub-and-spoke social networks, where listeners are each experiencing a common context created by the speaker. For the speaker, influence is derived from an engaging message that holds the shared context together. The speaker and the message are key points of leverage.

- *'Oral Tradition' (H, O, N, D.)* With rumors and oral tradition, the message is re-shaped as it is repeated through the contours of an organic social network. As is quite evident to anyone attempting to stamp out a rumor, this yields a fast-moving and resilient message kernel, but one that can diverge from the original truth source just as rapidly. A message's trustworthiness is a function both of its logical content and the relationship between the sender and receiver. Oral Tradition, much like Twitter, is a powerful tool for influence, but an influencer must consider both message and the intermediary network.

- *'Town Hall' (H, I, N, C.)* Juxtaposed with the meandering messages of 'Oral Tradition,' public interactive meetings in the tradition of New England town hall bring disparate opinions into collision around a nexus in the hopes of reaching consensus. Similar to Internet aggregators, messages with viral potential and speakers with social authority are influential.

- *'Happy Hour' (H, I, N, D.)* In the world of unstructured conversation, the social structure is itself the message, at least in part. Social embeddedness is key, perhaps even more so than

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[32] "Fax Against Fictions," *Time*, n.d., http://www.time.com/time/magazine/article/0,9171,957964,00.html; "Will Facebook Remake the World?," *FPIF*, n.d., http://www.fpif.org/articles/will_facebook_remake_the_world.

informational content; much as with Facebook, ideas do not need to be particularly robust to prove meme-worthy.

The fourth quadrant, narrow-span and narrow-speed, is inhabited by archival writing and artwork. Whether hand-written notes or cuneiform carvings, these communicative worlds trade bandwidth for durability. While messages can meander with speech, and print and electronic communications entail start-up costs, the personal notepad remains ubiquitous. In this world, as with print, the message is foremost – these media reward economy and creative use of space.

- *'Gallery' (L, O, N, C.)* These media carry a message of value to many within a constrained space. Examples include graphic art and archival official printing. This is similar to the Printing Press, though people need to come to the medium rather than vice versa; it is also similar to the Soapbox in the sense of congregating around the message, but places more emphasis on the message. Dominant strategies focus almost entirely on the message.
- *'Postcards' (L, O, N, D.)* Written correspondence exemplifies this world—messages are expounded at length and tailored to a specific recipient. In a day of electronic communication, the time and mental space required to hand-write a letter can serve as a costly signal and highlight an important relationship. The message matters, though the personal nature of these media rely on interpersonal trust. Since these media focus greatly on the relationship between sender and receiver, social embeddedness is key to influence.[33] Specifically considering radicalization, if a sender dominates the social world of a recipient, they have tremendous influence; conversely, if a recipient is socially embedded within a diverse network, then the demands of that network will moderate messaging.
- *'Corkboard' (L, I, N, C.)* Communities make use of written matter for *ad hoc* coordination, similar to Classified Ads in the sense of making specific utilitarian connections, and to Town Halls in the sense of aggregating common interest. These media congregate in common places and often include invitations for interaction such as tear-off slips. Understanding the flavor of the common place is key for influence.
- *'Scratchpads' (L, I, N, D.)* Hand-written notes and sign-up sheets provide effective means of small-scale coordination within a community. In these media, social coordination is the typical function of the message, and the messages themselves are largely banal. Information must be compressed through standardized formats or economy of words, so efficient conveyance is essential for influence.

Analytical Insights

This typology is technology-agnostic, which provides two analytical benefits. First, 'cyberspace' is an information environment that relies upon electromagnetic energy, but it has much in common with information environments that use chemical means to encode information (print) as well as those that use physical vibration (speech) or physical impact (archival writing.) Taking a step back

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[33] Granovetter, "The Strength of Weak Ties: A Network Theory Revisited."

from the newness of the electronic information environment, it is the social world that layers upon a communication technology that creates social outcomes, rather than the technology itself.

Second, technologies that fill similar social functions often create similar forms. For instance, in a tribal or an office setting, the social patterns of oral traditions and rumor mills advantage those who curry the most trust and can move the fastest to get out in front of the message. The same is likely true for a meme on Twitter, though with a much larger span. This common social outcome derives from common social structure – in both cases, the technology is filling a niche for rapid information dissemination, though at a cost of message content quality control.

Referring to Figure 1, the chart of social world's aids in reasoning by analogy. In order to better understand the social world of a media type, one may consider the other three media types in the media's Span/Speed quadrant. While meeting different needs in terms of configuration and interaction, these adjacent media share a broad audience space. For instance, in order to understand billboards, the other print media in the High-Span/Low-Speed quadrant provide a sense of the community reached by these media. They also help one understand how the diffuse but interactive world of billboards meet a social need not otherwise provided.

As a compliment to this method, similar spaces in other quadrants provide functional parallels. Considering the 'Hollywood' social world, parallels with book publishing, soapbox speeches and gallery artworks each illustrate how an individual or small group can package a message for larger consumption. Insights about content and packaging translate well, though in each case directed to a different audience. Accordingly, influence strategies from functionally similar historical media provide insights for the electronic information environment.

Media should also be considered in relationship to each other. Ideas move between media through multimode networks in two ways—multiplexing and translation. Multiplexing is when an idea is simulcast through several media at the same time. For instance, a book launch almost never occurs only in the 'Printing Press' world. Advertisements on television and in print, Tweets and an effort to build word-of-mouth 'buzz' about the work multiplexes the message, or at least interest in the message, in multiple social worlds. Translation moves a message from one communicative social world to another and, in doing so, may syncopate the message. As an example, a popular quote from a movie is repeated around water coolers, and finds itself integrated into online discourse. Office Space's[34] "TPS reports" quote, a 'Hollywood' satire of an organizational 'Postcard' process, became a decentralized protest of bureaucracy equally at home in the 'Social Network' and the 'Happy Hour' worlds. These transitions, like light moving from the medium of air to that of water, bend the evolution of the idea as it is re-interpreted in different social worlds.

Since people have diverse and highly overlapping communicative worlds—real-space networks become cyber-space networks become real-space networks—a robust idea is resident in multiple

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[34] "*Office Space*," *Wikipedia, the Free Encyclopedia*, November 12, 2012, http://en.wikipedia.org/w/index.php?title=Office_Space&oldid=521835675.

media simultaneously. An idea may sit dormant in print media, only to be activated in electromagnetic and speech media a century later, create dramatic social change (and scribal media in the process), and find itself re-archived in print media. Each phase transition changes the social capabilities of the message.

Insights for Radicalization

The tragic story of Nadal Hasan demonstrates the utility of this framework. Hasan, a U.S. Army medical officer, encountered Anwar al-Alawqi of Al-Qaeda at a DC-Area mosque in the early 2000s.[35] Nascent radical thought planted during this communication likely simmered through Violent Extremist online media such as al-Aulaqi's Inspire Magazine, an unfortunately well-produced online publication that espoused radical Takfiri Salafist thought.[36] From this persistent engagement with the message, Hasan began personal contact with al-Aulaqi.[37] These online conversations progressed to the point where Aulaqi came to dominate Hasan's social world. Already partially withdrawn from deep social interaction, this further dis-embedding distanced Hasan from friends who would contest any excessively radical demands on his person. Accordingly, having removed competing social claims, Aulaqi was able to weaponize this now fully socially disembedded individual. Hasan murdered 13 people on 5 November 2009.

Applying this typology to the Hasan episode, his interaction with Aulaqi follows three media mediated stages. The first of these is personal contact with Aulaqi through speeches and conversation while Aulaqi was in the United States a decade prior to the shooting. These conversations are difficult to engage, but have low span and can therefore be localized. Identifying opinion leaders (especially those with unique communicative skills) and understanding the community that surrounds them can help one understand these 'Soapbox' and 'Happy Hour' communicative worlds. The 'within quadrant' method highlights the importance of the immediate local social network in this early conversation.

Second, initial contact through an online magazine. Inspire is a wide-span, one-way publication. Despite being online, the publication itself is low-speed akin to a periodical due to low refresh rate and lacking high-bandwidth multimedia. Still, the al-Qaeda VEO media repertoire includes videos,

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[35] Susan Schmidt, "Imam From Va. Mosque Now Thought to Have Aided Al-Qaeda," *The Washington Post*, February 27, 2008, sec. Politics, http://www.washingtonpost.com/wp-dyn/content/article/2008/02/26/AR2008022603267.html; "On Al-Jazeera.net - First Interview with U.S.-Born Yemen-Based Imam Anwar Al-'Awlaki on Major Hasan and the Fort Hood Shooting: Nidal [Hasan] Contacted Me a Year Ago," *MEMRI - The Middle East Media Research Institute*, n.d., http://www.memri.org/report/en/0/0/0/0/0/0/3859.htm.

[36] Marc Sageman, *Leaderless Jihad: Terror Networks in the Twenty-First Century*, First ed. (University of Pennsylvania Press, 2008).

[37] "Senior Official: More Hasan Ties to People Under Investigation by FBI", November 11, 2009, http://abcnews.go.com/Blotter/official-nidal-hasan-unexplained-connections/story?id=9048590.

and, therefore, it serves to examine high-speed parallel worlds. It straddles the world of centralized and decentralized configurations, as it was hosted on an al-Qaeda website, but was likely produced independently. Therefore, our analysis begins in the 'Printing Press' world, where message is first and foremost. Considering adjunct high-speed media, the 'Hollywood' world highlights the importance of production value, an insight Aulaqi instinctively took to heart. Additionally, the decentralized worlds of 'Billboards' and the 'Blogosphere' underscore the value of viral memes in engaging would-be recruits.

Using the 'within quadrant' method, the audience targeted by Inspire is both broad and engaged enough to wait from one month to the next for the publication. While valuing graphics and the like, a resonant message is at the core of the media. Therefore, an effective counterstrategy for the social world that surrounds Inspire magazine must engage the arguments put forth, and do so with social relevance and production value. Using the 'between quadrants' method, one-way centralized media emphasize messaging over social embeddedness. This insight reinforces the importance of engaging content (though discrediting the sender would also prove useful.)

The third phase of radicalization moves from Inspire to Aulaqi's blog writing and personal communication. This narrow-span, high-speed, decentralized, and interactive communication leads to the 'Social Network Site' social world. With shades of low-speed, reciprocal one-way-at-a-time communication, this interaction includes some aspects of the 'Postcards' social world as well. In the world of the Social Network, social ties are the key to influence. Both 'within quadrant' and 'between quadrant' analysis confirms that, in this medium, embeddedness trumps messaging. An individual embedded in a number of different social networks is pulled in different directions and required to manage competing demands. This means that he or she will be unlikely to submit to any totalizing request such as the one put forth by Aulaqi. The critical imperative is to prevent Aulaqi from dominating Hasan's social network; while messages are important, the key is more to keep potentially radicalizable individuals tied into cross-cutting networks. These methods could be likewise applied to other radical communications strategies.

Violent Extremist Messaging was effectively multiplexed throughout this episode, but Hasan's experience better demonstrates translation. The social seeds planted through Aulaqi's speech translated into an interest in online media, whose persistence incubated these initial thoughts to a point that direct communication, with all its social implications, became possible. Each of these translations aids the meme—where the trust networks that undergird speech are ideal for inception, the persistence and anonymity of online media provides Hasan an avenue to continue to engage these ideas at least somewhat surreptitiously. Finally, these online media linked easily to an electronically facilitated 'Postcards' world of email exchanges with al-Aulaqi, who was able to re-activate interpersonal trust networks, and displace competing social claims. By tracing potential radicalization paths, these transitions could potentially be interrupted—perhaps if al-Qaeda's online presence had not been quite so robust, these ideas might not have incubated. If there had been a higher opportunity cost to contacting al-Aulaqi, perhaps the terminal phase of radicalization could have been avoided.

Conclusion

In contrast to tragic story of Hasan, social embeddedness can prove an effective counter-radicalization strategy, especially amongst tribal groups.[38] When a young member of the tribe has responsibilities to their family's livelihood, their tribe's future, and their friends, the community is likely to be less receptive to even the best messaging on the part of VEOs. When much tribal communication is conducted in the 'Oral Tradition' and 'Happy Hour' worlds, these structures value social loyalty and responsibilities highly. A culture structured along these lines will prove resilient so long as these social ties remain diverse. In effect, reinforcing embeddedness hardens local social structures against being coopted into a master VEO narrative, as described by Stathis Kalyvas his 2003 work "The Ontology of Political Violence."[39]

In a strangely similar note, during the most recent election season I found vastly different sets of messages advanced by friends on different sides of the political spectrum. I also found my own communications greatly moderated by the realization that all of these networks at odds with each other will read the same message. Perhaps, if my own social networks leaned farther from ubiquity to propinquity on one side or the other, this social constraint would be removed. If diverse friendships moderate the polarized American political climate, perhaps the same principle might find good use against VEOs.

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[38] Personal Interview, Joint Special Operations University, 2007.

[39] Stathis N. Kalyvas, "The Ontology of: Action and Identity in Civil Wars," *Perspectives on Politics* 1, no. 03 (2003): 475–494.

Cyber on the Brain: The Effects of Cyberneurobiology & Cyberpsychology on Political Extremism

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The 2010 National Security Strategy white paper states "cybersecurity threats represent one of the most serious national security, public safety, and economic challenges we face as a nation" (Department of Defense, 2011, p. 1). Although the focus of concern primarily appears to be network security, there is growing acknowledgement of the importance of examining cyberspace as a medium for information dissemination and as a tool for radicalization and mobilization. Advancements in cyber-based communication technology (CBCT) raise important questions about the blurring of lines between physical-based reality and cyber-formed reality and how they may differ in delivering catalysts for extremist action while potentially removing vital inhibitors. For example, CBCT may be thought of as an enabler to individuals and groups of individuals who might not otherwise be exposed to radical elements. A subsequent concern is whether psychological and emotional responses to radical information differ depending on the medium by which connections were made and through which dialog continues. Additionally, while researchers have recently demonstrated differences between individuals who have and have not been raised with CBCT, the full extent of those differences are empirical questions yet to be explored (Moody, 2001; Frank, Marci, & Martin, 2012). Similarly, there is much research on the role of CBCT in radicalization and mobilization that remains to be done (Patel, 2011; Borum, 2011a; Nasser-Edine, Garnham, Agostino, & Caluya, 2011). Nevertheless, practitioners can extrapolate from knowledge gained from research on radicalization in the physical realm by overlaying emerging insights from cyberneurobiology and cyberpsychology to augment understanding of the effects of CBCT on radicalization and mobilization. The main question guiding this effort is: *What are the implications of cyber-based communications for theories of political mobilization and mass radicalization?*

Radicalization and Mobilization

Despite the many efforts to understand radicalization, both operational and academic literatures fail to converge on a single comprehensive, empirically-grounded, and widely-accepted model or framework (Nasser-Edine, Garnham, Agostino, & Caluya, 2011; Borum, 2011a; Patel, 2011). The SMA team, in partnership with Dr. Clark McCauley, developed a SMA/McCauley "Two Pyramids" framework. The framework is based on a previous McCauley & Moskalenko model of radicalization and mobilization (McCauley & Moskalenko, 2008; Leuprecht, Hatley, Moskalenko, & McCauley, 2010). For the purposes of this paper, its application is principally illustrative; we use the pyramids as a basis for contextualizing and discussing the emerging findings from the fields of cyberneurobiology and cyberpsychology.

The two pyramids of the framework represent the opinion and action states that characterize individuals within a given population relative to a particular cause, which activists, radicals, and terrorists claim to represent. Within this framework, radicalization is a process that affects movement between opinion states, while mobilization is a process that affects movement between action states. Each pyramid is divided into four segments that correspond to varying levels—not necessarily ordinal—of radicalization (the opinion pyramid) and mobilization (the action pyramid). It is important to note that the two-pyramid framework is not a conveyor or stepwise functional representation of the complex radicalization and mobilization processes. Rather, the model assumes that individuals can exist at any stage in each of the pyramids and move fluidly within the pyramids.[40]

The 16 base states (e.g., neutral-inert, sympathizer-radical, or personal moral obligation-radical) and the transitions between (e.g., from neutral-inert to sympathizer-radical) them are shaped by, or follow from, a variety of factors that establish the context within which the base states are formed as well as the space in which activators and inhibitors operate and catalysts and interventions are staged. It is through exposure to activators or catalyzing basic factors that an individual or group transitions from its initial state to another state. The. The SMA/McCauley Two Pyramids framework amends the original McCauley & Moskalenko model (McCauley & Moskalenko, 2008; McCauley & Moskalenko, 2010) to offer eleven basic factors contributing to radicalization and mobilization. As specified in the framework, these are referred to as *transition factors*, which function as activators, catalysts, inhibitors, and interventions. These eleven transition factors do not operate in isolation; rather they interact with one another and may vary in their effects over time. In addition to the transition factors, we propose that there are certain aspects of an individual's local ecology—what we call "shaping factors" such as cultural values, genetic background, and access to technology— that condition whether and how transition factors, in combination with CBCT, play a role in their movement between radicalization states or levels of engagement in action.

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[40] For a complete explanation of the SMA/McCauley Two Pyramids Framework, please email adesjardins@nsiteam.com for a fully copy of the *Cyber on the Brian: The Effects of Cyberneurobiology & Cyberpsychology on Political Extremism* report.
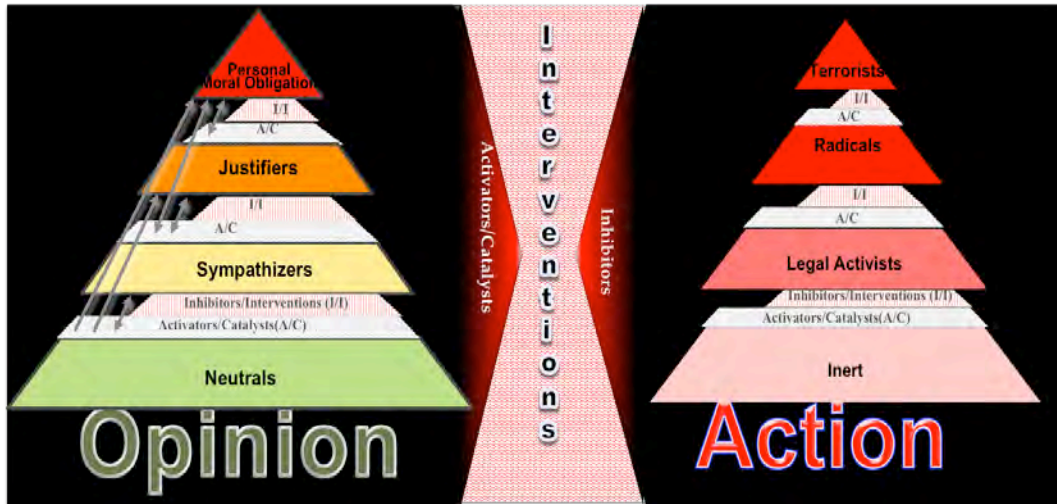
Figure 4: SMA/McCauley "Two-Pyramids" Framework

Shaping Factors

Radicalization and mobilization occur in an existing political, social, and economic context within which the activators, catalysts, inhibitors, and interventions operate. Critical shaping factors operate at different levels of analysis. At the level of communities and societal groups, critical shaping factors include the cultural worldview, which entails master narratives, cultural levels of interdependence (individualistic v. collectivistic[41]), ideology, and the values and beliefs that pervade the cultural and social milieu. Within these extended groups are social networks—the people and patterns of relationships that define a person's immediate and extended social connections and interact with the person's beliefs, attitudes, and behaviors. At the individual level, factors include the demographic characteristics of individuals, like gender, race, ethnicity, and language. Similarly, an individual's genomic ecosystem as well as the environment's interaction with his underlying genetic code (epigenetics) impacts the structure and orientation of various biological structures, namely the brain, that influence how an individual perceives and processes information from the outside world. Genomics, as well as related environmental interventions, impact an individual's risk of psychopathology and can alter the way the brain responds to particular stimuli. Finally, although this discussion is by no means exhaustive, technology, including the level of access and the types available, as well as an individual's exposure and comfort level with the available technology, all affect the potential impact of activators, catalysts, and inhibitors.

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[41] According to research by Hazel Rose Markus and Shinobu Kitayama (1991) on the concept of culture and self various cultures "have different construals of the self, of others, and of the interdependence of the two concepts. These construals can influence, and in many cases determine, the very nature of individual experience, including cognition, emotion, and motivation" (p. 224).

Transition Factors

Socialization into a radicalized culture is an ongoing process at the individual level, with various transition factors exerting more influence than others depending upon the context, individual, and associated social groups. While there are some individuals that radicalize, or act in a radical manner, in a matter of hours, days, or weeks, the vast majority come to it slowly after repeated perceived slights and exposure to a variety of transition factors (Horgan, 2008). The SMA/McCauley Two-Pyramid framework is constructed to emphasize the fact that the radicalization process is not linear, and time is not a critical element (e.g., someone can become radicalized or act in a radical manner in minutes or over a lifetime). In the context of the SMA/McCauley framework, the basic factors listed below are transition factors—factors that either catalyze or inhibit transition in opinion and/or action: *Sacred Values, Belongingness/Power of Love, Social Isolation, Grievance, Emotions, Anomie/Uncertainty, Reward/Pleasure Seeking, Personal Tragedy or Trauma, Narratives and Memes, Social Movements, & Financial Incentives.*

Implications of CBCT for Shaping and Transition Factors

Every form of communication technology has features and limitations that shape how people adapt to their chosen medium. Basic cell phones support synchronous two-way voice communication while smart phones may also support video calls that enrich the quality of interactions—provided the necessary computing power, user know-how, and bandwidth are available. Short Message Service technology (SMS, or "texting") supports rapid, asynchronous communication (such that there may notable latency between sending a message and receiving a response) via existing cellular networks and limits the interaction to short snippets of text. Computers with Internet access offer a dizzying array of options via locally- and web-hosted software and services that provide one-to-one or one-to-many communication capabilities that can be synchronous and real-time or asynchronous with considerable latency. These include email, Internet messaging (IM), Internet protocol (IP) telephony that may carry text, voice, and video (e.g., the Skype service), social networking services such as Facebook and Twitter, and browser-based environments such as chat rooms and discussion forums. Technologically, all of these services provide seamless global communications.

It can be argued that the impact of these communication technologies inevitably grows as their availability expands worldwide. Moreover, all such technologies benefit from network effects: while a telephone has virtually no value if only a single person has one—there would be nobody for that person to call—every additional telephone user increases the value of telephony for everyone. In some instances, the growth of CBCT goes hand-in-hand with reductions in cost, both to users and to the institutions providing the infrastructure. With this growth comes ubiquity and change, as can be seen in longitudinal data compiled by the World Bank (2012). For example, in 2000, the number of fixed telephone subscriptions worldwide was 16 per 100 people while the number of mobile-cellular telephone subscriptions worldwide was just 12.1 per 100 people. By 2010, driven in part by the lower costs of building cellular networks and the consequent availability and lower cost of service, worldwide mobile-cellular telephone subscriptions grew to 78.2 per 100 people while worldwide fixed telephone subscriptions crept up to only 17.2 per 100 people (down from a high of 19.4 per 100 people in 2005).

Not all CBCT variants have achieved a market penetration as high as mobile-cellular telephony. Although Internet usage has also grown in the last decade, the growth has been more moderate: from 6.7 users per 100 people worldwide in 2000 to 30.2 users per 100 people worldwide in 2010 (World Bank, 2012). To put that level into context, note that there were 74.2 Internet users per 100 people in the United States in 2010, and that across Scandinavia in 2010, there were 89.8 Internet users per 100 people. For much of the world, Internet usage remains somewhat of a luxury. In the Middle East and North Africa in 2010, while there were 86.1 mobile-cellular subscriptions per 100 people, just 30.4 percent of households had a computer at home and only 22.7 percent of households had Internet access at home. Although access to CBCT continues to expand and evolve, understanding the impact of CBCT on people in different regions of the world will require understanding which technologies are most prevalent and how they are being put to use.

Shaping Factors

Collective Level Shaping Factors: Culture, Narratives, Interdependence, and Social Networks

Advances in CBCT may affect various shaping factors, such as social networks, interdependence, and culture, by increasing the size of people's social networks, diversifying the composition of people's networks, and increasing the scope and rate of information flow to which people are exposed. Technologies and services such as Facebook and Twitter allow people to connect with others who may be far removed from their immediate strong social circles, thus becoming "networked individuals." CBCT allows for diverse social interactions and "looser, more fluid, but still meaningful social networks" (Wang K. , 2010). Expanding upon social science research, neuroscientists have found that larger physical and online social network sizes are correlated with increases in grey matter density in brain regions that have been previously implicated in social perception and associative memory (Kanai, Bahrami, Roylance, & Rees, 2012). More research is necessary to understand the full implications of this finding; however, it is indicated by current research that there are implications for transition factors such as social isolation and belongingness/power of love.

If such ties were enabled by technology, they would provide access to information that might not be available in a person's immediate physical network (Granovetter M. S., 1973). This novel information could include memes and other conveyors of culture that in turn may shape an individual's perceptions. However, it is important not to place too much emphasis on the idea that CBCT-enabled social networks will greatly expand people's connections with the world outside their immediate circles. Research indicates that, at present, the primary use of CBCT, including email, text messages, and instant messaging, continues to be the maintenance of existing relationships that span the cyber and offline domains (Valkenburg & Peter, 2007; Kanai, Bahrami, Roylance, & Rees, 2012). In fact, variability in the size of people's online social networks is correlated with variability in the size of their offline social networks, suggesting that most people use online social network services to support, maintain, reinforce, or otherwise strengthen existing or pre-existing offline relationships (Kanai, Bahrami, Roylance, & Rees, 2012). Moreover, social networking services are not the only CBCT media that expand people's access to information. Global news networks, YouTube, and Google, for example, can also shrink the distances between

people and events that take place around the world and increase the ways in which information is shared. Overall, CBCT enables individuals to maintain and strengthen their existing relationships while providing an opportunity for expanding networks and increasing access to information from outside their immediate physical networks, depending upon how individuals choose to use the technology. Finally, research on potential changes in the way we neurally process information with use of technology, exposure to either conflicting or supporting narratives, and persuasive memes through CBCT would add value to our understanding of CBCT on processing of important aspects of culture.

Individual Level Shaping Factors

Shaping factors that affect individuals internally, such as genomics, information processing capability, and familiarity with CBCT also impact the environment within which the transition factors operate. These factors are unique to the individual and may serve as differentiating elements for individuals exposed to the same collective, or group-level, shaping factors. While researchers have explored these fields for decades, applying to the findings to the study of radicalization and mobilization is relatively nascent and, as such, the discussion that follows should be treated as research insights highlighting the need for further research.

Genomics and Epigenetics

Genes underlie all neuronal and brain structures, thus influencing all emotion, thought, and action.[42] They code for all the machinery that allows neural transmission and, thus, cognition to occur. Scientists are just beginning to map genes to particular areas of the brain and are attempting to learn which complements of different genes may contribute to aspects of brain function (see Harmon-Jones & Winkielman, 2007). The implications of CBCT are yet to be explored; however, an initial understanding that there may be genomic differences underlying the way in which various cultures understand concepts, such as democracy, should be explored further as the field matures as this is an important consideration for understanding the impact of various transition factors.

Information Processing

Understanding the mechanisms by, and through which, people understand visual (words and images) and auditory (speech and sounds) information is critical to understanding how attitudes and opinions are formed and, as such, to understanding the ways in which individuals are malleable and vulnerable to suggestion. In recent studies designed to understand the impact of website design on information processing, researchers found that motivation (opinion-based versus emotion-based) to receive specific information and the style of the website, for example serious versus amusing, affected which route individuals utilized to process the information (SanJose´-Cabezudo, Gutie, & Gutie´rrez-Cilla´n, 2009). This finding implies that the motivation of an

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[42] Genes are sections of DNA that provide the master blueprint for every protein made in the human body. Each cell of the human body contains an identical set of genes inherited from one's parents; each cell only expresses those proteins that are necessary to help it perform its specific function.

individual using CBCT may impact the cognitive process engaged in, thus influencing the persuasiveness of an argument and subsequent opinion formation by the user.

Researchers studying executive function[43] have shown that individuals process information differently depending upon their ability to engage in executive function tasks (Ybarra & Winkielman, 2012). The factors affecting an individual's ability to process information, such as emotional state, level of stimulation, and mental well-being, "underl[ie] the[ir] ability to manipulate and maintain tasks, plans, and goals in an active state while monitoring performance and inhibiting distracting stimuli, whether from the environment or internally" (Ybarra & Winkielman, 2012, p. 3). Moreover, in an effort to increase efficacy, humans have integrated CBCT into executive function tasks. The implications of this are not yet fully understood; however, utilizing technology to enhance our working memory capacity may result in a de facto trust in the technology to provide individuals with accurate and relevant information. By placing de facto trust in technology, individuals may begin to process information received via CBCT heuristically, thus becoming more susceptible to low-effort persuasion, including targeted efforts to radicalize and mobilize, as well as the individual reactions by virtually-connected others to stimuli that gain traction in a community of interest. Over time, individuals may find themselves shifting attitudes or responding emotionally to a call to mobilize without fully understanding the motivations.

Exposure to and Comfort with CBCT

As CBCT has become more common, the question of differences between CBCT and face-to-face interactions has continued to spark debates among social researchers, with some arguing that CBCT is distant and impersonal while others find that differences between CBCT and face-to-face communications are small and fade over time (Derks, Fischer, & Bos, 2008). The extent to which CBCT affects the radicalization process will depend on the kinds of technologies that exist, the accessibility of those technologies to people of various demographics, and the comfort level people have with the technologies, including the degree to which a person has adapted to a tool's affordances and constraints.

Recent research has demonstrated that individuals who have grown up exposed to CBCT (web-savvy or "digital natives") demonstrate different areas of brain activation, information processing patterns, and comfort with using CBCT than individuals who are considered "digital immigrants" (Small, Moody, Siddarth, & Bookheimer, 2009; Frank, Marci, & Martin, 2012). Additionally, emerging neuroscience research demonstrates that in order to engage and capture the natives' attention, information must be presented in "bite size," relevant, and emotionally charged chunks (Frank, Marci, & Martin, A [biometric] day in the life, 2012). Natives tend to demonstrate shorter attention spans, higher trust in the technology and information generated by the technology, and often use technology to regulate their emotional states. A study conducted by Time Inc. and Innerscope Research found intriguing insights about technology use by digital natives, natives more

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[43] Including working memory, executive attention, or cognitive control and inhibition.

frequently use media to regulate their mood; for example, as soon as they grow tired or bored they turn their attention to something new. Arguably, the most striking difference between digital immigrants and digital natives is ability to process non-liner information. Digital immigrants are linear thinkers; they prefer stories to have a beginning, middle, and end, in that order. While digital natives still need a beginning, middle, and end to their stories, it does not matter what order they receive that information. Due to the near constant switching of platforms, natives can pick up different pieces of the story, from different platforms. "This study strongly suggests a transformation in the time spent, patterns of visual attention and emotional consequences of modern media consumption that is rewiring the brains of a generation of Americans like never before" (Lehamn, 2012). The long-term implications of this are still unknown. While further work must to be done to establish the effects on short-term and long-term memory, it is reasonable to suspect that web-savvy natives fold CBCT into short-term memory processes. Trust in technology, and information generated by it, could lead to misplaced trust online and the potential for highly malleable digital natives.

There are also gender differences in trust, both offline and online. Interestingly, women trust less than men and several surveys found evidence that women are less likely to believe that a majority of people can be trusted (Alesina & La Ferrar, 2002) (Glaeser, Scheinkman, & Soutter, 2000) (Terrell & Barett, 1979). In a study of online trust and brain behavior, fMRI scans found that the men and women encode trustworthiness in different brain areas (Riedl, Hubert, & Kenning, 2010). Notably, women activate more regions of the brain and confirms the "empathizing-systemizing theory, which predicts gender differences in neural information processing modes" (Riedl, Hubert, & Kenning, 2010). Moreover, differences in online behavior of men and women have been found. For example, although perceptions of e-mail differ between the genders, the actual use of e-mail does not (Gefen & Straub, 1997), and that in virtual communities, men communicate to establish superior social standing, while women communicate with an undertone of rapport, compassion, and empathy (Gefen & Ridings, 2005). These differences affect the respective perceptions of community quality for men and women (Riedl, Hubert, & Kenning, 2010). Finally, gender differences may affect the ease with which individuals become radicalized through CBCT. Trust in sources is essential to conforming to the worldview and values offered by online communities. If an individual is skeptical of these, their radicalization will be more difficult.

Transition Factors

Transition factors are those elements that function as activators, catalysts, and inhibitors that motivate or stymie movement among and between the opinion and action pyramids comprising the SMA/McCauley Two-Pyramids model. Transition factors do not operate in isolation, but rather are expected to interact with each other and with the shaping factors described above.

Sacred Values

Violations of sacred values, including attacks on cultural norms and values are critical activators or catalysts and sometimes even inhibitors of radicalization (Berns, et al., 2012; Borum, 2011a). By definition, sacred values are those values for which individuals will resist trade-offs with other values, particularly monetary or material incentives. Consequently, perceived violations to these

values are especially provocative. Recent examples of sacred value violations include the inadvertent burning of Korans in Afghanistan, the Netherlands Mohammed cartoon, the Mohammed movie, and the burning of Korans by a Florida minister. All of these events produced significant protest throughout the Muslim world. The almost-immediate global awareness of these events, and the subsequent global outrage, was quickly spread via social media, including Facebook and SMS texting, illustrating the significant role the Internet plays in the dissemination of information and potentially facilitating the catalyzing to violence. Sacred values may also act as inhibitors in that opposition to violence against civilians is often at the core of many religious traditions. In addition, respect and acknowledgment of shared values may serve as a powerful inhibitor by shifting the focus to common interests rather than differences.

Recent neurobiological research (Berns, et al., 2012) indicates that when individuals process statements regarding sacred values, which can be either heuristic (i.e., superficially) or systematic (i.e., elaborative thinking) depending on the context, they use neural systems generally associated with evaluating rights and wrongs (temporal-parietal junction, TPJ) and semantic rule retrieval (ventrolateral pre frontal cortex, VLPFC) but not with systems associated with utility estimations (determining costs and benefits). The involvement of the TPJ is consistent with the notion that moral sentiments exist as context independent knowledge in the temporal cortex. These findings are important because "when individuals hold some values to be sacred, they fail to make trade-offs, rendering positive or negative incentives ineffective at best" (Berns, et al., 2012). Thus, some of our best intervention strategies may be to inhibit the violation of sacred values. As Hatemi, McDermott, and Stenner note, "forcing one set of cultural values on populations who espouse a different set will be perceived as a direct psychological attack by the recipients of such persuasive attempts" (2011). Thus, there are major risks to deploying sacred values inappropriately, getting them wrong, or trying to provide viable alternatives.

Social Bonds (Belongingness and Social Isolation)

Advances in neuroscience and neurobiology have allowed researchers to explore the biological underpinnings and factors at play during the formation, dissolution, and aspiration of social bonds. For individuals seeking a sense of belongingness, CBCT opens up new ways for people to build connections both with existing friends and new acquaintances. Early studies of Internet newsgroup participants found that personal relationships between people who met online were "common" with more than half of those who reported forming online friendships characterizing them as "deep" and moderately interdependent, and roughly a third reporting that they established contact with their online acquaintances via telephone or face-to-face communication (Parks & Floyd, 1996). Although this research did not focus on communications about radicalization, it is important to consider the possibility that initial online encounters may be relatively benign, with radical ideas introduced during the ensuing offline encounters. Still, research on Western subjects provides evidence that people are cautious when entering online relationships, taking care to protect their anonymity by being truthful in general while withholding their names, and progressing from online communication to telephone communication before meeting face-to-face (McCown, Fischer, Page, & Homant, 2001). This caution may be related to the challenges inherent in building online trust, when individuals are engaging in central root processing of information, because the lack of

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personal contact and the relative anonymity provided by CBCT results in an information asymmetry in which one is initially unsure about the identity of and the quality of information provided by a new online acquaintance (Ba, 2001). Thus, while CBCT-mediated communications clearly provide opportunities for people to meet, it also raises the bar with respect to establishing trust and may therefore impede the formation of a sense of belongingness.

One area of research that deserves mention is online seduction. Although this research was rooted in romantic seduction, all relationship formation is a negotiated interaction between two parties; that is, relationships begin as a strategic communication process. Mantovani (2001a; 2001b) developed a conceptual model of online seduction that considers the objective-seeking behaviors of the participating individuals in light of the particular characteristics and affordances offered by the CBCT media that are in use. Seduction is defined as "a strategic and intentional behavior, primarily induced by the attraction ... to another person" such that the "main goal is the engagement and its outcome is the reduction of interpersonal distance in view of a relation of intimacy" (Mantovani, 2001b, p. 148). There is reason to believe that the Internet, as a setting for this process, may be particularly amenable to the shy and to people with extremist views who are seeking out similar others (Counter Terrorism Implementation Task Force (CITTF), 2011). Anonymity allows a person to "test the waters" without being immediately at risk, while the asynchronous nature of many CBCT media allows a slow and cautious reciprocal exchange of information that might not have a chance to evolve in face-to-face interactions. Whether an individual is seeking to recruit a new member to a radical group, or a person is trying to approach a group with the goal of joining, Mantovani's model of online seduction may offer insight into the strategic steps people take to bridge the social gap and build a relationship with others who initially appear to be a good match.

Social Isolation
A desire to achieve belongingness or to feel as though one is part of something larger is often a hallmark of feelings of social isolation. An individual's failure to integrate into a community or society (for example, as a first- or second-generation immigrant or a student studying abroad) can catalyze radicalization. The failure to integrate into a broader social milieu and perceptions of alienation can drive individuals closer to other, more minatory groups with which they can identify. Wilner and Dubouloz (2010) note that as "'alienation is replaced by identification with the group, powerlessness is replaced by potency derived from being involved in group operations, while humiliation is mitigated by participation in actions." Individuals who feel disconnected or unable to integrate into their immediate offline communities may turn to an online environment to find a place to fit in (Ko, Yen, Liu, Huang, & Yen, 2009). The main objectives of terrorist messages are to build a sense of community, instill a sense of responsibility to defend it, and promote that it is under attack from a specific enemy (Counter Terrorism ImplementationTask Force (CITTF), 2011; Attrill, 2012). Recent work on lone wolves theorizes that the Internet can provide "virtual wolf packs" (Goldsmith & Siegel, 2012), providing previously assumed lone wolves a virtual community.

Whereas the communications aspect of CBCT spans a wide range of human relations and interactions, the connecting aspect, as reviewed here, focuses more on the role CBCT plays in making an initial connection with another person or a group and potentially developing that

connection into something that is personally meaningful. Hence, CBCT as a platform for connecting may have substantial implications for several transition factors. As a medium for building new social connections, CBCT provides a way for individuals to mitigate perceptions of social isolation and establish a sense of belongingness. CBCT also presents opportunities to reduce uncertainty, regulate mood, air grievances, and deal with the consequences of a personal tragedy or trauma through interactions with others who are experiencing similar challenges. Although the evidence is mixed, such online relationships may prove to be deep and meaningful enough to satisfy people's needs. A potential consequence of utilizing CBCT for communication is the potential for individuals to become accustomed to positive and immediate reinforcement of their opinions providing instant gratification and triggering the neural reward process. The areas that are activated during this process are the same areas activated with reward and addiction (e.g., orbitofrontal cortex) resulting in a desire to continue to achieve the "high" attained through instant gratification and continuation with the rewarding behavior (Hoeft, Watson, & Kesler, 2008).

Grievance

While the Internet and other CBCT provide users with near limitless access to information, one of the most profound features is that they also reduce costs and other barriers so that virtually anyone with access to CBCT can publish, produce, or broadcast their own ideas or content, including their grievances. Personal home pages, blogs, and microblogging services (such as Tumblr and Twitter) are all low-cost ways in which people can share their ideas with a community of followers without requiring the infrastructure of a major media outlet. Moreover, Web technology development in the past decade has created a widespread norm in which information consumers are given a voice alongside producers' original content. Several features of CBCT, including ubiquity, anonymity, and asynchronicity (which allows people extra time to craft their thoughts and responses and also relieves them of the threat of immediate repercussions), all contribute to an environment in which people can freely express their thoughts and air their grievances.

Several implications may follow from people using CBCT as a medium for airing grievances. First, people who use CBCT to air their grievances may actively seek—or be found by—others who share a common perspective. A dialog may arise through responses to an author's original post or between like-minded commenters who visit the same web site. If grievances are posted to a chat room or discussion forum, a person may encounter a group of people who are sympathetic to the grievance. Interactions such as these may provide needed social support and psychological buffers (Lewandowski, Rosenberg, Parks, & Siegel, 2011) as well as new ideas that could reinforce the grievance, or may instead mitigate the grievance and reduce its power to activate a radical shift. The discovery of a shared grievance may serve as a trigger for a process of online seduction (Mantovani, 2001a; 2001b) in which one party seeks to establish a relationship with another who has expressed a shared grievance. The seduction process may be part of recruitment for existing terrorist or extremist organizations that identify vulnerable targets based on their expressed grievances. Online communities that harbor people who share a common grievance can produce a shift to more extreme perspectives while creating a false consensus (McCauley C. , 1972; Wojcieszak, 2011). In other words, participation in the online CBCT-mediated group may increase the possibility that the original grievance will be a factor in transitioning to a more extreme opinion

or behavior state. This may happen despite that fact that individuals simultaneously reside in the online community and in an offline community that may include close ties with people who do not share the extreme perspective (Wojcieszak, 2009; 2011).

Emotion

According to Taylor and Horgan (2007), the critical contributors to terrorism are the "psychological and emotional context of the individual on which the bigger and essentially non-psychological forces of opportunity and context operate." Thus, emotions, while possibly being a trigger from one position of the pyramid to another, may also be an inhibitor. According to some literature, if individuals are in a positive mood, they are more likely to engage in heuristic or peripheral processing of information (Beer, 2007). This can result in quicker actions, underestimation of risk, and an overemphasis on positive explanations to explain decisions or judgments (Beer, 2007). On the contrary, when individuals are in a bad mood, they are more likely to engage in more effortful processing of information, react slowly, overemphasize risk, and focus on negatives when attempting to explain their decision or judgment (Beer, 2007). Additionally, research indicates that emotion, especially emotions shared by individuals with regard to their own group or other groups, helps regulate social behavior and, in some instances, prevents social chaos (Matsumoto, Yoo, Alexandre, Altarriba, Anguas-Wong, & et., 2008).

An early and widely cited study found an unexpected phenomenon among new Internet users. Specifically, the "Internet Paradox" study found that increased use of the Internet for communication was associated with lower levels of communication between family members in a household, a reduction in the size of people's social circles, and increases in people's sense of loneliness and depression (Kraut, Patterson, Lundmark, Kiesler, Mukopadhyay, & Scherlis, 1998). A follow-up study reexamined a subset of participants after three years and found that the originally observed negative effects had dissipated (Kraut, Kiesler, Boneva, Cummings, Helgeson, & Crawford, 2001). The second study also examined a second sample and found differential effects of Internet usage with positive effects on communication, social involvement, and psychological well-being for people with more social support, but worse outcomes for people with less support. Both studies, and others that followed from the original Internet Paradox Study, demonstrate the linkages between Internet usage and people's emotional states. Other studies have linked increased Internet usage with decreased psychological well-being (Huang, 2010; Schiffrin, Edelman, Falkenstern, & Stewart, 2010). Moreover, while computer-mediated communication has been found to have an effect on people's emotions, the effect is not the same as face-to-face communication. Specifically, in one study, whereas high degree face-to-face friendship networks—those in which individuals had a relatively high number of close, offline friends—were associated with low levels of both social and emotional loneliness, high levels of Internet use were associated with low levels of emotional loneliness and high levels of emotional loneliness (Moody, 2001). Similarly, online support groups are apparently not as effective as face-to-face support in helping people deal with disruptive life events (Lewandowski, Rosenberg, Parks, & Siegel, 2011).

According to research conducted by advertisers, email messages (and presumably other online media) are more likely to be forwarded if the "messages spark strong emotional feelings—humor,

fear, sadness, or inspiration" (Eckler & Bolls, 2011). Indeed, even infrequent email senders are more likely to pass along emotional appeals or messages than more neutral messages—potentially inspiring a contagion effect based upon the emotions of one individual or a group of individuals. While in advertising, it is positive (awe-inspiring) messages that more readily become viral, the dissemination of an individual's heightened emotional arousal (e.g., anxiety, fear) among a disaffected or primed population might instigate greater emotionality among receivers of those messages (Berger & Milkman, forthcoming). Therefore, emotional appeals by radical groups or movements might prove more compelling to vulnerable populations. Finally, even offline emotionally engaging material creates online buzz. An Innerscope study found that advertisements that emotionally engage consumers are likely to create online buzz and influence an individual's online social network (Siefert, Kothuri, Jacobs, Levine, Plummer, & Marci).

Anomie/Uncertainty

Anomie[44] and the desire to seek an end to uncertainty can act as an activator/catalyst of radicalization. The power of anomie to instigate radicalization and mobilization may be mitigated, or inhibited, through exposure to new social groups that may reduce uncertainty and provide alternative group norms. Moreover, the Internet may guide a person to an online community, group, or forum where information is shared by other users providing access to different cultural norms and groups that can either increase or diminish feelings of connectedness with group norms. To the extent that the people who frequent a given online community do so because they feel a connection and kinship with others, such communities can amplify the "echo chamber" effect created by search technology. Although one would expect information filtering to occur in any media, the key implication of CBCT for the transition factors of anomie, uncertainty, and personal tragedy is that many technologies that are used for information seeking and information exchange, by their very design, may drive people toward a self-fulfilled foregone conclusion (Walther & D'Addario, 2001) while creating the impression that there is widespread agreement or few alternatives.

Reward/Pleasure Seeking

To ensure survival of the species, humans are innately designed to engage in behaviors that end with reward (reward-seeking) and avoid behaviors that can result in loss (loss-avoidance). When individuals perceive a potential reward (e.g., food, money, social reward) the brain begins to set the reward-seeking system into action (Knutson & Wimmer, 2007). Numerous studies demonstrate that when predominantly dopamine - the 'pleasure' chemical - centers of the brain are stimulated (in a controlled lab setting with electrical stimulation), subjects reported intense feelings of well-being (Aharon, Etcoff, Ariely, Chabris, O'Connor, & Breiter, 2001; Olds & Milner, 1954). The desire to engage in experiences that result in the release of dopamine can, in some cases, result in individuals engaging in dangerous behaviors at the expense of the individual's' overall well-being

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[44] Anomie is described as the lack of social norms and describes the subsequent fragmentation of social identity and social norms after the breakdown of the social bonds between individuals and their community.

(e.g., addictive behaviors or engagement in extreme activities that warrant praise or attention from others). The desire for release can serve as a potential transition factor for some individuals as they seek behaviors or actions that have the potential to result in reward, in some cases acting as a catalyst, in other cases—when the release of dopamine is inhibited—acting as an inhibitor. Furthermore, studies suggest that "Internet addiction…has a unique impact on aggressive behavior" and that heavy Internet use has influence on real-world aggressive behavior among adolescents" (Ko, Yen, Liu, Huang, & Yen, 2009).

Some individuals may find physiologically rewarding behavior through engaging with CBCT to such an extent that they exhibit neural activation similar to that of addicts. Studies suggest that Internet addicts "have enhanced reward sensitivity and decreased loss sensitivity" than non-addicts (Dong, Huand, & Du, 2011). Web developers, including game, gambling, and websites in general, attempt to satisfy individual's need for achievement while increasing the individual's desire for small victories, over and over again during play. This may lead to online behavior continually rewarded by "feelings of being in control, they synchronous interactive quality, the immediate achievement, and the freedom of self-representation" (Leung, 2004). Further study has shown that individuals who are engaged in reward seeking behaviors have lower impulse control ability, enhanced reward sensitivity, and more likely to show high preferences for present reward with neglect for long-term adverse consequences (Dong, Huand, & Du, 2011; Becker & Murphy, 1988). This reward seeking behavior may be as simple as updating a Facebook status. If the user receives positive feedback (i.e., the reward), it incentivizes the user to repeat this behavior. This could be of concern if the individual begins to post extremist opinions and receives rewarding affirmations thus embarking upon a feedback loop, driving them to repeat the behavior with the potential for escalation of opinion.

Personal Tragedy or Trauma

Tragic and traumatic events may serve as "disorienting dilemmas" (Wilner & Dubouloz, 2010) that compel an individual to seek ways to resolve or rectify newly perceived inconsistencies between the way one thought the world operated and the experiences that violated that expectation. A critical element for recovering from a personal tragedy or traumatic event is an individual's ability to cope with or manage stress. Researchers from the fields of neuroscience and neurobiology suggest that while there are environmental factors at play in stress response, there are various biological factors that foster a predisposition for some individuals to respond stronger or take more time to recover from stressful events (Kudielka, Hellhammer, & Kirschbaum, 2007). For example, numerous studies have demonstrated that men have a more pronounced response to stressful stimuli (Kudielka, Hellhammer, & Kirschbaum, 2007; Kirschbaum, Wust, & Hellhammer, 54). Recent findings demonstrate that digital natives utilize CBCT to regulate their emotion by using CBCT as a way to share, vent, or sufficiently process the tragedy without turning to extreme anger. However, instant communication and instant awareness means that some may instantaneously respond with anger, not thinking of consequences (Lehamn, 2012; Frank, Marci, & Martin, A [biometric] day in the life, 2012). Furthermore, research demonstrates that CBCT provides a platform for enhanced empathy in already more empathetic people, which may be a sufficient transition factor for some.

Narratives and Memes

Following Corman and colleagues (see, for example, Corman, 2011; Halverson et al., 2011), a narrative is "a system of stories that share themes, forms, and archetypes" such that narratives have the ability to organize and structure how people make sense of the ideas, events, and people they encounter by providing a way in which to "communicate attitudes, values, beliefs and opinions across generations" (Motsumoto & Juang, 2007, p. 6). While the stories that make up a narrative need not have exactly the same features, together they elaborate the overarching meaning of the narrative. Master narratives are a specific class of important narratives that are "deeply engrained" in the minds of people who share a common culture and can be invoked by making reference to simple words and phrases rather than by retelling a full story that is a component of the narrative. Master narratives form the basis for local narratives that provide structure and meaning to the people and events of a particular time and place and personal narratives through which people "project themselves as characters in local narratives" (Corman, p. 37). The collection of narratives that exist within a culture creates a rhetorical vision, which "contains a stock of values, morals, story forms, archetypical actors that can be used in narrative action" (Corman, p. 38).

As with the sacred values transition factor a key consideration regarding narratives and memes as a transition factor is not simply that they exist or are known to a person, but rather that there may be incidences or deliberate efforts that affect how a person frames and understands a narrative or meme such that the new perspective motivates a change in the person's opinion or action state. Halverson, Goodall, and Corman (2011) described this in terms of a reinterpretation of a master narrative. When considering the implications of CBCT for the narratives and memes transition factor, key issues include how CBCT can be used to communicate alternative interpretations of the narrative, to propagate information or materials that support an alternative interpretation, and to create and reinforce a meme that conveys a particular unit of cultural knowledge that strengthens one interpretation over another.

Social Movements

Social movements are defined by Zald and McCarthy, as cited in Borum, (2011a), as "a set of opinions and beliefs in a population, which represents preferences for changing some elements of the social structure and/or reward distribution of a society." The critical aspect of this emphasis is that social movements are viewed as occurring at the collective level. There are two perspectives in the literature with regard to social movements. As Borum (2011a) describes, social movements may operate as rational, somewhat coordinated, phenomena. Social movements persist because "adherents/members collect and maintain a body of supporters."

An alternative perspective takes a complex systems perspective and views social movements as emergent phenomena. Emergent social movements do not function under the direction of any central coordinator, but rather arise as a consequence of the individual, local decisions that people make in response to their own needs, wants, and opportunities. Individuals get caught up in the movement, but it is the independent, synchronous action of multiple individuals that leads to an emergent group phenomenon that may eventually become self-reinforcing. Regardless of approach or perspective, social movements can empower protest and radicalization. The Internet provides

opportunities for self-publication of ideas and content, which enables many voices and wide (global) distribution such that members of a movement can find, and be found by, new members. The relayed messages communicated over the Internet can, in a short period of time, affect many individuals who independently experience emotional reactions or cognitive shifts that drive behavioral changes such that a movement emerges without any central coordination. The extent of this dissident cyber activity through Facebook, Twitter, blogs, and YouTube is not known; however, "there is a sense of agreement that social media had a significant effect on the effectiveness and speed of regime overthrow" (Goldsmith & Siegel, 2012, p. 7). These various platforms were used to disseminate information, inspire activists, and coordinate between different groups.

Financial Incentive

A powerful catalyst for mobilization to violence can include financial incentives, particularly in situations of chronic unemployment or economic hardship. Financial incentives can activate the reward system and can relate to reward and pleasure seeking behavior or can be perceived as a simple method of survival for individuals and their families (Africa Center for Strategic Studies, 2012). In fact, monetary loss is "associated with decreased activation in the anterior cingulate cortex (ACC)." The ACC is strongly implicated in adverse processing and is part of "a network suggested to mediate emotional responses to pain" (Vogt and Sikes, 2000). Furthermore, Petrovic et al., found that the activation in ACC was enhanced in line with the increased unpleasantness ratings for losses (2008). Decreased activation in this region may help explain why some individuals indulge in mobilization and fail to worry about the consequences of their actions (Dong, Huand, & Du, 2011). While the draw of money is a potentially strong catalyst, the power of financial incentives can be minimized by demonstrating the cognitive dissonance between opinion states and the activities required for payment as well as the provision of alternative, non-illicit sources of income. Finally, CBCT facilitates ease of financial transactions through the ease of making connections between those looking to earn money and those who want to pay someone. For example, radical group recruiters could obtain online gambling sites' rosters and target those who are deeply in debt, making those individuals vulnerable to extortion.

Conclusion

The Internet and other forms of cyber-based communication technology do not likely contribute to radicalization and mobilization to political extremism in a linear fashion. It is more likely that the various modes of CBCT interact with shaping factors and transition factors to produce psychological and behavioral outcomes (McKenna & Bargh, 2000). It is important to note that only a very small subset of individuals become more radical in their thinking or becoming mobilized due to interactions with CBCT. Additionally, the impact of a given mode of communication on a person is dependent on that individual's motivation for using the medium (Stevens & Neumann, 2009). For some individuals, the Internet provides the opportunity to construct new identities, test out new personalities, and experiment with modes of self-presentation and representation to others. Since an Internet user develops contacts with a new peer group that may lack any ties to their offline social groups, the user can "successfully implement wished for changes in their self-concept…increas[ing] feelings of self-worth and acceptance" (McKenna & Bargh, 2000, p. 62). In this regard, the Internet can be an escape from an inhospitable offline world—for example, a gay young

man in a rural, conservative area might reach out to other gay young men on the Internet and develop a sense of community online that he does not have offline. Not only can people garner positive reinforcement for things that they may be stigmatized offline for, but a radical's negative social beliefs can be reinforced by the positive feedback and encouragement of other like-minded individuals. This feeling of social support for atypical and radical beliefs is only further encouraged by a reasoning fallacy sometimes called the "illusion of large numbers" (McKenna & Bargh, 2000, p. 64). Since the Internet facilitates the development of social groups organized around fairly rare shared interests or ideologies in ways that would not typically be possible offline, radicals (and others) on the Internet may believe that the few thousand members of their website represent the tip of the iceberg of support, when in fact they represent a ceiling on total support for the movement or ideology.

While advances in CBCT may impact the ways in which individuals receive and process information and connect with others, "the Internet does not....have by itself the power or ability to control people, to turn them into addicted zombies, or make them dispositionally sad or lonely (or, for that matter, happy or popular), and neither does the telephone, or television, or movies" (McKenna & Bargh, 2000). Rather, the Internet provides ready and fast access to information, facilitates the coming together of likeminded individuals, and encourages the development of the "self," a concept that can change daily from the observer's perspective. Additionally, the Internet provides increasingly unique and isolated individual information streams, providing an echo-chamber of sorts, with individuals selecting to read—often automatically through applications like Google Reader—information that confirms and is consistent with their existing world view rather than encountering information that is potentially contradictory or disconfirming (Kristof, 2009; Duneier, 2012). This echochamber, the ready access to like-minded individuals that was not possible before the advent of the Internet, along with the illusion of large numbers may increase the extremity of an individual's beliefs, but it does not, generally, incite them directly because the Internet is only one of "several social domains in which an individual can live his or her life, and attempt to fulfill his or her needs and goals, whatever they happen to be" (McKenna & Bargh, 2000, p. 72).

Complexity, Neuroscience, Networks, and Violent Extremism: Foundations for an Operational Approach

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What do conscious thought, the modern information environment, and networks of violent extremists have in common? They are all examples of complex systems at work.

In this overview, I will make the case that a familiarity with complex systems concepts can help us build the improved theoretical frameworks we need to account for the cognitive, informational, and social dynamics that combine to build and sustain violent extremist networks. Armed with these insights, we can then design operational approaches that leverage the dynamics of complex systems to design tailored intervention strategies that attack not just the symptoms of violent extremism, but the driving forces behind it as well.

A Daunting Task

When we consider all of the relevant knowledge required to understand how violent extremist networks are born, grow, and thrive, it would seem that there is too much for any one person to be able to grasp in one lifetime. But we can, and must, break it into the most critical areas of understanding if we are ever to act effectively as strategists. First, we need to understand the neurobiological underpinnings of identity and purpose that convince someone to personally choose to fight, kill, and perhaps even die for their political ideology. Second, we need to understand the processes of socialization by which individuals interact with other individuals, share ideas, and form the group identities, shared narratives, and social processes that undergird violent extremist movements. Third, we must understand how the constantly changing physical and electronic networks of the modern information environment enable and augment personal development and socialization in the first and second areas, creating new ways for groups of like-minded people to meet and organize.

All of these factors combine dynamically in any political movement, and conflict between groups with differing ideologies is as old as human history. In the case of violent extremism, political movements make the act of committing violence itself part of their group identity. Violence becomes a rite of passage, a means to achieving personal honor and status, a signal of intent and resolve, and ultimately a method of increasing political power and influence over other groups.

How can we understand and defeat such groups unless we understand more about the myriad components and processes that contribute to the formation and sustainment of violent groups, ones that are increasingly making us the targets of their violent acts? If we are to design operational approaches to defeating such organizations, and the ideologies that fuel them, how should we conceptualize and model these organizations to help us detect their vulnerabilities and weaknesses? After over a decade of largely unsatisfactory strategic results in combat against violent extremists, despite a vast preponderance of tactical successes, it appears that our current tools and concepts for building holistic understandings of extremist networks are lacking.

What Do You Mean by Complexity?

Whether we are talking about the neurobiological processes that drive extremist violence, the informational networks that spread violent extremist ideology and help extremists organize, or the social processes that combine to turn shared thoughts into action, there is one thing in common to all: they are manifestations of complex systems at work.

What do we mean by complex systems? Complexity scientist Scott E Page describes them like this:

> When we describe something as complex, we mean that it consists of interdependent, diverse entities, and we assume that those entities adapt - that they respond to their local and global environments. Complex systems interest us for several reasons. They are often unpredictable, they can produce large events, and they can withstand substantial trauma. Complex systems produce bottom up emergent phenomena, where what occurs on the macro level differs in kind from what we see in the parts. Emergence takes many forms, including self-organization. Finally, complex systems produce amazing novelty, from sea slugs to laser printers. (Page)

In The Logic of Failure, Dietrich Dörner describes complexity thus:

> Complexity is the label we give to the existence of many interdependent variables in a given system. The more variables and the greater their independence, the greater the system's complexity…The links between the variables oblige us to attend to a great many features simultaneously, and that, concomitantly, makes it impossible for us to undertake only one action in a complex system.

Yaneer Bar Yam of the New England Complex Systems Institute (NECSI) teaches that complexity also describes a relationship between the observer and the observed, a relative measure of our ability to accurately predict the results of the interactions within a defined context. (Bar Yam, conference comments). Like strategy, there is no single definition one can use to understand complexity in all of its nuances, but several descriptions in combination provide a much better sense of what the term complexity represents.

Complicated things, like an intricately designed Swiss watch, can appear to be complex to us until we gain the conceptual tools need to understand how the parts fit together and move. Once we understand the mechanics behind it, and how the parts fit and move together, we can predict with high precision what the clock will do – the rules of form and motion do not change. What really makes a system complex, in a manner that might be quantified and compared to other systems, is how quickly the connections and interaction rules change as the entities in the system adapt to one another. With even a few moving pieces and changing rules, the possible combinations of results

can quickly overtake the computational capacity of any computer we have, or any we are likely to have in the future. Because of this inherent limitation, we must find a way to dealing with complexity that utilizes the most powerful parallel processing and pattern recognition tool in the universe to keep up with the changes. We must use our own minds to model complex systems, supplemented with inputs from formal models for the parts of the problem that can be computed, and use our informed intuition for the rest

While the elements and forces that contribute the most to change in different complex systems are not the same at each level of scale, we can use many of the same complexity concepts to help us understand what is happening, and can use intuitive insights from one complex system to inform our intuition about other kinds. From the detailed workings of individual cells of the human brain, to the social processes of groups and societies in conflict, to the growth of social media, most of the same basic processes of interaction and adaptation are in play. Thus, the basic hypothesis is this: If you understand how adaptive processes work in general, you will be able to detect and gauge the driving forces behind specific cases faster.

How Complexity Concepts Can Help

The common thread behind all of these topics relevant to understanding violent extremism is the idea that complex things like conscious thought, social narratives, societies, and even the World Wide Web all start from relatively simple beginnings, with only a few basic components and rule sets, which then interact to create something much more complex over time, usually with little or no central direction. Complexity scientists describe this scale free property of complex adaptive systems as *emergence*, the creation at the macro level of properties that cannot be predicted or described in terms of the components and microprocesses that combine to create them. A key implication of emergence is that you cannot just impose macro properties from the top down without the supporting microprocesses to sustain them – the driving force of creation are local interactions at the micro level responding to local rule sets, and abrupt changes to these processes are more likely to crash than control the system.

Conversely, when you have a better idea of how emergence works from the simple parts and rules up, and which key variables and processes have the most influence over the emergent phenomena that you want to influence, you can often trace back to the parts of the process that you can leverage with the ways and means available to you. When small things have big effects on a system, the ability to understand and influence those small things can give you access a very big levers of influence, or help you avoid negative unintended ones, especially in systems so big you can never hope to control them through brute force alone. This process of tweaking key variables in the smaller scale process to change outcomes in the macro level has been described in social contexts as "nudging" the system, but the concept applies to other contexts as well, and is also key concept behind the notion of "harnessing" complexity (Thaler and Sunstein, Axelrod and Cohen).

When emergence happens, the combined interactions of the various component agents can form a new agent as seen from a higher level, called a *meta-agent*, which is best described in terms of their group properties, such as a school of fish, a forest, a military formation, or an ocean wave. These meta-agents can combine with other meta-agents to form even higher level meta-agents, with new aggregate properties that are adaptive as well. In this case, the complexity of the interactions of the meta-agents may be very different in nature to the interactions of the parts. For example, the dynamic complexity of the individual fish moving within a school of fish may be much higher than the dynamic complexity of the school itself relative to its surroundings. In this case, it is often most

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useful to treat the meta-agent individually, focusing on the collective properties of the whole rather than the individual properties of the parts. This is perhaps one of the key concepts of complexity theory, providing insights that cannot be as easily discerned by traditional analytic methods of linear inquiry. Even when the specific interactions cannot be accurately described by formal models, having an intuitive awareness of the nature of this process can help us better grasp how growth and change happen in many different kinds of complex adaptive systems.

In all kinds of complex systems, there are properties of the system that drive the adaptation of agents and meta-agents. In some cases, these properties are physical or chemical ones; in others they might be informational. Studies at the Santa Fe Institute, New England Complex Studies Institute, and similar efforts have demonstrated that both living and nonliving systems have a capacity to adapt and evolve. How is it possible that DNA protein strands, slime molds, ants, and crystals all seem to have the capability to organize in complex ways, despite the fact that there is seemingly no central authority directing their actions? The answer is that something is pulling them in the direction of greater order, even if their response to the pull is not a conscious one. These forces which drive change in a complex system, whether they are physical forces or intangible concepts, are described in systems theory as *attractors*.

Attractors can either be physical forces, like gravity, or conceptual ones, like the human norms and values that drive the interactions of self-organizing systems. If these forces can be discerned, interdependence between key variables in the system can be better understood, thus allowing a degree of prediction at the macro even when it might not be possible at the micro level. Additionally, systems theorists posit that some attractors can be controlled or influenced, thereby increasing our ability to apply leverage on the system in the transactional environment. This is especially true of attractors such as norms, ethics, and cultural values, which act as constraining elements of the decision process. (Gharajedaghi 36).

Two related concepts from complexity are *sensitivity to specific conditions* and *path dependence*. When systems become complex, the degree of sensitivity—how much a change in one influences a change in the other—between entities in the system may be constantly in flux, as various entities adapt to each other, changing both the topology and the rulesets that produce the emergent outcomes of the system. But at certain times, and with certain patterns of interaction, changes in entire system may become highly sensitive to the position of one node or attractor. Thus, the degree of effect that one entity has on any other entity is highly dependent on the current interactive state of the system, and their relative position and connections within it. Because of this, outcomes depend heavily on the initial conditions of the system, and the path by which interactions occur. This makes it difficult or impossible to establish causation in complex systems, because it is very difficult to trace the degree of influence of individual variables on the whole when many variables are influencing outcomes simultaneously.

Complexity theory is not incompatible with traditional linear methods of inquiry – often subsets of complex systems are approximately linear (especially in shorter timescales), and traditional linear analysis is often suitable for approximating those elements of the system for the purposes of modeling and prediction. We are still seeking empirical evidence for computationally difficult complex problems, and we still need thorough investigation and documentation to verify complex systems theories. The intuitive sense gained from studying complex systems will help us deal with ambiguity when computation is not possible, and also help us to intuitively seek key process insights in systems that defy simple cause and effect explanations. Even when we cannot break out the key components of the process, there is inherent value in knowing when your analytical tools

cannot match the complexity of the system you are trying to measure or model. You always have to model the world to understand it, but complex systems understandings can help you detect when the available r models and explanations are insufficient for the types of questions you are asking. This helps you avoid falling into the trap of using oversimplified predictions and prescriptions in complex situations, which usually generates more harmful unintended consequences than the intended helpful ones.

Complexity and Neurobiology

The human brain is perhaps the ultimate complex adaptive system in the universe, save the universe itself. As neuroscientist and biologist Stuart Firestein describes it, there are "some 80 billion nerve cells that make up the human brain, and they make about 100 trillion connections with each other. Keeping second- to-second track of each cell and all its connections is a task well beyond even the largest and fastest of supercomputers." (Firestein 71). We have only begun to probe how the brain learns, grows, and stores information, but what we are finding is that even with its immense complexity, at the foundations, the functions of the brain are enabled by many relatively simple chemical, electrical, and physical processes that encode and store information through bottom up network formation—as Steven Johnson has stated, ideas themselves are in fact networks (Johnson). But it is not the shape of the neurons, or the strength of the chemicals, or the degrees of interaction and inhibition that turns the physical structures into something useful. It is their interactive combination, their place within and relation to *neural networks*, that makes the emergent properties of memory and thought happen. As neuroscientist Robert Sapolsky describes it:

> Essentially, the way this all works - or the basic notion - is information is not contained in a single neuron. Information is not contained in a single synapse, potentiated or otherwise. Information is contained in patterns of excitation, in networks of excitation, where the same neurons can overlap in different networks and be used in different settings. (Sapolsky 81)

Thus, it is a dynamic systems process, not static neural geometry or potential gradients, which creates our emergent properties of thought, memory, emotions, etc. The brain itself can serve as a model of emergence, helping us understand how this process might work at even higher levels of social organization with no central director to orchestrate the action.

Another thing we can take away from neuroscience is that neural networks combine to form what we can approximate as countless mental submodels, acting as meta-agents, which compete for our attention in our conscious thought and action. This often makes it difficult to know ourselves why we make some decisions, as the often nagging voice in our own heads tells us when we have to make difficult choices between various options, and then continue to second guess ourselves after we have made a choice (that is, until we have more time to convince ourselves that our choice was the best one). Thomas Schelling described the difficulty of assigning conscious choice to ourselves in his book, *Micromotives and Macrobehavior*, using the example of the various competing motivations that dictate where we're likely to sit in a theater: we balance between several optimization functions in our heads at once, usually subconsciously (i.e., the desire to be close to the stage but not too close, the desire to sit close to some people but not to others, how close to sit the center vs. the aisle or wings, wanting to sit the right distance from the orchestra or speakers for optimum sound, conforming or resisting the peer pressure to sit when others sit down, etc.). Shelling's point is that when the choice is made, we seldom fully realize ourselves how our own conscious decisions were ultimately made. We can often make up a story to explain it afterwards, but we do not necessarily know ourselves what tipped the balance between the tradeoffs. The main

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point is that much of human behavior is like this—our choices are driven by subconscious motivations that we do not often realize, thus models and theories that try to model our choices by linear optimization functions are usually wrong, or only right given certain assumptions that can't match the pace of change and interaction in the real world. We need intuitive theories that are more agile than our computation models to gauge and predict social outcomes, and we will still probably be wrong.

While complex, human cognition is not beyond all prediction as illusionists, con artists, storytellers, motivational speakers, and advertisers have always known. As we are increasingly learning from neuroscience, there are some fairly predictable ways that most people access some mental models at the expense of others, giving us ways to predict and influence trends in conscious experience and decision (Ariely). We call these associated patterns of thought heuristics, and many of them seem to have developed due to the strong evolutionary advantages of socialization, cooperation, and reciprocity, without which no human can survive infancy or early childhood. In fact, complex systems theories can help us understand how heuristics form and adapt – experience gives us a relatively static mental model to predict future behaviors, which is then adapted a little bit at a time in an iterative fashion as new experiences present additional evidence about how the world is constructed. It is this balance of structure and fluidity that gives our minds the incredible powers of subconscious learning and conscious thought that makes it the most powerful computational tool in the known universe. And it is all driven by bottom up emergence.

Neuroscience also gives us a model for how to intervene in complex systems by exploiting knowledge of the simple rules that drive the larger process of mental emergence, in order to nudge the processes of cognition in favorable directions. In the case of the brain, we are increasingly able to localize the drivers of some of the key actions and processes behind cognition at the molecular level, and can design medications that target specific processes to correct maladies and imbalances in the natural processes, while at the same time leveraging the natural processes themselves to assist the transition from illness to wellness. It is this same way of looking at the problem that we need to take to higher levels of scale when we talk about influencing high level thought, or collective thought in groups.

The big themes that drive our social thought should come as no surprise—they fill the plots of our legends, morality tales, religious codes, laws, etc. From a complexity thinker's perspective, they are the *attractors* of social behavior, the mostly unquantifiable social forces that pull our action and thought in certain directions given certain situations. Some heuristics tend to dominate over others largely depending on which heuristics are called up by our physical sensing of the environment, in which order they are evoked, how strongly they have been reinforced in the individual by past experience, and how much weight they have in the tug and pull of the cognitive process that results in both conscious (choice) and subconscious (autonomic/reflex) decisions. Thus, heuristics act like meta-agents, competing for priority in a neurobiological process of competition to influence decision that we still do not fully understand, with much of the interaction occurring below the subsurface of conscious thought. We can never fully predict which heuristics are likely to dominate because individuals' minds are formed differently by a combination of genetic and experiential factors. Neuroscience is helping us to detect, with some empirical basis, that in certain situations, with most people, certain heuristics tend to drive thinking more than others, especially those related to what becomes someone's core identity and source of belongingness and meaning within their social networks. When certain information is received in certain ways, and resonates with things like previously accepted ideas of identity and grand narrative, it "sticks" more easily. If you can find a source of prediction of what causes certain heuristics to be evoked, and relate them to

specific ranges of likely choices, you can devise strategies to take advantage of this insight by proactively trying to manipulate those cognitive processes with your actions and messaging.

Complexity and the Information Environment

Where neuroscience tells something about us how humans think in certain situations, their place in their social networks gives us much the context we need to guess what combinations of motivations are in play in a given situation, and which ones are likely to win the internal competition of heuristics. Socialization has always required communication, but what we see now with the rapid expansion in digital media is that new modes of communication are becoming possible, dramatically increasing the ways that social groups can form, organize, and plan for action in all social endeavors. As we combine insights from neuroscience and social network formation, we are also finding that connectedness in the modern information environment tends to reinforce, not replace, our basic human motivation to connect with others in person (Orlina and Desjardins, 23). It emphasizes the ties we have already made, makes new ties possible, exposes us to new sources of information and contacts on topics we are already interested in, but also tends to canalize our thought and associations as we are often directed by search engines designed to feed us more of what we have already shown a preference for. Instant feedback plays to our sense of identity, and we seek those who validate our sense of identity and place in the world. Highly connected people spread ideas, and make new associations possible. As Clay Shirky puts it, "The centrality of group effort to human life means that anything that changes the way groups form will have profound ramifications on everything from community and government to media and religion (Shirky, 16).

To understand these ramifications, we must know something about the shape and growth of both the social network and the informational network that connects it. As Christakis and Fowler put it in *Connected*, "The social network in which we find ourselves defines our prospects." (Christakis and Fowler, 79). Where people are in the network, and who they are connected to, defines what information and assistance is available to them and which people and ideas will have a larger pull on social system outcomes than the others. This is described in complexity theory concept of path dependence and sensitivity to specific conditions—to know something about any highly connected complex system, you have to understand which nodes in the network have the most influence over changes in the others and what changes can make the relative effect on the system change. If you understand it, you can often manipulate the patterns of connection and contagion between the key nodes and the others in order to push dynamic system adaptation in directions that favor your outcomes.

In the case of the information environment, it is a matter of understanding how the information networks are connected and how they drive traffic, but it is also a matter of knowing which people are highly connected within those networks, which then make information available to others though a combination of push and pull information sharing schemes and tools. A high number of connections does not necessarily equal the most influence – the same social capital considerations that apply to interpersonal contact can influence the degree of impact any player on the network has, despite their reach in terms of number of followers. So again, we have a process that defies accurate tracking or mathematical modeling – the rate of adaptation and the sensitivity in the social forces is more complex than even the best computer models can ever hope to keep up with unless

they aggregate, and when they do, they're likely to miss or conflate significant variables or attractors that often emerge quickly or unpredictably. We need an intuitive sense of what is going on if we ever hope to keep up, and when you are talking about understanding how information and social networks emerge, complexity is the best way to start understanding the process, and maybe get you close to asking the right questions about which details are relevant.

Emergence applies to the growth of both social connections and the information environment, in fact, the emergence of both are inseparably intertwined. "Real, everyday social networks evolve organically from the natural tendency of each person to seek out and make many or few friends, to have large or small families, to work in personable or anonymous places" (Christakis and Fowler, 13). In the case of the communications tools that create the emergent information environment we call the Internet, the attractors that control the bottom up growth and shape of the information network are the hardware, the programming languages, and the operating systems rules of the software that controls data stream transmission and processing. If you know these rules, and you understand processes of emergence, you begin to see all of the various places in the cyber "stack" where intervention is possible, helping you to monitor, influence, or direct some actions in the networks that emerge.

Complexity and Violent Extremism

Where complexity concepts help you understand how ideas themselves form in neuroscience, and the interdependence of social networks and social media in the information environment, it also helps you see how all of these are related when it comes to violent extremist networks. Complexity science applies to the entire cycle of violent extremism—what we have in each layer of interaction is a bottom up building of networks with physical, cognitive, and eventually moral elements. We need to understand how all of these networks interact to create violent extremist movements. To understand the complex processes involved, and determine where we might successfully intervene, we can describe the emergence of extremism from the bottom up, starting with the neurobiological processes of individuals.

Violent extremists are human, just are like the rest of us. They are social within their identity groups, and form their self-identities by relating their personal story to group narratives and social structures. They seek validation and status in the context of those stories and groups, form their self-identity in relation to their place within both, and jockey for position within the pecking order of their chosen groups. In some cases, members choose freely to belong to these groups, even when alternatives exist. But when few alternatives exist, or when the prevailing sentiment of the group tends towards extremism, ideological alignment may be more driven by subconscious adaptation to social realities than by conscious choice. Pakistani writer Ahmed Rashid describes such forces in play in his book *Taliban*:

> These boys were a world apart from the Mujaheddin whom I had got to know during the 1980s – men who could recount their tribal and clan lineages, remembered their abandoned farms and valleys with nostalgia and recounted legends and stories from Afghan history…They had no memories of the past, no plans for the future while the present was everything. They were literally the orphans of the war, the rootless and the restless, the

> jobless and economically deprived with little self-knowledge. They admired war because it was the only occupation they could possibly adapt to. Their simple belief in a messianic, puritan Islam which had been drummed into them by simple village mullahs was the only prop they could hold on to and which gave their lives some meaning. (Rashid 32)

Stories give people meaning and position within the group, and are effectively the attractors that drive mental model formation in the complex system of the human mind. We can influence these patterns of identity formation in a number of ways. We can attack the extremist narrative, showing how the leaders distort sacred values for selfish motives or delegitimize them by offering alternative interpretations of the narrative that marginalize violence. Eliminating physical proximity can reduce the effects of subconscious imitation of violent individuals, and the subtle influence resulting from people spending time together.

While the current information environment has made it easier for them to find like-minded members, and to reinforce their messages, they have the same need for personal contact to solidify identity with group, and establish sacred values that one would kill or risk prison, maiming, or death for. To coordinate their actions, violent extremists must communicate, organize, raise funds, meet, plan, and coordinate their operations. When they do, informational, financial, and logistical footprints emerge in the process. When we detect such patterns, and correlate these activities to groups sustained by violent narratives, we can intervene by influencing the linkages of these groups to the supporting subsystems. We can seek to isolate or divert participation from these groups once we detect them, forcing them to constantly adapt to new means and methods, increasing their costs of organization. If one's effectiveness within a network depends on one's position in it, we can effectively deny violent extremists groups the informational "high ground" by controlling their access to the physical and electronic nodes that make them effective in achieving audience, finances, etc. Finally, if we cannot co-opt, marginalize, or disconnect the subsystems that combine to convince people to organize and conduct acts of violent extremism, we must use these tools to find them, and remove them from the battlefield before they can act if possible, and before they can act again whenever possible.

Developing Operational Approaches That Leverage These Insights

The foundational concept of our current operational art, as described in joint and service doctrine, is the concept that we can describe the operational environment, and identify points of leverage, by looking for "centers of gravity" (CoG) in both friendly and enemy systems. We then determine what critical capabilities (CCs) sustain them, what the critical requirements (CRs) are that enable & sustain those capabilities, and what critical vulnerabilities (CV) we can leverage with our military capabilities to ultimately influence those centers of gravity—this is the model developed by Dr. Joe Strange to describe how centers of gravity (a Clausewitzian concept) can be influenced.
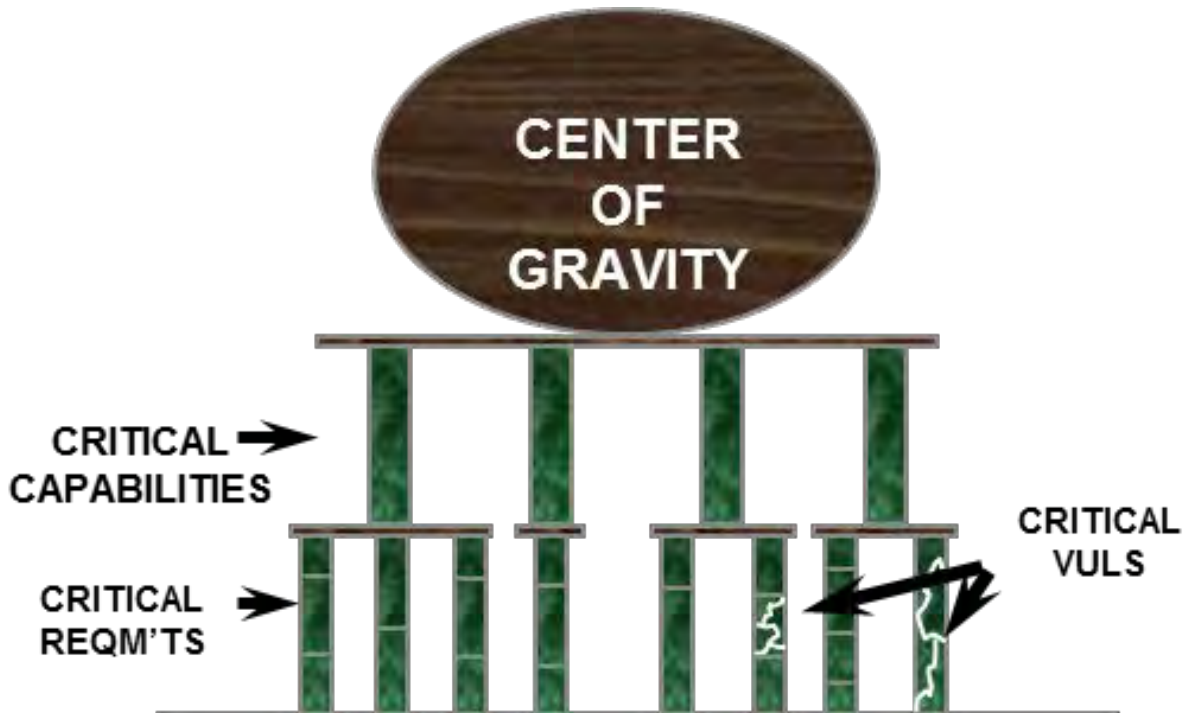
Figure 2. 505th Training Squadron, slide 6

Such visualizations of the linkages between critical variables are extremely useful in identifying connections and interdependencies, but interpreting the concept too narrowly in a physical sense can be misleading. While the Center of Gravity concept can indeed accommodate non-physical aspects of the operational environment, the temptation is often strong to overemphasize collapsing enemy systems by physically attacking vulnerabilities in an attempt to crash the enemy system. But this narrow interpretation of center of gravity analysis does not help us understand how to influence the parts and processes of the system in more favorable directions without collapsing or destroying it. We need a more organic understanding of how the social systems we are trying to influence are put together, something better to choose our points of leverage and types of interventions to influence the living, moving parts of the systems that we do not destroy. This is where a static, hierarchical conceptualization of the linkages between critical factors does not help us—complex social systems do not resemble static structures to be collapsed; they are much closer to flexible, spider webs that adjust when one part is damaged or degraded, and can be respun in new directions when the old ones are denied. We need a richer conceptual model that describes not just structure, but dynamics. We need models to help us picture in our heads how key nodes and attractors interact in the physical, cognitive and moral domains, and use this context to determine the best places to intervene in living, open systems.

We might start with a simple model like this, showing the interrelationship between groups of people, ideas, and the tools they use, all influencing the adaptation of the others over time:
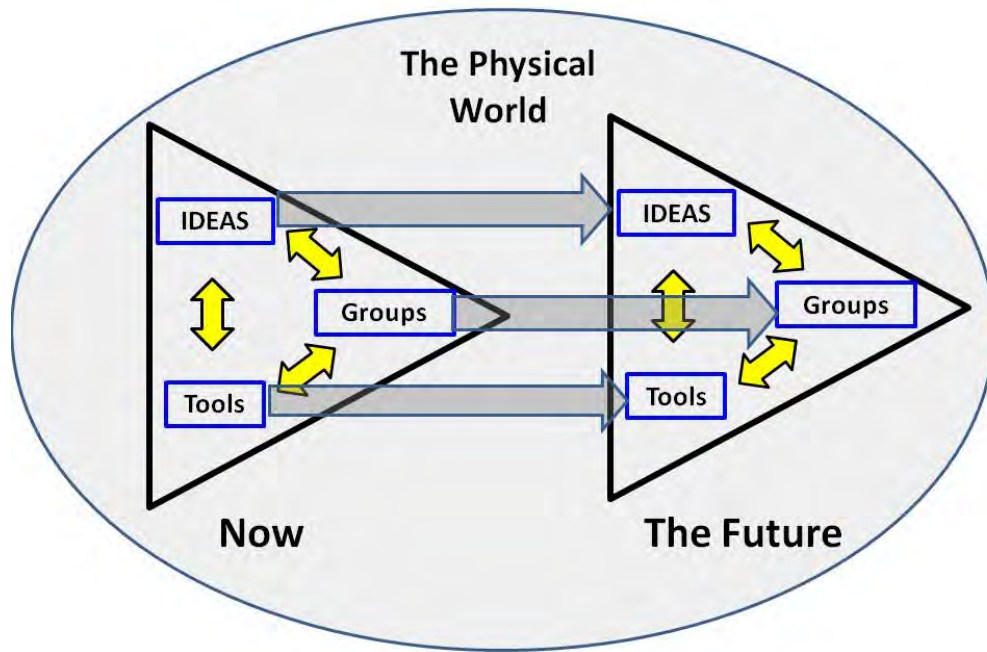
Figure 3. The Physical World

Metaphysics and religious beliefs aside, the foundations for all of what we are concerned about in military strategy ultimately resides in the physical world—ideas are networks of neurons in the heads of individuals, which through the interactions and processes of groups can spread from one person to another in the form of approximately shared mental models. Tools are the physical artifacts that both constrain and enable us to interact with the world and each other, and include the tools we use to communicate with each other. All three mutually and inseparably influence each other as we move forward in time, and we must consider the relative "pull" of each. But how do we describe the relationship between people, tools, and ideas?

We can also think of the word as existing in three domains, a model with some historical precedent. In classical Greece, Plato modeled the word in such a manner, describing the physical domain, the mental domain, and the Platonic mathematical ideal world of forms. In 1926, in his book *The Foundations of the Science of War*, JFC Fuller described the world in terms of the physical, mental, and moral domains. We will advance a similar model, and define it as such:

Physical Domain: the physical artifacts of the world, to include the earth, ourselves, our tools, and the electromagnetic spectrum.

Cognitive Domain: this describes the means by which we process information from the physical world, through a combination of individual neurobiological processes, social interaction, and interaction with the physical domain using various forms of information technologies. This also includes the subconscious processing of information in the human brain.

The Moral Domain: The uniquely human domain that defines the personal and collective meanings of the information we process in the cognitive domain. This includes the conscious portion of human thought and memory that interprets the various signals produced in the cognitive domain, and gives them meaning in a social sense.

So if we combine the insights of the last two models above, we see that

- Ultimately, all three domains are reducible to interactions in the physical domain. You can access points of leverage in all three domains if you know what these physical processes are, and how nodes in the process can be accessed and modified though your own physical capabilities to change the processes that create the cognitive and moral emergent states

- The cognitive domain determines how information is processed, and ultimately what information is provided for interpretation in the moral domain. We can better predict and influence moral outcomes if we know either the machine or human heuristics in play in the cognitive realm and can either anticipate or influence their activation in specific contexts

- The moral domain determines what is socially acceptable to do in the physical realm, and also influences our human cognitive processing (both conscious and subconscious) when stories and moral lessons interpreted in the moral domain are encoded into memory and sense of identity through indoctrination in the physical domain
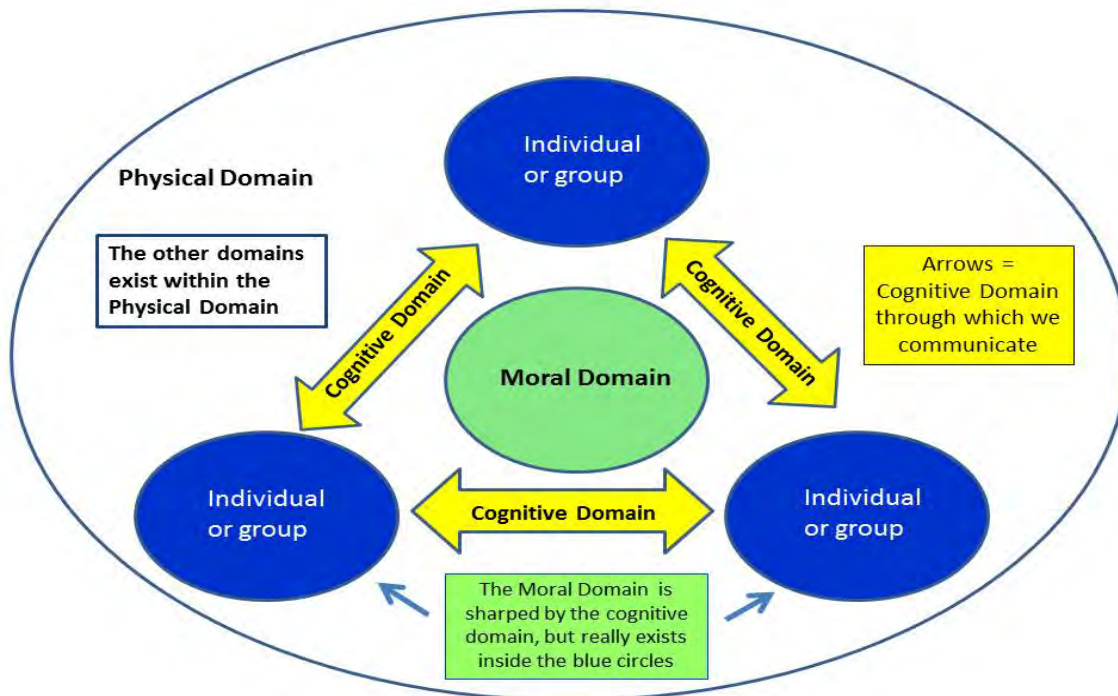

Figure 4. The Moral Domain

So, how can we relate this to our doctrinal critical factors? First, we reject the concept of a center of gravity at each level of war. There are many points of leverage throughout the domains all connected to one another through visible and invisible chains of influence, and their relative influence on each other—the pull—is constantly changing in ways that do not resemble the mechanics of physics described by the concept of gravity, as many often too literally interpret the concept. They also span many different kinds of networks, thus there is no centrality. In the cognitive and moral domains, attractors can reverse polarity and strength in the blink of an eye depending on the different meanings that can be assigned to the same sets of facts, depending on how they information is processed in the cognitive and moral domains.

Combining the insights from neuroscience, the critical factors from Dr. Strange's Center of Gravity model, our simple model of dynamic change, and our model of the three domains, we can propose a new method for framing questions that will help us identifying critical capabilities, critical requirements, and critical vulnerabilities for complex social systems in in all three domains:

1. Identify the moral components that give the group its identity and sense of purpose
2. Identify the physical components that enable the growth and sustainment the extremist network
3. Identify the flow and transmission methods of the individual and group cognitive processes that the extremists use to maintain their identity, purpose, and justification for access to resources, and define the physical components that enable them
4. Determine which of your own physical components can be applied to influence their physical and cognitive process within the context of the current moral domain factors, seeking to change the patterns of interaction that are leading to violent behavior

Moral Domain Considerations:

Key questions to ask when seeking CCs, CRs, and CVs in the moral domain:

- What are the master narratives and value systems that serve as the foundation for the violent extremists' personal and group identities, and how have they modified them to suit their political purposes?
- Are there alternative interpretations to the narrative that can be used to weaken their position?
- Which moral positions have key individuals and subgroups staked their reputations on, or used to justify their place in the social pecking order, and are there alternatives available to allow them to shift from that position?

Points of Leverage based on neuroscience: People have an innate need to belong to social groups, define their place in the pecking order of the group, and include themselves in the story of that group. Once something becomes part of their identity, the brain actually processes information about it differently, and in some ways, predictably if you understand which stories and identity definitions are driving individuals at the local level. Narratives also constrain both individual and

group action, so you can somewhat predict which behaviors will be allowed by the social dynamics of the group.

Attractors to consider/exploit: Master narratives, historical legacy, group heroes and what made them heroic, religious and cultural codes, laws, formal and informal norms, stated positions of policymakers

Possible interventions: Show their position in a different light through alternative narratives that resonate within local master narratives and norms to make the extremists own messaging run counter to the extremist organization's goals; expose the hypocrisy of leaders who do not practice what they preach; make extremist positions, customs, and positions look ridiculous or archaic in popular media; and have former extremists expose the flaws of the organization.

Physical Domain Considerations

Key questions to ask when seeking CCs, CRs, and CVs in the physical domain: Which parts of the population are most vulnerable to the violent extremist narrative due to physical circumstances?

- Which physical factors are serving as attractors or accelerants to radicalization (i.e., geographical proximity, lack of alternative economic or social opportunities for advancement, lack of security)?
- What are the unique, traceable patterns of physical insurgent organizational activities, and where are points of detection/ intervention/ interdiction?

Points of leverage from network science and neuroscience: All ideas need to take some physical form to be acted upon, and social organization still depends largely on people physically meeting with people, because the chemical reactions in the brain that we call trust and affiliation are still most strongly influenced by person to person contact in local interactions. When people organize, it creates a physical footprint that can be anticipated, identified, tracked, and acted upon.

Attractors to consider/exploit: basic survival requirements, access to resources, physical capacity for labor, security, industry, bureaucracy

Possible Interventions: focus counter-radicalization direct intervention efforts on the most vulnerable populations in terms of geography or physical capacity. Focus economic development efforts in areas most susceptible to extremist recruiting via financial incentives, offer financial incentives for reporting extremist activities. Detect extremist activity by linking messaging and informational footprints to the physical social footprint, and disrupt the physical footprint through co-opting, disruption, or destruction.

Cognitive Domain Considerations

Key questions to ask when seeking CCs, CRs, and CVs in the cognitive domain:

- What mode of communication is the extremist organization using, and are there certain demographics that are especially impressionable to this form of media?

- What combinations of virtual and physical contact are the extremists using to recruit and retain their membership, and which kinds are more important at critical phases of the recruitment, planning, training, and execution cycles of violent extremist acts?
- What are the outward symbols and practices that communicate pecking order and status inside the group?
- Can we deny or marginalize the extremists' communication methods, or co-opt it to present their audiences alternative viewpoints to interpret the same physical facts?

Points of leverage from neuroscience: Some modes of communication are more effective for certain demographic groups, knowing what technology is available to them, and what has been popularly adopted, will tell you where to look for extremist activity, and also which forms of media can be used to counter their messaging

Attractors to consider/exploit: available modes of communication, preferred media types, command and control structures, formal bureaucratic processes, informal social processes

Interventions: Use data mining and pattern recognition tools to identify and track sources of extremist messaging to their sources of finance, create false identities to collect info on and draw out extremist recruiters and expose their methods of recruitment and socialization, seize physical assets and funds of the organization when able. Use denial of service attacks on extremist websites, use established censoring/fact checking methods on social media to remove extremist propaganda and distortions from public online venues. Offer alternative viewpoints using the same media approach. Use humor or investigative reporting to discount the extremist outward symbols and practices. Use non-extremist personal relationships to override online extremist indoctrination before membership or affiliation becomes part of the individual's identity.

None of these recommendations are new and novel in themselves – many are being implemented today, albeit in isolation from the others by often stovepiped organizations. Without the understanding of how they all relate simultaneously in all three domains, you may be missing the right combinations of simultaneous interventions in all three domains that will have the greatest effect on the systemic processes and attractors driving the emergence behind extremism. Keeping the full range of intervention opportunities in view will help us to design holistic intervention strategies targeted at the specific nodes that drive the bottom up emergent processes that allow them to grow and flourish, which should be ultimately more successful and sustainable than merely addressing the extremists individually.

Conclusion

We have always had an intuitive sense of how to deal with complexity as we have formulated strategy, and there is plenty in classical military theory that speaks directly to complexity. But we have not always had precise enough theoretical tools to describe the entire range of physical, informational, and moral activities that drive the emergence of an idea into a violent social movement. Traditional Center of Gravity and Critical Factors analysis is still a useful concept, but there is one major problem as it is current described—in a complex adaptive system that exists in

three domains, there is no "center," and there is only "gravity" in the physical sense. What complexity science offers is more precise definitions and concepts of how dynamic change occurs in all kinds of complex systems, so we can look for and find better fitted tools and points of leverage for intervention. Better, more nuanced models help us escape narrow interpretations of system connectedness, and help us see what is driving the process, not just what the components of the system are. If you understand the basic process of bottom up emergence and change in networks, you will see the points of leverage more quickly, and be able to make sense of the key variables, both physical and conceptual, that are contributing most to creating networks of violent extremists.

Prediction is possible, even in complex systems. We have evolutionary wired habits of socialization that will not be replaced anytime soon by modern technological developments--"social tools don't create new motivations so much as they amplify existing ones." (Shirky 294). When we use modern tools to satisfy basic human needs for interaction, it creates an increasingly traceable topology that we can exploit to identify the conditions that foment extremism, and also to detect the formation of violent extremist networks. When extremist groups take the next step in socialization and meet in person, that creates another signature that we can detect, and another opportunity for intervention. Strategies to defeat extremism that are based on a solid understanding of the dynamic linkages between all three social domains (physical, cognitive, and moral), coupled with solid comprehension of complexity concepts like bottom up emergence, are more likely to help us choose the right combinations of interventions to successfully derail radicalization before violent ideas become violent acts, and violence becomes part of the unquestionable core identity of the individual and the group.

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Neuropsychological Operations: A Concept for Counter-Radicalization

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Abstract

Countering Violent Extremism (CVE) is a principle national military objective and Military Information Support Operations or MISO (formerly psychological operations or PSYOP) is a critical offensive capability in CVE. PSYOP/MISO has long been reliant on methods employed in social and behavioral science for target audience analysis, product development, and operational assessment. However, current research in cyberpsychology and neuroscience, in conjunction with advances in persuasive technologies, human computer interaction, and more traditional methodologies, can be used to develop influence tactics tailored to counter-radicalization operations. Relevant scientific research can be applied to validate specific observable behaviors that can be used as empirically derived priority intelligence requirements (PIR), decision-points, and even measures of performance/measures of effectiveness (MOP/MOE) for more specific PSYOP/MISO objectives.

Introduction[46]

The 2011 U.S. National Military Strategy prioritizes Countering Violent Extremism (CVE) amongst the national military objectives (Mullen, 2011). Given the enormity of the challenge and the proximity of the threat, CVE must address target audiences at the macro (population) and micro (individual) level. Military Information Support Operations (MISO), formerly psychological operations (PSYOP), is a critical offensive capability in CVE. Engagement with those who seek to affiliate with or support violent extremist organizations (VEO) is most likely to occur in cyberspace, a domain hat affords a unique opportunity to engage at-risk target audiences in order to deny, delay, and/or disrupt the radicalization process. To exploit an asymmetric advantage, counter-radicalizations operations must utilize every relevant scientific and technological advantage available.

PSYOP/MISO have historically been, and will continue to be, reliant on methods employed within the social sciences. Deviations from such empirically based methods have lessened the effectiveness of PSYOP/MISO (MacKay et al, 2012). Emerging research in cyberpsychology and cyberneurobiology can be integrated with existing PSYOP/MISO processes to both create a set of individualized influence tactics and guide their implementation. Cyberpsychology and cyberneurobiology are both interdisciplinary fields that examine the interaction of humans and emerging cyber technology; the former focuses on the psychological (cognitive, affective, behavioral) aspects while the latter concentrates on the biological (genetic, anatomical,

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endocrinological). Research findings from the aforementioned fields, particularly as they apply to cyber-based communication technology (CBCT), can be synthesized with existing operational data to create a more empirically supported approach to counter-radicalization. This extension of Szafranski's (1997) concept of neocortical warfare uses knowledge of individual psychology, neurobiology, and online behavior to influence the consciousness of prospective extremists.

Government agencies, academic researchers, and think-tanks have identified the potential applications, risks, and ethical challenges of employing neuroscience and/or neurotechnology in support of national security objectives (Committee on Military and Intelligence Methodology for Emergent Neurophysiological and Cognitive/Neural Science Research in the Next Two Decades, 2008, The Royal Society, 2012; Defense Science Board, 2012; Giordano & Wurzman, 2011; Tennison & Moreno, 2012). While the collective recommendations are necessary and prudent, include how to apply these advances specifically to degrade the will of an enemy. None suggest as direct an application as Szafranski (1997, p 404) who recommends targeting that "influences the adversary leaders' perceptions of patterns and images, and shapes insights, imaginings and nightmares." Making a similar point, Bostick (2012) argues to refocus PSYOP/MISO on degrading the will of adversaries. The following paper seeks to extend the arguments of both by recommending the incorporation of modern scientific methods into the PYSOP/MISO process in support of counter-radicalization.

Counter-Radicalization

The increasing connectedness of global society has rendered CBCT, particularly social media, systems of social, technological, and operational significance. Connectedness has enabled more rapid and robust information sharing but it has also led to a decline in perceived credibility amongst traditional authorities (Beddington, 2013). The decreased distinction between the virtual and physical worlds increases the influence potential of weak social ties (Dean et al, 2012) and reconceptualizes how individuals calculate whom to trust (Piorkowski, 2012). Online communities provide a medium through which individuals establish relationships for financial, spiritual, and social benefit. However, those same mechanisms facilitate illicit networks, ranging from black market economies to human trafficking in persons (Abbasi & Chen, 2008). Online communities 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 PSYOP/MISO.

CBCT is an enabler of radicalization; VEO have employed these technologies to facilitate strategic communication, command and control, recruitment, training, fundraising, and targeting (Bos et al, 2013). However, CBCT is neither a cause of nor risk factor for radicalization; rather it serves as a platform that facilitates the spread of emotionally evocative messages and creates a digital echo chamber the reinforces preexisting and/or acquired biases (Canna et al, 2012). The conditions of such an environment heighten both endogenous and exogenous risk factors, often contributing to increased anti-social behavior (e.g. violation of social norms) in at-risk demographics (Reilly, 2011). Radicalization is the process by which an individual, group, or mass of people move from legal participation in the political process toward violent political action (Crossett & Spitaletta, 2010) while counter-radicalization is the set of operations planned and executed to deter, disrupt, and/or

defeat that process. McCauley & Moskalenko's (2008) often-cited radicalization mechanisms have illustrated that terrorism is not a static phenomenon; terrorists do not necessarily exhibit either a psychopathological and/or genetic predisposition toward political extremism. Canna et al (2012) and Orlina and Desjardins (2012) employed a dual-pyramid model derived from those mechanisms that can be useful in developing counter-radicalization tactics. Specifically, the catalysts or triggers that precede behaviors of interest may correlate with key transition points between ideological and/or behavioral categories. Thus, an empathetic individual with sufficient emotional vulnerability and access to inflammatory materials could succumb to a particular constellation of endogenous and exogenous triggers. Canna et al (2012) defined a trigger to be an event, individual, or threat that motivates a particular behavior. Using this definition, Orlina and Desjardins (2012) prioritized 78 transitions of interest from amongst the set of 240 possible transitions. Despite the fact that these ideas have been derived from valid sources using rigorous methods, there is insufficient empirical data to support explicit linkages between triggers and specific behaviors, and thus experimental validation is necessary. A list of those factors along with corresponding applications of scientific and technological research is located in Table 1.

Neuropsychological Operations

Traditionally, effective PSYOP/MISO requires methods employed in political science, anthropology, sociology, and social psychology for target audience analysis, product development, and operational assessment (Phases II, IV, and VII of the doctrinal process depicted in Figure 1). However, synthesizing these traditional methods with recent advances in neuroscience, cyberpsychology, and captology (the study of persuasive technology) can result in an advanced set of personalized persuasion tactics. Research in decision neuroscience has contributed much to the scientific understanding of consumer behavior; the combination of laboratory and naturalistic methods employed in those disciplines could be readily applied to the challenge of countering online extremism. This synthesis is not necessarily a new concept but rather, much like the field of neuroeconomics, an attempt to integrate neuroscience research into a discipline that has long relayed upon research and analytical methods from the social sciences.
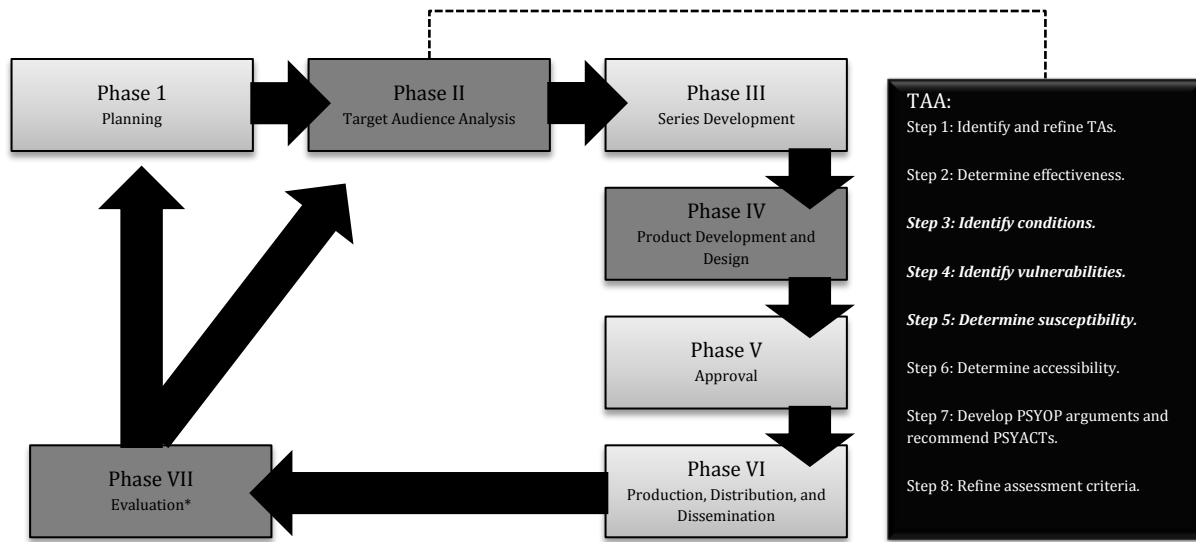
Figure 5. FM 3-05.3 PSYOP Process (Adapted from HQDA, 2005).

In addition to neuroscience and persuasive technology research, incorporating analytical methods such as social network analysis and leadership analysis[47] will require shifts in existing processes. The principal difference being that instead of remote personality assessment (though in some cases, that may be employed), a set of identified web-behaviors will be compared with empirical data to determine likely susceptibilities to type, format, and content of a specific message. Messages can then be specifically tailored to an individual's psychological vulnerabilities and/or susceptibilities. The body of literature on online personalized persuasion in is relatively small yet growing, with contributions being made from both the marketing and academic communities (Yoon et al, 2012). Valuable contributions can be made from cyberpsychological and neuroscience research to more completely understand the correlation between individual differences and interactions mediated by CBCT. That research will allow PSYOP/MISO planners to rely upon firmly established linkages between perception and actions when developing both their intelligence requirements and the desired psychological effects of products/series.

Target Audience Analysis

The first area of application is Phase II of the doctrinal PSYOP process, target audience analysis (TAA): the systematic research and analysis of relevant information within a selected population that may be exploited to achieve a desired objective (HQDA, 2005). Objectives can range from altering perceptions to affecting objective reasoning to changing behaviors. TAA is an indispensable component of not only PSYOP/MISO but also of marketing and media programming. The inclusion of cyberpsychological and/or neuroscientific methods will not supplant, but rather reinforce approaches resulting in a richer contextual understanding. Hirsch et al (2012) for example, found

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[47] Leadership analysis is the study of the human factors that effect how individuals manage their environement, process information, and make decisions stem from their underlying motivations, beliefs, thinking style, and personality (Bos et al, 2013).

that subtle changes to 140-character short-message system content, based on an individual's personality dimensions, resulted in statistically significant differences in the likelihood of compliance. The capacity to appreciate this phenomenon at a neural level will provide planners greater insight into the effect a product/series will have on a target audience or individual.

If the appropriate unit of analysis in counter-radicalization operations is indeed the individual, as Canna et al (2012) suggest, TAA should include not only the group, but also the individual. The identification of conditions, vulnerabilities, and susceptibilities lend themselves to include individual level analyses. Identification of conditions is generally focused on events, issues, or characteristics over which an individual or group has little control. Many of these conditions can be activators/catalysts (factors that enable or facilitate movement within or between pyramids) or inhibitors (factors that prevent or stall progression). These conditions can also include the perception of a particular message as well as the overt behaviors of the target audience in response to the message. Data associated with the latter provide the baseline from which changes resulting from an intervention are measured. Vulnerabilities are the needs, wants, or desires that arise from the aforementioned conditions (HQDA, 2005); they are traditionally social, but can be extended to include cognitive and neurobiological. These idiosyncratic vulnerabilities may be addressed through both the message content as wells as the dissemination mechanism. Susceptibility is the degree to which a particular message is likely to influence a target audience (HQDA, 2005). Susceptibilities are often identified through both primary and secondary methods in either background research and/or product testing. These approaches can be augmented by neuroscientific methods, such as patterns of neural activation in response to particular memes and/or product formats that go beyond self-report measures or established heuristics. For instance, the work of Abbasi and Chen (2008) analyzed extremist chatrooms and identified how differences in emotional intensity (which correlated with violent acts) varied by geographical region. Examining such online behavior (if not in-situ, then replicated in a laboratory) would provide a more thorough explanation of the user experience, informing the development of lines of persuasion. Existing neuroscience technologies and methods can accommodate such experimental designs, findings from which can provide a much richer understanding of the user experience. Each line of persuasion can then be evaluated based on its ability to influence both the target audience's behavior and neural response. Thus, provided there is sufficient ecological validity, this line of research can benefit from not only operational but also experimental data.

Shifting the level of analysis from groups and populations to individuals will require approaches from disciplines that study individual behavior. Methods of remote personality assessment have been employed with success since WWII (Bos et al, 2013) and research methods from political psychology can be adapted to existing PSYOP/MISO research methods to facilitate this shift. Whether the analytical frameworks are psychodynamic, behavioral, cognitive, or personological (or a combination thereof), their inclusion increases the potential for the development of more precise themes and messages. Unlike more traditional approaches to leadership analysis, many of the targets of counter-radicalization will be essentially anonymous, except for a set of observable online behaviors. While acknowledging that methods such as content analysis of an individual's social media contributions will not provide the same fidelity as a clinical personality assessment, it

will provide the opportunity to create more refined messaging and/or counter-messaging. Collecting psychophysiological and/or neuroimaging data on individuals as they are engaged in CBCT tasks and comparing them with behavior will enable the development of generalized profiling methods. Profiles including personality, emotional proclivities and/or cognitive attributes of at-risk users would greatly enhance the precision and ultimately effectiveness of online social influence efforts. Existing research has identified various regions of the brain that respond to emotional stimuli. If, for example, the amygdala or insular cortex are activated in response to a particular product, those activations provide a richer contextual understating of how that product is perceived by an individual. Therefore research should seek to correlate online behaviors with persuadable attributes.

Product Development and Design

The shift in target audience unit of analysis to the individual should rely upon information derived from a combination of online behaviors and a database of correlated psychophysiological and/or neurobiological attributes. Incorporating applied research from neuroscience and captology, amongst others, will facilitate individually tailored products/series. Designing technologies with the explicit intent to change behavior is relatively young (Fogg, 2002), however, it is not a radical departure from traditional PSYOP/MISO. Incorporating persuasive technology into product design would expand existing procedures to include research from human-computer interaction, cyberpsychology, and decision neuroscience. This incorporation would expand the medium through which themes and messages are disseminated as well as the devices and/or interfaces themselves. The objective of personalized technologies is to improve user experience by tailoring the interaction based on an individual's set of system preferences, interests, and/or other relevant data (Berkovsky et al, 2012). Persuasive technologies advance personalized equipment by employing similar user-derived preferences to change opinions, objective reasoning, and ultimately behavior through the confluence of human-centered design and social influence. Contemporary microtargetting incorporates open-source aggregation to develop a demographic profile (Korolova, 2011), but few techniques take the intermediate step of creating a psychological profile then tailoring the message accordingly (Hirsch et al, 2012).

Persuasion, emotion, and trust have become design criteria in online influence and their applicability PSYOP/MISO is evident. Many of these influence principles derived from both research and application can be applied at (Kaptein et al, 201) or below (Dijksterhuis et al, 2006) conscious awareness. Both personalized and persuasive technologies attempt to influence behavior (Berkovsky et al, 2012); synthesizing elements from each in conjunction with established methods of social influence holds potential for countering online radicalization. Affecting the user experience of an individual seeking information disseminated by a VEO may disrupt the radicalization process while developing a personalized alternative message may force exposure to a competing narrative. Understanding the neural correlates of user experience will provide insight into how to alter those experiences, as the objective requires. When employing CBCT to influence or delegitimize VEO, it is small narrative bits (or narbs) and that should be countered (Mitra, 2010). Research in decision neuroscience has contributed much to the scientific understanding of consumer behavior; the combination of laboratory and naturalistic methods employed in those disciplines could be readily

applied to the challenge of countering online extremism. Understanding the psychological effect of a particular product/series from both a subjective and objective perspective is daunting (Casebeer & Russell, 2005) but findings from efforts such as the Defense Advanced Research Projects Agency's (DARPA) Narrative Networks[48] program and/or similar research efforts will provide a decisive scientific advantage to PSYOP/MISO in countering radicalization.

Evaluation

Evaluation focuses on determining the effectiveness of a product or series over time and is accomplished by analyzing observable behaviors related to the PSYOP/MISO objectives (HQDA, 2005). Measuring the effectiveness of PSYOP/MISO has been a scientific and operational challenge since the U.S. formalized the set of tactics during WWI (Linebarger, 1954); the difficulty of assessment has not waned despite increased attention and effort (King, 2004). Effective evaluation requires not only using measures that are aligned with the objective, but also ensuring the measures are valid. Validity is a primary concern when establishing evaluation criteria, particularly as intelligence constraints and lack of information can result in a tendency to assume a causal relationship due to sequential occurrence. Evaluation is generally based on correlational research since an explicit causal relationship between products/series and target audience behavior is challenging due to innumerable extraneous and mediating variables. Erroneous causal inference is but one threat to the establishment of useful MOP/MOE; there are numerous threats to validity and, therefore, far more research is necessary to correlate specific online behaviors as observable triggers. Triggers serve as empirically derived assessment criteria and intelligence requirements, which are integrated into the intelligence, surveillance, and reconnaissance collection plan.

There are not only experimental but also technological challenges associated with developing feedback mechanisms for online behavior. Cuggelman (2010) outlines many of those challenges along with numerous multi-modal research approaches that may be employed to identify the effectiveness of social marketing techniques. An important consideration is the limited feedback mechanism for online behavior through open-source methods. These interdisciplinary approaches may benefit from applied neuroscience research as well as advances in technical intelligence collection and analysis since online feedback mechanisms are limited (Cuggleman, 2012).

Integration

Both the research summarized by Orlina and Desjardins (2012) and the arguments proffered here require additional testing and validation prior to being operationalized. Incorporating empirical data from neurobiology and cyberpsychology to PSYOP/MISO is not science fiction, but it is not yet reality. The U.S. must identify the areas where the basic tenants are most well understood and develop an operationally relevant applied research strategy. The first step would be identifying the

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[48] Narratives Networks is a DARPA research effort exploring (1) quantitative analysis of narratives, (2) understanding the effects narratives have on human psychology and its affiliated neurobiology, and (3) modeling, simulating, and sensing-especially in stand-off modalities-these narrative influences.

observable behaviors associated with a particular activator/catalyst (or risk factor for radicalization). From there, identifying the corresponding neural correlates will enable the linkage between neuropsychology and cyber behavior. As that relationship is better understood, experimental manipulations will help inform product/series development to determine the appropriate content and medium through which it can be delivered in order to produce the desired effect. The result will be an empirically informed process designed to target underlying neural mechanisms to create specific psychological effects on a target.

Required research to achieve that result includes not only laboratory experiments but also operational analysis to ensure product/series are developed to influence the desired behavior and not simply expose the target audience to novel stimuli. The failure to link product/series with observable behaviors results in ineffective operations (MacKay et al, 2012). Table represents a first attempt to link triggers to the PSYOP/MISO process. The information included should be taken as a generalized set of research areas and not necessarily as viable recommendations or priorities at this point. The explicit PSYOP/MISO objective would determine the specific applications of these ideas. While the relative scientific and operational maturity of the ideas varies, and not all possess the same potential for operational application, each cell in columns 2-4 requires additional research and vetting prior to making any definitive conclusions.

Table 1. Integration of Activators/Catalysts and Operational Applications.

Activators /Catalysts	Application (TAA)	Application (Development)	Application (Evaluation)
Threat to sacred values	Understanding not only what the sacred values of a target audience are but also the psychological effect of exposure to relevant themes and message	Constructing products/series that do not overtly challenges sacred so as not to cause aggressive reactions or to	Identifying when the neural regions corresponding to threats to sacred values are activated in response to specific stimuli will enable greater inference to be drawn from online behaviors after exposure to products/series.
Social Belongingness (Power of Love)	Psychological and neurobiological correlates of kinship and how they manifest themselves within a particular group can provide greater insight into	Products/series that appeal to a target on both social and neurobiological levels has a greater likelihood in endangering the desired affective reaction.	Tracking connectedness and/or other social network analysis measures should provide feedback regarding the creation and destruction of links of interest
Social Isolation (seeking social/self identity)	Social network analysis can identify relative isolation, but it cannot identify the concomitant emotional strain that results. Identifying online behaviors tor proverbial "calls for help" associated with such feelings will enable Understanding the relevant "narbs" within the pertinent social media domains will allow for more individualized analyses.	Affective appeals to less radical pathways using search engine optimization and/or tactics that provide more information about alternative approaches to filling the subjective void may deter the radicalization process.	Measuring social isolation is somewhat more difficult than connectedness depending on how active one is online. Behavioral changes in those with no virtual presence can obviously not be measured through online mechanisms.
Grievance	Proximity and/or strength of connection of one individual to another who was victimized (or perceived to be) by an out-group will increase the likelihood for radicalization. Understanding the neural correlates of grievance will enable more personalized TAA.	Grievance is subjective and products/series that seek to assuage the associated responses must be sufficiently nuanced as not to exacerbate or trivialize the experience.	Neural correlates identifying transition from anger to disgust (and back) may provide feedback as the relative risk for violence of an individual as the result of various stimuli.

Activators /Catalysts	Application (TAA)	Application (Development)	Application (Evaluation)
Emotion	Understanding the emotional state of an individual at various points in the radicalization process is difficult, but crucial in identifying the appropriate type and intensity of product/series. This should be a research priority.	Captology and online social marketing approaches have a library of approaches for designing technologies and/or interfaces with persuasion, emotion, and trust in mind. A set of these would likely be applicable to online radicalization.	Individual motivation changes too frequently and in response to too many different stimuli for it to be easily definable or have sufficient predictive validity; however, there are likely laboratory measures that may be adapted to provide at least a heuristic assessment.
Anomie/uncertainty	Cultural values such as uncertainty avoidance as well as the corresponding cognitive effects can provide insight to both susceptibility and vulnerability.	Uncertainty and/or intolerance of it can be exploited by compounding both the heightened sensitivity toward threat and in-group biases	When behaviors are framed as decisions, determining those under risk and/or uncertainty might be feasible.
Physiological Response (Reward and Pleasure Seeking)	Identifying the both reward and punishment preferences (and comparing them to experimental pathways) of an individual based upon online behaviors is possible.	Tailoring content based on personal preferences using an adaptive design is more feasible if those adaptations are based on statistical models and not necessarily real-time feedback (at least at this stage of technological development).	Again using statistical models, correlating online behaviors with a set of reward pathways activations is an empirical question that can be tested.
Personal Tragedy	The neural correlates of grief, bereavement, and depression have been well researched; it would not be exceeding difficult to apply relevant findings to individualized analysis.	Similar to Grievance (above), nuanced products/series are required to avoid exacerbating or trivializing the experience.	Identifying online behaviors that correlate with post-traumatic growth may provide indicators of positive (or at least less negative) affect.
Influential memes	Extending the identification of susceptibility and vulnerability to influential memes is a research question within DARPA's Narrative Networks program. Once that data is published, it may provide further recommendations in this area.	A well-crafted message that appeals to a variety of vulnerabilities (sociocultural symbols, individual affective vulnerability, etc.) within a selected target audience will help create an environment that supports the radicalization process.	Comparative analysis of narratives and counter-narratives as well as the corresponding behavior requires additional research, but the area holds great promise in counter-radicalization MOE.
Financial Incentive	Financial need is more easily identified through more traditional means, but there may be a set of online behaviors (from access points to search patterns) that may provide a better idea of an audience's subjective perception of their socioeconomic status.	Product/series targeting this risk factor can only augment existing programs that provide employment and/or some alternative to radicalization.	There have numerous MOE identified with economic behaviors, tailoring some to counter-radicalization efforts is not unreasonable.
Social Factors (social movement, broader social networks, etc.)	Similar to social belongingness and isolation (above), identifying susceptibilities and vulnerabilities requires and interdisciplinary approach but is not beyond the realm of reasonable.	Appealing to a target audience's subjective need for affiliation is a common marketing practice that is easily adapted to counter-radicalization.	Tracking affiliative behaviors in virtual and physical domains should provide a set of effective assessment opportunities.

Conclusion

The decision to adopt an extremist ideology and actively participate in its physical manifestation is impacted by the psychological disposition and state of the individual. Some individuals possess a predilection toward violence as an acceptable means toward an end. Coupled with that is the sympathy or affinity with the sociopolitical narrative used to frame a movement. The degree to which that sympathy is personalized correlates positively with the likelihood of radicalization. Last is the conditioned fear of the consequences, which is promoted by external events, and accumulated

and interpreted by the individual. Each of these risk factors is exacerbated when placed in an environment where external factors corroborated individual biases. The social domain is integral to radicalization as the influence of friends, family, and associates can influence either enable or retard the process. The modern information domain with its ready availability of material, including ideological narratives as well as tactics, techniques, and procedures, can have a pronounced influence upon the cognitive process by which one determines violence is appropriate (Crossett & Spitaletta, 2010). The confluence of the social and information domains, social media, presents an opportunity for counter-radicalization operations as it affords the potential to leverage scientific and technological knowledge gained from studying the effects of various forms of communication technology on human neuropsychology. Social media has transformed the social identify of individuals in many societies (Beddington, 2013) and the malleability of identify that CBCT affords can be employed to counter violent extremism online.

There are compelling finding among published cyberpsychology and neuroscience research (Frith & Frith, 2012) whose methods can be adapted and incorporated into research designs to test some of the ideas presented in this paper. The most significant change to current PSYOP/MISO tactics will be the increased analytic rigor and specificity of target audience analysis. Developing reliable sensors, be they human or technological, to provide indications and warnings will remain a challenge until sufficient reliable and valid empirical data can be collected. Formulating research questions around the transition factors and the concomitant PSYOP/MISO applications is a step toward operationalizing findings from neurobiology and cognitive science experiments or captology case studies. However, that promise must be tempered with skepticism, as the degree to which any of that data may be applicable has not yet been validated. Additional research is required to identify the observable behaviors associated with particular activators/catalysts (or risk factors for radicalization). Relevant research can be applied to validate the aforementioned triggers that, once validated, can become empirically derived PIR, decision-points, and assessment criteria. Triggers can be correlated with established risk factors for radicalization; as the set of risk factors increases (and/or intensifies), engagement tactics can adjust accordingly. More sophisticated laboratory collection and analytical techniques may also be employed to validate the claims many have made regarding unconscious (or subliminal) messaging (Dijksterhuis et al, 2006). The resultant findings could represent a significant, but not unprecedented, shift in the scope of PSYOP/MISO.

When facing a morally and legally unconstrained adversary, asymmetric advantage lies not necessarily in more sophisticated hardware but in more intelligent application of scientific and technological capability. Those charged with countering radicalization should be able to apply every relevant scientific and technological advantage at their disposal. Technological superiority will not overcome cultural ignorance; the historical reliance on traditional social science research methods will continue to provide the rich contextual understanding necessary for effective PSYOP/MISO. Appending existing processes to included experimental findings in neuropsychology, and cyberpsychology along with technological advances from captology will allow the U.S. to combat radicalization across domains with greater precision. By employing its considerable

resources, the U.S. can invest in applied research to identify, refine, and ultimately apply some of the tactics discussed to achieve future PSYOP/MISO objectives to counter-radicalization.

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Acronyms

AltDNS	Alternative Domain Name Systems
CBCT	Cyber-Based Communication Technology
CCs	Critical Capabilities
CoG	Center of Gravity
CRs	Critical Requirements
CVs	Critical Vulnerabilites
DNS	Domain Name System
GTLDs	Generic-Top Level Domain Names
ICANN	Internet Corporation for Assigned Names and Numbers
IE	Information Environment
IETF	Internet Engineering Task Force
IIA	Inform and Influence Activities
IPv4	Internet Protocol version four
IPv6	Internet Protocol version six
MISO	Military Information Support Operations (formerly psychological operations or PSYOP)
MOP/MOE	Measures of Performance/Measures of Effectiveness
NIST	National Institute of Standards and Technology
PIR	Priority Intelligence Requirements
POTS	Plain Old Telephone System
PSYOP	Psychological Operations
TAA	Target Audience Analysis
TOR	The Onion Router
VEOs	Violent Extremist Organizations