

2018 MINERVA RESEARCH INITIATIVE TOPICS OF INTEREST

See full Funding Opportunity Announcement for further details

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SPECIFIC MINERVA RESEARCH INITIATIVE TOPICS

The following Minerva topics indicate domains of inquiry relevant to the Department of Defense. Interest areas are not mutually exclusive and proposers are not limited to the questions, scope, or regions listed. Researchers should aim to balance the specificity of their proposed research with the generalizability of the expected results. *The Minerva Research Initiative is particularly interested in proposals that align with and support the National Defense Strategy, which is available at:*

<https://www.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>

Proposals that reflect basic research that engages the strategic priorities in this document may be reviewed more favorably. (See Section V of the FY 2018 Minerva Funding Opportunity Announcement for proposal evaluation criteria).

Proposals may leverage existing data or, with justification, collect new data. Preference may be given to studies by experts capable of analyzing source material in the original languages and to studies that exploit materials that have not been previously translated. *The DOD also values geospatially-referenced data across multiple geographic scales gathered in the course of research.* It is expected that collecting viable empirical data relevant to context and situation may require field research, which is looked upon favorably.

Researchers are encouraged to incorporate novel research methods. Well-theorized models linking micro and macro analyses and cross-method approaches, such as simultaneously using both inductive and deductive analytic strategies, and qualitative and quantitative methods are also of interest. Proposals should be fundamentally rooted in the existing social science research literature and have a clear basic science component that describes the future utility of the insights the research will generate for social science.

Disciplinary approaches of interest include, but are not limited to: anthropology, area studies, cognitive science, demography, economics, history, human geography, political science, psychology, sociology, and computational sciences. Interdisciplinary approaches are strongly encouraged, especially when mutually informing and/or cross-validating (methodological integration). Researchers need not focus exclusively on the contemporary period, but they must be able to explain the relevance of findings to contemporary DOD strategic priorities.

The 2018 Topics are situated within DOD strategic priorities that reflect the general, department-wide interests and those more specific to each Service. There is, of course, overlap and collaboration between the respective interest areas, but in framing their proposals researchers are encouraged to consider both the area of interest and the general context of needs it represents.

Topic 1: Sociopolitical (In)Stability, Resilience, and Recovery

Topic 2: Economic Interdependence and Security

Topic 3: Alliances and Burden Sharing

Topic 4: Fundamental Dynamics of Scientific Discovery

Topic 5: Adversarial Information Campaigns

Topic 6: Automated Cyber Vulnerability Analysis

Topic 7: Power, Deterrence, Influence, and Escalation Management for Shaping Operations

Topic 8: Security Risks in Ungoverned & Semi-Governed Spaces

A. Topic 1: Sociopolitical (In)Stability, Resilience, and Recovery

POC: Harold Hawkins, Office of Naval Research, harold.hawkins@navy.mil

Recognizing that all issues of security exist within a social context, the Department of Defense seeks to enhance the basic social scientific understanding of factors contributing to social stability or conflict; processes of community formation and dissolution—including how communities construct meaning and value that drive political and collective action; and the impact of differing cultural visions on security at micro, mezzo, and macro levels. Of additional interest is the impact of extreme environmental events on sociopolitical (in)stability. Most generally, this interest area concerns a focus on conflict vis-à-vis the mechanisms of sociality. It is interested in research that offers innovative, interdisciplinary insights into thematic topics including:

- The role of great-powers in managing global stability. How are traditional and emerging great-powers'—including but not limited to China and Russia—understandings of security impacted by the social, cultural, and political environments in which they exist and what factors hold together the ability of great-powers to mobilize within and beyond their territories? To what extent do culture and society determine how do the identities of great powers evolve and how those identities shape their perceptions of security and interactions with other states? How do structural changes among various states impact global order? Do changing ideological visions impact the utility of multilateral alliances? How do non-state actors influence established state mechanisms for managing conflict?
- Influence of social, political, economic, and environmental change on identity, group cohesion, and the ability to live with diversity. Such changes of interest include those influenced by labor migration, refugee displacement, urbanization, and shifts within the existing global order. Among the numerous factors worth consideration: the influence of trade and trade networks, shifting employment opportunities, and income inequality impacting livelihoods and stressing communities; how perceptions of insecurity are impacted by demographic shifts and the long-

term consequences of such changes; and how changing populations and group-divisions influence various structures of governance (democratic or otherwise) differently.

- Extreme environmental stressors such as droughts, earthquakes, hurricanes, tornados, tsunamis and flooding have, and always will, impose profound impacts on society. These impacts can manifest as a broad range of interlocking effects, including human death and injury, agricultural degradation, destruction of physical and socio-political infrastructure, potentially violent competition for limited resources, and human displacement/mass migration. According to a number of environmental models, extreme events will increase in frequency and severity over the years ahead. Regardless of the accuracy of these predictions, extreme environmental stressors and their socio-political-economic impacts will continue indefinitely. This Minerva interest area aims to foster multidisciplinary approaches, entailing the contributions of social, environmental, political, psychological, and computer sciences as well as economics and military subject matter expertise, to develop and validate a formal computational framework for assessing the socio-economic-political impacts of environmental stressors on cultures ranging from primitive to moderately well-developed.
- The impact of intervention or failure to intervene. How can one more efficiently understand the social, political, economic, and environmental consequences—short, medium, and long term—of engagement? How do understandings of engagement across different international and cultural contexts influence outcome and effectiveness? How are national and regional interests managed, especially in relation to varying understandings of obligation and responsibility that are at times framed morally in individual, communal, and/or ideological terms? Are capacity building programs effective and if so, at what level are their successes context and culturally specific and where are approaches generalizable across different cultural environments?
- The evolving role of global interconnectivity in relation to understandings of connectedness within communities of belonging. How do economics, politics, environmental change, and ideological visions influence social relations at the micro, mezzo, and macro levels? What underlies changing relations within communities and how are counter-hegemonic movements understood differently by states and individuals? To what extent do these differences in understanding reflect the substance of alienation or the challenge of competing visions of community? How do different understandings regarding the primacy of individuality and communality impact the coordination of activities between states and cultures? What factors—including social media and cyber-related interactions, as well as more traditional forms of knowledge transmission and communal engagement—most influence social cohesion within and across different parts of the world?

B. Topic 2: Economic Interdependence and Security

POC: David Montgomery, Basic Research Office, david.w.montgomery61.civ@mail.mil

Great power competition is taking place in an international system characterized by high levels of economic interdependencies. These interdependencies may have implications for how states pursue their national security and defense objectives. Yet there is little basic scientific understanding of how these economic relationships arise and evolve. Moreover, the short- and long-term implications of these relationships have not been accurately modeled to provide insight on how economic interdependencies impact a state's national security and defense objectives. The interdependencies are often multi-faceted (e.g., involving a complex network of trade partners that changes over time and involves different goods/services exchanges). Depending on the market, balances of power in the economic sphere may change suddenly and rapidly, or may be relatively stable over time. The factors that impact such balances may include governance shifts, cultural change, technological innovations, entry/exit of trading partners from a market, and other factors that have consequences for the network of states engaged in economic relationships.

This Minerva topic seeks to develop data and models to capture complex economic interdependencies and assess the implications of those interdependencies for national security among the nation states in the networks. Ideally, data and models will capture longitudinal relationships and identify how those relationships change over time, are linked to policy, relationships, and operational outcomes relevant to the states in the networks. Questions of interest for this topic could include:

- What are the implications of economic interdependence for states in diplomatic and military competition with each other?
- How do states use their economic power to achieve national interests in competition short of armed conflict?
- To what extent have economic instruments been used as effective means of coercion in international politics?

C. Topic 3: Alliances and Burden-Sharing

POC: David Montgomery, Basic Research Office, david.w.montgomery61.civ@mail.mil

Global security in the contemporary world is characterized by inter-state alliances. The dynamics of these alliances may vary substantially, depending on the partners to alliances, the resources they bring to the alliance, and the objectives of the different allies. One challenge is ensuring that the different partners contribute to common objectives. Allies, however, may have different resources to bring to the table, different objectives with respect to maintaining an alliance, and different perspectives on what constitutes a fair distribution of the burden for maintaining an alliance. That is, burden-sharing is a complex issue that depends on the interests of different partners, their resources, their goals, and the extent to which their goals are being met. An every-present risk in forming an alliance is that one's partner(s) will free-ride. That is, one or more agents may take advantage of the resources others bring and access those resources for their own interests without providing comparable contributions to the alliance.

Scientific research in this problem domain of burden-sharing in alliances is scant, although social science has a long history of research on social exchange, distributive justice, social network analytics, and economics, all of which may be relevant to addressing this issue. These and other scientific approaches require scaling to more macro scales to address the issue of global alliances and burden sharing. Additionally, cultural variation, international agreements, national policies/laws, and governance structures may all play a role in shaping the form of burden-sharing and capacity to limit free-riding. This Minerva topic seeks to support research that will generate and validate new models to better capture the dynamics of burden-sharing in alliances with attention to factors that limit or eliminate free-riding. Empirical questions that the research should address may include:

- What are the incentives for burden-sharing within alliances?
- What constraints limit burden-sharing in alliances?
- How does burden-sharing differ within the context of bilateral and multilateral alliances?
- How do changes in the alliance partners impact burden-sharing?
- How can states more effectively manage alliances in order to achieve a greater degree of burden-sharing?

D. Topic 4: Fundamental Dynamics of Scientific Discovery

POC: Enrique Parra, Air Force Office of Scientific Research, enrique.parra@us.af.mil

Scientific discovery is a highly unpredictable endeavor, in which research sponsors and indeed scientists themselves rarely foresee the nature and source of major advances. One source of uncertainty is that scientific discovery is the result of complex social processes that are poorly understood, including

communication within and between groups, team processes, social networks, group identification, and formation of social norms. Moreover, although the scientific enterprise is a global endeavor, it is managed and operates differently across nation states. A greater understanding of the relationship of social processes and scientific discovery, particularly from a comparative perspective, would allow organizations to adopt policies and procedures that more reliably lead to transformative research, and guide the DoD in making informed, cost-effective, investments in the sciences. Moreover, there is a need for valid and reliable measures of the impact of scientific discovery on technology, policy, national security, and society. An understanding of the fundamental principles of scientific discovery could lead to metrics that are more meaningful than current impact factors or citation rates.

The scientific and technology (S&T) literature is growing exponentially, with the number of peer-reviewed publications doubling every 15 years and now reaching over 2 million annually. Despite this data deluge, the way we announce and exchange scientific advances remains largely unchanged since the invention of the research paper in 1665. Moreover, the digitization of the scientific literature and the advent of search engines have increased our speed of access without altering the way we process scientific information. The worldwide creation of knowledge and innovation is of high interest to the DoD. Given the US' remarkable research portfolio of \$140 billion, very little is spent to understand what is created, how the scientific enterprise works, how knowledge spreads, and what fuels discoveries. There is a growing need for new ways to process scholarly output and identify promising research. DoD requires a richer understanding of the fundamental drivers of science; i.e. how research communities conduct themselves and interact with others and how insights are generated, shared, and grow to become useful innovations. A deeper awareness of the precursors of successful science will enhance the way DoD drives innovation and creates societal value.

The objective of this Minerva interest area is to explore the fundamental social dynamics underpinning scientific discovery in the S&T research enterprise in order to develop validated techniques to identify promising research, recognize potential scientific breakthroughs and measure their significance. This topic seeks innovative, multidisciplinary research embracing quantitative, predictive big data approaches and involving collaborations among natural, computational and social scientists to explore the patterns of scientific production with rich mathematical and computational models.

Sample topics include:

- The social conditions that promote scientific discovery
- Development of frameworks to understand the process of scientific research and discovery
- Comparative cross-national frameworks that identify similarities and dissimilarities in the scientific enterprise
- Validated, quantitative models describing the temporal dynamics of scientific communities and disciplines
- Evolution of scientific careers and collaboration networks and their influence on the S&T enterprise from a global and cross-cultural perspective
- Quantifying critical features and fitness of scientific ideas beyond citations.
- Characterization and prediction of the dynamics of scholarly impact
- Identification of emerging research trends and research gaps

DoD policy makers will benefit from a better science of **Scientific Discovery** by increased understanding of the challenges, opportunities, and limitations of social science research processes. The result of such investment will engender more actionable social science research. This would improve the value of Minerva Research to DoD.

E. Topic 5: Adversarial Information Campaigns

POC: Rebecca Goolsby, Office of Naval Research, Rebecca.goolsby@navy.mil

The use of bots as a system of message amplification to influence crowds requires a research focus on multiple issues in social cognition and computer science (and to some degree artificial intelligence) but also rhetoric and narrative. The four key techniques of disinformation: distort, dismiss, dismay, and distract (Nimmo, 2015) are reckoned to be the master set of categories in which to sort these messages. In various combinations, these tactics generate “information maneuvers” (such as group polarization, character assassination, social hysteria propagation, and manipulation of beliefs and value) that an adversary can use to move a target audience toward strategic goals. Disinformation, the deliberate creation and propagation of lies, relies on the manipulation of the social and the psychological worlds of the target audience. Disinformation campaigns are not just instances of “fake” news, but are part of larger attempts to manipulate discourse and narrative. These campaigns are most effective when they are attached to master narratives – collections of stories that are deeply embedded into the worldview, folk beliefs and values of a society. This is why campaigns that do well in one country may fail in another; effective disinformation and influence campaigns rely on attaching to master narratives which vary by culture. European scholars such as the NATO Strategic Communication Center of Excellence, refer to campaigns of disinformation and influence designed to persuade audiences by befuddling, confusing and moving them away from critical thinking as “adversarial information campaigns.” The creation of “echo chambers” in online communities has also been shown to be critical to understanding why and how these campaigns are effective.

This topic would examine master narratives and their association with adversarial information campaigns in Europe. It would examine adversarial information campaigns in Europe and explore the master narratives, information maneuvers and themes to help explore what makes these campaigns compelling to their target audiences. It would examine the role of amplification, through bots, sharing activities, and other computer/online tactics in the creation of the echo chambers. It will examine why these techniques and tactics are effective, identify key features in the development of echo chambers and the creation of adversarial campaigns, and explore the current tactics in “jumping on the bandwagon” of available, potentially divisive topics to meet strategic objectives. This topic should also consider the role of cross-platform communications (such as from blogs to Twitter, Reddit and Twitter, blogs to Facebook, etc.) to consider the role of the online community in developing, validating and spreading memes and messages in an adversarial campaign and sustaining the adversarial narrative over the long term.

F. Topic 6: Automated Cyber Vulnerability Analysis

POC: Harold Hawkins, Office of Naval Research, harold.hawkins@navy.mil

Over the past decade, cyber assault on military, governmental and industrial networks has grown dramatically in frequency, sophistication and effectiveness. These attacks range from data theft to system denial or degradation, and their impact, whether directly on military systems, or indirectly, on the networks used by organizations contracted or sub-contracted to support the military, has the potential to compromise the effectiveness of military operations. The vulnerability of our cyber systems constitutes a critical threat to national security.

Current approaches to vulnerability assessments of information technology (IT) or operational technology (OT) infrastructure suffer from two primary limitations. First, while static and dynamic code analysis tools are critical for secure development of specific components, they cannot account for complexities arising from all possible data-input/run-time execution paths. Vulnerability scanning tools such as Nessus are useful but they only provide a snapshot in time of known vulnerabilities on a small subset of nodes where scale is limited by the number of well-trained individuals and their availability to perform the scans. Second, state-of-the-art vulnerability scanning tools focus on assessing the logical software infrastructure while largely ignoring the human element that interacts with that infrastructure. This is the

case, despite of the fact that most vulnerabilities are introduced through human error as exemplified by acts of omission (e.g. forgetting to close a port), commission (clicking on a phishing link), misplacement (e.g. connecting a classified machine into an unclassified network), or malicious intrusion (e.g. insider threat). The state-of-the-art vulnerability scanners are not designed to detect vulnerabilities introduced by humans interacting with the system because they contain no formal characterization of the cognitive and social behavior of the attackers. While social engineering assessments can be effective, they also require expensive involvement of experienced security professionals.

Needed are autonomous vulnerability assessment tools that can work in conjunction with human analysts to provide greater coverage of a network over more sustained periods of time. The tools should be given a logical network coverage area and then work independently to discover vulnerabilities within that area while alerting the analyst only when they find significant vulnerabilities that require immediate attention. Autonomy is necessary to reduce cognitive workload of the cybersecurity analyst so that they can focus on more operational-level tasks such as determining the most critical parts of the network to scan based on mission criticality and current threat intelligence.

This Minerva topic seeks innovative multidisciplinary research, entailing the contributions of artificial intelligence (AI) as well as behavioral, social and statistical sciences, aimed to develop automated techniques for the assessment of network vulnerability to cyber assault along lines described above. We seek solutions with four primary features. First, they should be designed to apply to a broad range of network types, extending across scales, structural implementations, and applications. Second, because the techniques and targets of cyberattack are rapidly evolving, the solutions must be developed to be modular and capable of extensive scale-up. Third, they should be developed with the capability to uncover an extensive range of possible sources of vulnerability. Lastly, they must be informed by socio-psychological theory and analyses addressing the sources of errors in judgment that raise the vulnerability of cyber systems to attack and provide the bases for techniques to mitigate/remediate these errors.

We envision a research effort that includes an analysis of existing cyberattack databases, augmented with insights from social psychologists and both civilian and military cyber subject matter experts, to identify potential vulnerabilities and their sources. It should include development and demonstration of an executable system for automated vulnerability analysis. In addition, it should include a creditable demonstration of the validity of the system.

G. Topic 7: Power, Deterrence, Influence, and Escalation Management for Shaping Operations

POC: Martin Kruger, Office of Naval Research, martin.kruger1@navy.mil

There has been an increase in basic research on power, influence, and escalation management methodologies but a lack of empirically tested or theoretically founded decision support tools for selecting the best strategies. Multidisciplinary approaches to generate new theories and methodologies that incorporate strategy and strategic thought, psychology and decision-making, area studies, and culture, sociology and economics are needed to understand the potential and limitations of power, influence, and escalation management options and to understand how to develop predictive capabilities. Compared with the relative certainty and stability of the Cold War, introduction of new global threats has increased in recent years. These threats come from resurgent peers, rogue states, and international terrorist organizations. As the numbers of hot-spots increases, so do power projection, influence, and escalation management options particularly cyber risks. Examples of power projection include information warfare and cyber-attacks, action affecting economic conditions, diplomacy, and kinetic attacks. Influence and escalation management strategies include those options as threats as well as carrot and stick approaches (e.g. aid funding, Foreign Military Sales (FMS), stability force training). This topic seeks predictive models of power, influence, and/or escalation management strategies in shaping the future of a specific

hot-spot and whether generalized theories allow lessons learned in one region to be applied to another region. Theories that establish causality between action and outcome and action and prediction are desired on power projection, influence, and escalation management strategies to predict and measure their ability to shape an area of interest. The aim is to make it easier for US and allies to identify the best strategy for a situation and to recognize strategies that are most dangerous options for the US and allies. Specific areas of interest include the use of power projection/influence/escalation management actions on/between non-state institutions, rising military powers and rogue states and the use by those states on US and Allies.

Power projection

- Drivers affecting how a state or states influence others through the projection of power
- For those drivers, what observables (direct and/or proxy) can determine if actions are effective?
- Novel approaches for validating the causal dynamics between specific *power projection strategies* (*diplomacy, information, military, and economic* (DIME)) actions and outcomes
- Advancing theory that allows a prediction of outcomes resulting from power used by A on B.
- The balance of power between the state and other traditional and non-traditional institutions

Deterrence Theory

- Drivers affecting how states decide how to deter decisions made by others
- For deterrence drivers, what observables can be used to determine if actions taking are effective?
- Measuring the balance of power between the state and traditional and non-traditional institutions
- Approaches for validating causal dynamics between specific deterrence strategies and outcomes.
- Advancing theory that allows a prediction of outcomes resulting from a deterrence

Beyond conventional deterrence and power projection

- Approaches for validating the relative importance of power/deterrence actions on outcomes
- Advancing theory that predicts outcomes resulting from multiple power and deterrence actions
- Theory governing the use of power and deterrence concurrently
- Frameworks for escalation dynamics in reciprocal power and deterrence actions

Influence theory

- Processes and factors that affect state decisions on how to influence decisions of other states
- Approaches for validating causal dynamics between specific influence strategies and outcomes.
- Advancing theory that allows a prediction of outcomes resulting from influence

Escalation management

- Approaches for validating the relative importance of power/influence actions on outcomes
- Advancing theory that predicts outcomes resulting from multiple power and influence actions
- Theory governing the use of power and influence concurrently
- Frameworks for escalation dynamics in reciprocal power and influence actions

Area studies

- Social, cultural, and historical factors affecting success/failure of power projection or influence actions applied to an area to shape decision spaces, and application to the realities of today
- Social, cultural, and historical factors affecting the choice of power projection or influence actions to shape the decision space of others, and application to the realities of today.

Operational effectiveness

- What combination of power/influence/escalation management techniques, under what conditions are successful in creating decision outcomes that favor US and Allied interests. Given successful decision outcomes, can those techniques be generalized and applied to similar or varied conditions?

H. Topic 8: Security Risks in Ungoverned and Semi-Governed Spaces

POC: Lisa Troyer, Army Research Office, lisa.l.troyer.civ@mail.mil

This topic aims to support research to understand areas vulnerable to sociopolitical instabilities in physically and virtually contested spaces that lack strong governance infrastructures and to understand the

dynamics of great power competition in these spaces. The emphasis is on building scientific understanding about how these ungoverned and semi-governed spaces evolve, and the consequences for the nation and world from a cross-national perspective. How do contests over these spaces affect the global balance of power? There are three domain spaces of particular interest: (1) Regions undergoing transitions in governance (e.g., areas of the Middle East, Africa, Eurasia); (2) Spaces subject to rapidly evolving and varying degrees of international conflict and governance (e.g., cyberspace); (3) Areas in which international laws are undergoing shifts (e.g., outer-space, polar regions, deep sea and international waters). These diverse types of domains represent contested or potentially contested regions in which social structures, particularly governance and political structures, are increasingly unpredictable and which pose security risks. Many of these contested regions are repositories for high-demand, valuable resources, and social control implies resource control. Additionally, technology has opened human access to these semi-governed domains. For example, outer-space, cyber-space, polar regions, and deep sea areas are all characterized by a lack of comprehensive formal law and universally agreed-upon governance structures. As well, states undergoing formation or transition (esp. after crises) lack stable governance. This topic also seeks insight on how different nation states are formulating policy and governance structures related to these semi-governed and ungoverned spaces.

Little scientific attention has been paid to these spaces, despite the fact that they pose substantial risks of illicit activity, international conflict, violence, and threats to national security and global social order. This Minerva interest area seeks better understanding of these dynamics and their implications in a wide range of types of spaces (i.e., geographical, technical, environmental). How do state and non-state actors organize to control regions of limited formal governance? What determines resource control? What are the implications for surrounding domains? Can related national security risks be identified? Addressing these and similar questions will benefit from rigorous, interdisciplinary study by researchers with experience in a variety of geographic regions. Mixed-method approaches that integrate qualitative and quantitative analytic strategies are encouraged, as are multi-disciplinary theoretical approaches that facilitate the development of causal models and robust validation methods.

Specific foci may include, but are not limited to:

- Evolving sociopolitical and economic structures in currently contested geographic regions (including for example regions of the Middle East, Africa, Eurasia), with a comparative lens;
- Effects on control of these spaces on the global balance of power;
- Balance between state and non-state actors;
- Resource control (e.g., mineral, natural, technological) in contested regions on earth or in outer-space;
- Emerging governance structures and markets in ungoverned and semi-governed spaces