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Deterrence and the United States Coast Guard: Enhancing Current Practice with Performance Measures

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Deterrence and the United States Coast Guard: Enhancing Current Practice with Performance Measures

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16. Abstract (MAXIMUM 200 WORDS) Deterrence displaces or delays unwanted behavior. More ambitiously, deterrence aims to permanently discourage an individual or individuals from such behavior. It operates through the <i>prospect</i> of pain or pleasure. Fear of future pain and hope of future pleasure influence choices, habits, and predilections. Individuals seek to avoid pain and maximize pleasure. Expectations of pain and pleasure will vary, but given an individual's or group's specific sensibilities a pattern of pain-minimization and pleasure-maximization persists. An effective deterrence strategy rewards "good behavior" and punishes "bad behavior." Coast Guard deterrence effectiveness is anchored in a multifaceted approach to safety, stewardship, and security in maritime <i>communities</i> . The Coast Guard is also effective in customizing its approach to particular communities or sub-groups within a community to deter unwanted behavior. However, the Coast Guard has not adopted an explicit data-informed strategy of deterrence. As a result Coast Guard practice and outcomes are uneven, measurement is not possible, and continual improvement is accordingly difficult. The effectiveness of Coast Guard practice is limited by the absence of an organizing theory, systematic process, and measures of performance. Based on the long-time Coast Guard practice of deterrence observed, this study has identified several complementary theories of psychology, sociology, and economics that may be applied to develop a deterrence strategy. Specifically, the theories of Becker, Ostrom, and Kahneman provide a theoretical foundation for a proposed strategy of deterrence and a methodology/tool proposed here called the <i>Deterrence Integration Modeling Environment</i> (DIME). DIME combines these theories with Coast Guard practice and data-informed technology to bridge the gap between theory and operations. Based on these findings, this study recommends the Coast Guard design and build a DIME proof-of-concept system to capture and manage "big data" to advance the new strategy of deterrence.					
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EXECUTIVE SUMMARY

Deterrence displaces or delays unwanted behavior. More ambitiously, deterrence aims to permanently discourage an individual or individuals from such behavior.

It operates through the *prospect* of pain or pleasure. Fear of future pain and hope of future pleasure influence choices, habits, and predilections. Individuals seek to avoid pain and maximize pleasure. Expectations of pain and pleasure will vary, but given an individual's or group's specific sensibilities a pattern of pain-minimization and pleasure-maximization persists.

An effective deterrence strategy rewards “good behavior” and punishes “bad behavior.”

Interviews with personnel from each of the six core Coast Guard programs and the Maritime Awareness function were conducted for this study. The interviews found an absence of any consistent Coast Guard definition of deterrence. Yet this study observed that the Coast Guard is often an effective practitioner of deterrence, regularly using the prospect of pain and pleasure to achieve its mission.

Its effectiveness is anchored in a multifaceted approach to safety, stewardship, and security in maritime *communities*. The Coast Guard is also effective in customizing its approach to particular communities or sub-groups within a community to deter unwanted behavior.

But the Coast Guard has not adopted an explicit data-informed strategy of deterrence. As a result Coast Guard practice and outcomes are uneven, measurement is not possible, and continual improvement is accordingly difficult. The effectiveness of Coast Guard practice is limited by the absence of an organizing theory, systematic process, and measures of performance.

This study reveals an untapped opportunity for the Coast Guard to leverage and extend its tactical application of deterrence into a strategic strength. **Specifically, we recommend that the Coast Guard elevate deterrence to a strategic level.** An explicit strategy of deterrence will identify specific expectations for the relationship between practice and outcomes and will track this relationship to support continual improvement

Based on the long-time Coast Guard practice of deterrence observed, this study has identified several complementary theories of psychology, sociology, and economics that may be applied to develop a deterrence strategy. Specifically, the theories of Becker, Ostrom, and Kahneman provide a theoretical foundation for a proposed strategy of deterrence and a methodology/tool proposed here called the *Deterrence Integration Modeling Environment* (DIME). DIME combines these theories with Coast Guard practice and data-informed technology to bridge the gap between theory and operations.

Based on these findings, this study recommends the Coast Guard design and build a DIME proof-of-concept system to capture and manage “big data” to advance the new strategy of deterrence. DIME would be fielded on a limited basis to determine its full benefits and costs.

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

COIN	Counter Insurgency
CPT	Cumulative Prospect Theory
DIME	Deterrence Integration Modeling Environment
DCIP	Detention, Classification, Identification, Prosecution
GAO	Government Accountability Office
ISN	Instrumental, Social, Normative
LMR	Living Marine Resources
MSO	Maritime Security Operations
PROTECT	Port Resilience Operations and Tactics to Counter Terrorism
SES	Social-Ecological Systems (Theory)
SIG	Social Identity Groups



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1 THE FUNDAMENTALS OF DETERRENCE

Unwanted behavior takes many forms. In the maritime domain it ranges from neglecting safety regulations to purposeful over-harvesting to drug-running, terrorist operations, and much more.

The maritime domain of the United States is huge. The Coast Guard does not have – cannot have – sufficient resources to protect, preempt, or interdict every unwanted or even every illegal act. Yet on most days in most places most of those operating in the maritime domain do not consciously choose to break the law and unintentional neglect harms a comparatively small number.

The Coast Guard is one part – an especially important part – of a complex system that encourages “positive” behavior and discourages “negative” behavior. In this system positive and negative are defined by the Coast Guard, but also reflect the values, observations, and interventions of others. Deployed properly, the system sets conditions that encourage positive habits and choices well before an individual or group takes action. The system does this (or not) by influencing how individuals and groups view themselves, interact with others, view the Coast Guard, interact with the Coast Guard, understand right and wrong, perceive their self-interest (especially in regard to pain and pleasure), and anticipate the future. From this mix of perceptions emerges behavior.

Deterrence is a purposeful, strategic engagement with the whole system to achieve specific goals – especially suppression of unwanted behavior – and often to influence specific individuals or groups.

The meaning of deterrence has morphed considerably. During the late 18th Century it combined both pain and pleasure. During the late 19th and first half of the 20th Century it came to be understood mostly as the threat of negative sanctions to discourage criminal behavior. During the Cold War deterrence was redefined as the threat of massive retaliation for a narrow range of unacceptable choices by an adversary. Since the close of the Cold War the word has begun to morph again. (See Annexes for *Morphology of Deterrence in the English Language*.)

But all the definitions share a focus on influencing the emotional, pre-cognitive¹ attitudes of targeted individuals or groups. All of the definitions are based on an understanding that humans seek to maximize pleasure and minimize pain.

In this context pleasure and pain are more than immediate sensations. Rather they are the outcome of how individuals relate to their society, define themselves, and understand past, present, and future.

Prospective pain can include death or injury, guilt for contributing to the death or injury of another, the financial costs of a legal sanction, the shame of being caught in an illegal or immoral act, and so on. Prospective pleasure can include good health, wealth, social respect, self-respect reflecting a particular value system, and so on.

For the purposes of deterrence, the emphasis on *prospective pain or pleasure* is important. Prospective pain or pleasure is a frame-of-influence that nudges individuals or groups in one direction rather than another through unconscious predilections and habits, even more than directly influencing an immediate choice. A

¹ Pre-cognitive: Habits and other predispositions to action of which the actor may not be explicitly aware.

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security patrol may “deter” a planned attack if it happens to be at the right place at the right time (or the terrorists happen to choose the wrong place at the wrong time). But a strategy of deterrence is much more effective if it can cultivate a frame-of-influence that discourages the planning long before the terrorists arrive on-target.

Over the centuries a number of philosophers and even more parents have attempted to understand what mix of prospective pain and pleasure is most effective in deterring unwanted behavior (and encouraging desired behavior). Over the last half-century this goal has produced a significant number of empirical studies of psychological and sociological behavior. Over the last two decades – as computational power has increased and become less expensive – these empirical studies have been complemented by more accurate predictive models. The most pertinent models are presented below.

1.1 Predicting Behavior in order to Deter Behavior

While the effective practice of deterrence remains as much art as science, it is increasingly a science-informed art. Compared to forty years ago or even twenty years ago we know much more about how (and why) human populations behave in certain ways and how to influence this behavior. This new knowledge is transforming several domains including advertising, retailing, political campaigns, supply chain management, policing, and more.

The experience of policing is especially relevant. In the last 15 years several large and mid-sized police departments have adopted an approach very similar to that which will be recommended in Section 5.0 of this paper. According to Cynthia Lum writing in *Ideas in American Policing*:

Three areas of technological diffusion into policing provide the tools needed for evidence-based policing... They are the use of integrated information technology and sharing systems; the adoption of computerized crime-mapping programs for hot-spot and problem-oriented policing; and the employment of crime analytic packages for long-term strategic planning. Agencies are realizing that information is central to their effectiveness and those technological tools that facilitate the collection and management of data may help reduce crime.²

This focus on reducing crime is a deterrence strategy. Instead of reacting to criminal activity, evidence-based policing looks for precursor patterns and proactively intervenes with a suite of tactics designed to influence behavior and prevent criminal acts. We are especially interested in the *use of integrated information technology and sharing systems; the adoption of computerized crime-mapping programs for hot-spot and problem-oriented policing*. In other words, this strategy is data-driven, meaning that the precursor patterns are obtained using information technologies such as data-mining, predictive analytics, and others. (Technical methods will receive more attention in Sections 4.0 and 5.0.)

There are many models, matrices, cubes, and other frameworks that organize collections of data and analyze information to facilitate deterrence strategies. These frameworks are collectively called *big data* here – an approach advocated in Section 6.0. Big data collected on space/place, and various behaviors within the space/place, is used to record and evaluate various intervention options that influence behavior in the

² Lum, Cynthia, [“Translating Police Research into Practice”](#), *Ideas in American Policing*, page 4, The Police Foundation (August 2009)

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space/place. For example, big data sets containing crime statistics, demographics, and classification (car-jacking, drugs, assault, etc.) can be used to focus on high-crime areas. Appropriate strategies such as increasing lighting, surveillance, or community involvement may be applied as a deterrence, the results measured, and the decrease (or increase) in crime observed. By collecting evidence over time on the relationship between interventions and behaviors a deterrence strategy is able to apply increasingly customized and effective tactics. Successful tactics are encouraged. Unsuccessful ones discarded.

These models are adapted to the particular needs of a particular place. What works for New York is probably not optimal for Los Angeles, Tokyo, or London. The same is likely to be true for the maritime domain and for particular sectors or ports within the maritime domain. A possible “starter” model for deterrence in the maritime domain is highlighted in the graphic shown in Figure 1.

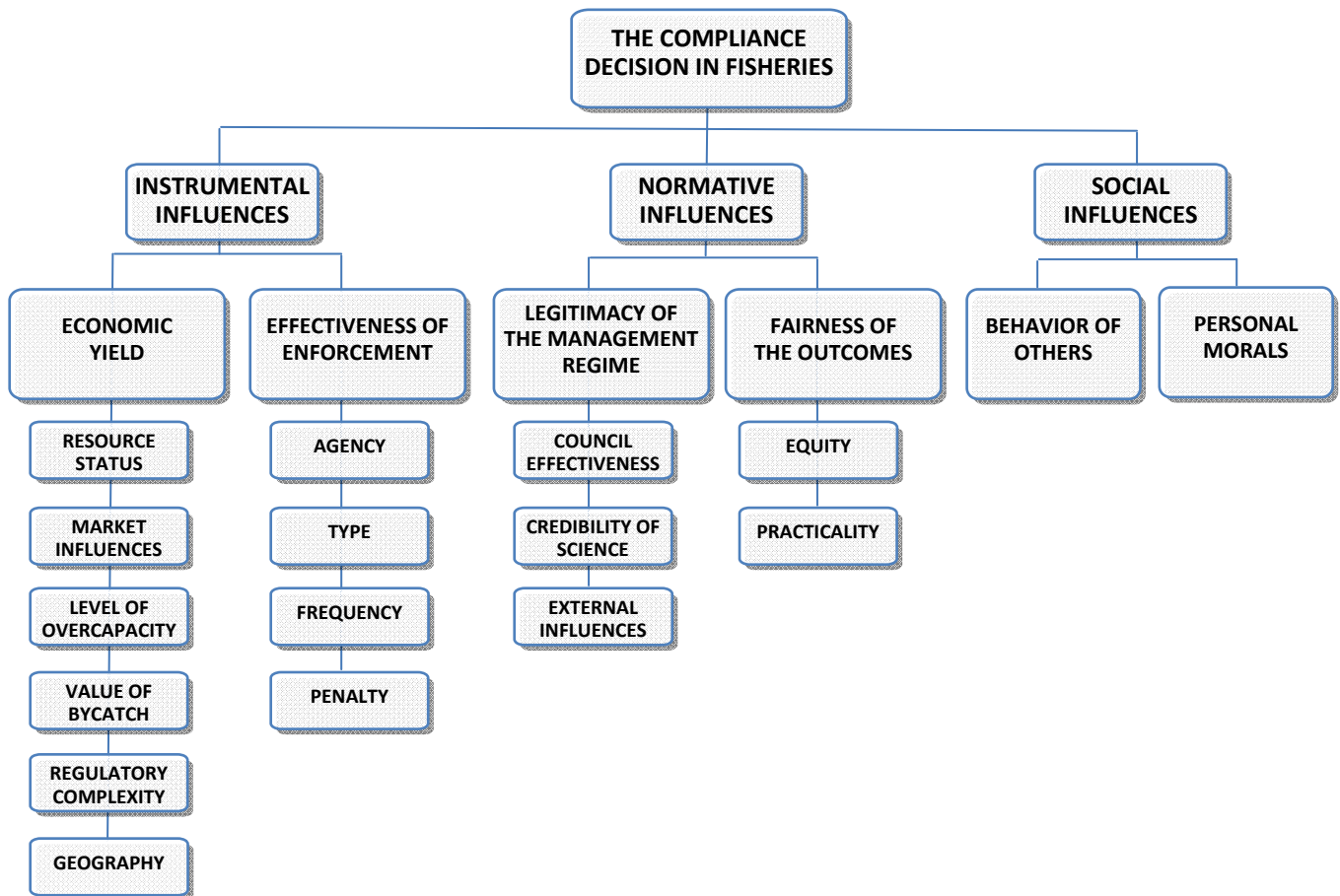


Figure 1. The ISN Compliance Model from Improving Compliance in US Federal Fisheries. Jeffrey Randall, Ocean Development and International Law (2004).

Randall’s ISN model is focused on one behavior: the compliance decision in fisheries. A strategic deterrence model will encompass a range of behaviors. But Randall’s ISN compliance model in Figure 1 is especially helpful in deriving three recurring frames-of-influence from maritime experience: Instrumental, Normative, and Social influences. An array of research suggests these influences will be at the core of any effective deterrence strategy:

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Instrumental: What are the environmental (pleasure/pain) influences on behavior? How does anticipated economic return (pleasure), likelihood of interdiction, or the prospect of punishment (pain) influence habit, choice, and predilection? How can these variables be managed to deter unwanted behavior (and encourage desired behavior)?

Normative: What are the cultural or other values that influence behavior in any particular community (any persistent collection of self-perceived “insiders”)? Are the instrumental influences perceived to be coherent with or in conflict with these values? Are rules, regulations, and “outsider” expectations perceived to be grounded in the best interests of the insiders? Are rules, regulations, and outsider expectations perceived to be fair? Is the enforcing agency (Coast Guard) seen as an agent or adversary of these values? Are Coast Guard values reinforcing of or in tension with community values?

Social: What are the human relationships that influence behavior? What are the social sub-groups within a population? What is the relationship between sub-groups? Do these sub-groups share similar normative values? How do social groups sanction – positively and negatively – identity with and conformity to the social group? Is the enforcement agency an insider or outsider in terms of social identity?

The three influences obviously overlap, but the distinctions between them are crucial and especially important when and where there is *less* overlap. If, for example, instrumental actions are seen as mostly in conflict with the normative and/or social categories, there will be wide-spread efforts to avoid and undermine the goals of instrumental action. In such a situation deterrence will be ineffective. The goal of an effective deterrence strategy is to calibrate all three categories, to create as much overlap as possible consistent with mission and policy objectives.

1.2 The Key Role of Social Identity Groups in Deterrence

Deterrence targets the highly social nature of most humans. Most of us want to be *a part of something larger than ourselves*. This is usually a source of pleasure. The challenge is in how to retain individual identity within a social identity. Struggling to retain a particular role in the social identity group (SIG) is a critical aspect of our social motivations. This is commonly achieved by establishing a voice within a smaller SIG that in turn finds a voice in a larger SIG.

Social identity groups are defined in terms of the values they collectively maintain and willingly defend. These values are defined in terms of opposing forces and often emerge in relation to other SIGs. For example, it may be acceptable to poach in one group of fishermen, but not in another. When SIGs come in contact with each other the results can be varied.

Sometimes the two SIGs will define a shared set of values that they collaboratively pursue. Sometimes they will develop adversarial relations with the intent to destroy/disintegrate the other (and optionally incorporate the defectors). Sometimes one will ‘apprentice’ to the other with the intent of maintaining a unique identity within an ultimately integrated SIG defined by the other. And sometimes SIGs will engage in something more like a mutual apprentice courtship. Most often, however, contacts between SIGs are characterized as tentative explorations of what kind of relation best serves their individual and collective interests.

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Much of human motivation can be understood in the context of the dynamic interplay between instrumental, social and normative influences. Each category is rich with opportunities for pain and pleasure. The U.S. Coast Guard should try to maximize its ability to engage this reality in order to deter unwanted behavior.

2 CURRENT COAST GUARD PRACTICE

Many Coast Guard publications and reports were reviewed for this analysis. A wide array of academic research was also accessed (See Annexes for *Research Bibliography*). Seven interview sessions were conducted between August 10 and September 27, 2011. The interviews involved personnel from all eleven mission areas and each of the Coast Guard program management areas: Maritime Security Operations, Maritime Law Enforcement, Maritime Prevention, Maritime Response, Defense Operations, and Maritime Transportation System Management.

The interviews found the absence of any consistent US Coast Guard definition of deterrence. While deterrence was perceived as an outcome of many Coast Guard functions and operations, it is usually not the focus of consistent planning or operations. It is widely assumed, for example, that patrolling a port has some deterrent effect, but for most of those interviewed, protection – not deterrence – is the purpose of patrol operations. “No one ever executes a deterrence mission,” one of the interviewees stated.

There are exceptions. The Maritime Security Operations Program – and especially the PROTECT project within that program – conducts operations that are conceived and executed with deterrence specifically in mind. But MSO personnel interviewed agreed that in general the Coast Guard tends to see deterrence as the after-effect of pursuing other purposes, especially interdiction.

While no official definition of deterrence was referenced during the interviews, it was possible to discern a general understanding of deterrence: “bad guys” are deterred by the imminent threat of detection and follow-on action. The physical proximity of an enforcement asset effectively transfers risk from one place to another place and/or from the present to the future. It is the general impression of Coast Guard personnel that deterrence is a temporary effect that deflects execution from “here and now” because the prospect of detection/detention is perceived as too likely. But because bad guys – terrorists, drug runners, illegal immigrants, and others – are *bad guys* they will attempt something similar as soon as the imminent threat of detection is removed.

The absence of a commonly-accepted definition of deterrence was surprising to most interviewees and troubling to some. In one case several days after the interview was conducted, an interviewee sent the interviewer the definition of deterrence from the Department of Homeland Security Lexicon.³ But this definition was never mentioned by anyone during any of the interviews. In reviewing Coast Guard documents, the research team did not find an official written definition of deterrence, and in most publications any reference is infrequent.

³ From the “Department of Homeland Security Lexicon”: *DETERRENT* -- Definition: measure that discourages, complicates, or delays an adversary's action or occurrence by instilling fear, doubt, or anxiety. Sample Usage: Robust countermeasures can serve as a deterrent to some adversaries, causing them to change, delay, or abandon their plans. Annotation:

1) A deterrent reduces threat by decreasing the likelihood that an attack (or illegal entry, etc.) will be attempted. 2) One form of deterrent is a prospective punitive action intended to discourage the adversary from acting (e.g., massive nuclear retaliation, Mutual Assured Destruction during the Cold War, or prison for conventional crimes). Another form of deterrent is a measure or set of measures that affects the adversary's confidence of success (e.g., fences, border patrols, checkpoints).

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The United States Coast Guard: America's Maritime Guardian (Publication 1) makes two references to deterrence. One relates to a historic role in deterring rum runners. The other is as follows:

Coast Guard cutters, aircraft, and their crews make up the second type of forces. These multi-mission platforms are assigned operations domestically or globally, and enable maritime presence, patrol, response, and interdiction throughout the maritime domain. With their military command, control, and communications networks, they allow the Coast Guard to deter criminal activity and respond to threats and natural or man-made emergencies. (Page 21)

The contemporary US Coast Guard mission is conceived and executed through six program areas. Two of the program performance plans make no reference to deterrence. Maritime Prevention references deterrence once. Defense Operations references deterrence twice. Maritime Law Enforcement has nineteen references. Maritime Security Operations has twenty-one references.

But failing to explicitly refer to deterrence does not mean deterrence is not practiced. It depends on how deterrence is understood.

When personnel from the Maritime Response Program arrived for the interview they were very clear that they do not practice deterrence. But they do give considerable attention to behaviors, habits, attitudes, tendencies, intentions and a wide range of “human factors.” They are very conscious of attempting to influence these factors to advance the US Coast Guard mission and to reduce the likelihood of events requiring a response. The interviewees were not, however, confident that their work constituted a form of deterrence.

As the interviews proceeded – especially influenced by interviews related to Maritime Safety and Maritime Stewardship – a new question was appended to the interview process. The question was, “Do you agree or disagree with the following definition of deterrence: *Action taken to specifically influence human choice in order to avoid or reduce unwanted behavior.*”

When stated in this way most of those interviewed agreed they were actively engaged in planning and practicing a deterrence mission. One of the Maritime Response Program interviewees stated, “That’s what we do every day, all the time.”

Listening carefully to the interview responses a pattern emerged: If a perceived “bad guy” is the target, action to influence the attitudes, tendencies, and habits of the bad guy(s) is understood as deterrence. If a perceived “good guy” is the target, action to influence attitudes, tendencies, and habits is understood as prevention. Most recreational boaters are perceived as good guys. Most maritime commercial operators are perceived as deserving the benefit of the doubt. Terrorists and drug runners are bad guys.⁴

With each of these targets – and other targets – the US Coast Guard undertakes to influence the emotions, perceptions, and behaviors that precede a choice. When the target is perceived as a bad guy the tools of influence are limited almost exclusively to the threat of detection, classification, identification and prosecution (DCIP). When a target’s motivations are considered more ambiguous a much wider range of

⁴ Coast Guard personnel were sometimes uncomfortable characterizing illegal immigrants as “bad guys”. Further in several instances Coast Guard personnel suggested illegal immigration could be “prevented” (deterred?) by a variety of measures that did not involve the threat of interdiction or force.

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tools tend to be applied. The threat of detection/prosecution and force is always in the mix. But outside the law-enforcement and security programs, a whole host of more positive tools are also utilized.

In the following short sections interview results are summarized by mission area.

2.1 Deterrence and the Safety Mission

In safety operations “good guys” are the typical deterrence target. Boaters and other maritime operators are presumed to have good intentions, but can be distracted and negligent. Information, education, and other forms of engagement are designed to encourage their good intentions to operate in a safe manner. In safety operations *deterrence* is usually referred to as *prevention* and focuses mostly on the pleasure principle, but includes the threat of negative sanctions.

The Maritime Transportation System Program and Maritime Prevention Program, especially through Marine Safety operations, are the principal means of organizing the US Coast Guard’s safety mission. “Everything we do is designed to influence an operator to choose safety,” is how a Maritime Response interviewee summarized the work.

Safety operations deploy the prospect of pain through compliance enforcement.

In a typical year the Coast Guard conducts more than 70,000 domestic vessel inspections and 10,000 port state control examinations, and reviews more than 15,000 vessel plans for technical compliance. On an annual basis, the Coast Guard conducts 7,500 examinations and 7,000 boardings, either dockside or underway, on uninspected commercial vessels including fishing, towing, and passenger vessels. The Coast Guard’s 24,400 container inspections in FY10 led to the identification of over 4,100 deficiencies resulting in 750 cargo/container shipments being placed on hold until dangerous conditions were corrected. The Coast Guard conducted 14,800 facility inspections to ensure compliance with safety, security, and environmental protection regulations, identifying over 5,400 deficient conditions, and monitored 1,400 oil and hazardous substance transfers to ensure compliance with environmental protection regulations and operating procedures.⁵

Several studies have been conducted and protocols have been developed to enhance the efficacy of ship inspections and other compliance activities.⁶ But given the number of vessels in US waters, these compliance activities directly involve a small percentage of total commercial and recreational platforms.

The Coast Guard also engages in a wide range of private-public partnerships that are force-multipliers to encourage safe maritime practices. In collaboration with these partnerships – involving commercial and civic organizations – the Coast Guard sponsors or actively supports promotional, informational, and educational programs such as the Mariner Credentialing Program (involving over 200,000 merchant mariners), the Commercial Fishing Vessel Safety Exam, Boat Responsibly!, Tow Safe, Navigation 2040, Safe Bridges, Waterways Watch, and Atlantic Wind.

⁵ United States Coast Guard, *Maritime Prevention Program Performance Plan, Fiscal Years 2012-2017*

⁶ Armacost and Pet-Armacost, *Risk –based management of waterway safety* (2002); Heij, Bijwaard, Knapp, *Ship Inspection Strategies* (2010); Merrick and Harrald, *Making Decisions about safety in US Ports and Waterways* (2007); Moffett, Bohara, Gawande, *Governance and Performance: Theory Based Evidence from US Coast Guard Inspections* (2004); Talley, Jin, Kite Powell, *The US Coast Guard Vessel Inspection Programme* (2005)

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The Marine Transportation System Management Performance Program explains that it seeks to ensure “a safe, secure, efficient and environmentally sound waterways system. We accomplish this through Ocean and Waterways policy and planning in collaboration and partnership with 27 federal agencies and other local, state, national, and international stakeholders.”⁷

Through cultivation of community standards, social expectations, and a spectrum of positive and negative sanctions, the Coast Guard facilitates application of the pleasure principle to discourage unwanted choices.

2.2 Deterrence and the Stewardship Mission

In stewardship operations the unconscious tendencies, unrecognized habits, and explicit intentions of those being targeted are perceived to be more ambivalent. While it is presumed that most of those involved in harvesting fish, oil, or other maritime resources are inclined to play by the rules, it is recognized that economic motivations can sometimes result in consciously cutting corners, and there are a small percentage who will try to get away with whatever they can. But, mostly, in regard to stewardship, the Coast Guard engages marine operators as well-intentioned. In managing marine resources, deterrence is referred to as *prevention* or *monitoring* or *regulating* and gives attention to both pleasure and pain.

The Maritime Response Program, Maritime Law Enforcement Program, and Maritime Prevention Program, especially through its Marine Environmental Protection operations are the principal means of organizing the Coast Guard’s Stewardship mission. These programs explicitly apply a full spectrum of deterrence strategies.

The prospect of pain is certainly invoked:

Over 8,500 fixed and mobile facilities fall under Coast Guard responsibility. Waterfront facilities are inspected for compliance, including scheduled annual inspections and random spot checks. Transfer monitor activities are performed to ensure vessels and facilities engaged in the movement of oil and hazardous materials have implemented required safeguards, monitoring, and communication protocols. Containers used in the transport of hazardous materials are examined to ensure structural integrity is sufficient to withstand the stresses of global transport, and that hazardous materials are packaged, labeled and declared properly.⁸

Non-compliance is punished by fines, seizure, and imposition of legal liability for any harm that results from operations, whatever the cause, regardless of motivation or intent. Several efforts are underway to increase the likelihood of detection, speed of detention, and severity of punishment for those who are non-compliant.⁹

But these Coast Guard programs are also the most active in systematically engaging stakeholders to develop a shared commitment to standards, positive processes, and compliance. In many cases stakeholder engagement is a statutory requirement. For example, the Oil Pollution Act of 1990 specifies several

⁷ United States Coast Guard, *Marine Transportation System Management Performance Plan*, Fiscal Years 2012-2017,

⁸ United States Coast Guard, *Maritime Prevention Program Performance Plan*, Fiscal Years 2012-2017

⁹ Among others: Armacost, Robert, *A 0-1 nonlinear programming model for Coast Guard fisheries law enforcement aircraft patrols* (1992); Cohen, Mark A. *Empirical Research on the Deterrent Effect of Environmental Monitoring and Enforcement* (2000); Heyes, Anthony, *Implementing Environmental Regulation: Enforcement and Compliance* (2000)

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proactive processes involving risk assessment, planning, and preparedness. Steven Wischmann finds, “The development of area contingency plans and the associated activities appear to have engendered a dialogue between industry and state and federal agencies that in the past may have existed but in a less systematic manner. The advantages of these and other similar efforts have indeed allowed for the enhancement of the pollution and response posture throughout the United States.”¹⁰ More broadly Wischmann argues,

The Coast Guard is in the business of managing risk. To do this requires the most open and honest dialogue possible with the public and industry. This reality does not do away with the responsibility for enforcing regulations as they exist, but it does encourage the kinds of discussions that allow for determining how best to achieve the requirements of statute and, if necessary, to alter regulations to maximize the attainment of the intent of law.¹¹

The Coast Guard is also involved in a wide range of dialogues with fishery stakeholders. Some of these dialogues are established by statute; others are a long-standing practice of the Coast Guard. Coast Guard personnel interviewed noted that especially in regard to living marine resources (LMR) the Coast Guard is seen as both cop and firefighter. While the compliance mission is always present, so is the rescue mission.

The combination of “enforcer” and “savior” gives the Coast Guard a uniquely credible role in fostering and managing meaningful dialogue among all major stakeholders. Some may not appreciate the regulatory role, but the vast majority of the maritime community honors the courage and skill of the Coast Guard in making rescues and, as a result, will engage the Coast Guard in a more positive way than would otherwise be the case even on regulatory and other enforcement issues.

In both the safety and stewardship mission areas the US Coast Guard consistently deploys a wide range of tools to influence emotions, attitudes, habits, and tendencies. Outside the security mission, the Coast Guard applies both pain *and pleasure* through a wide variety of techniques, relationships, and programs.

2.3 Deterrence and the Security Mission

In security operations deterrence targets are perceived to be largely “bad guys”: illegal migrants, drug runners, terrorists, and other adversaries. Here deterrence is most often referenced explicitly and focuses almost entirely on the threat of pain through detection, detention, and punishment. In contrast with the safety and stewardship missions, the concept of deterrence used in the security mission is much less layered, and presence is restricted mostly to the physical proximity of tactical force.

One of those interviewed with the Maritime Law Enforcement Program volunteered his personal definition of deterrence: “The application of force to influence choice.”

But even in the Security Mission area, Coast Guard personnel distinguished between different kinds of bad guys. In one interview it was suggested that Cape Verdeans might be deterred from smuggling if they were assisted in better managing their Exclusive Economic Zone. But this was contrasted with the Mexican cartels or Somali pirates who were characterized as through-and-through bad and only susceptible to the threat of force.

¹⁰ Wischmann, Steven M., Cooperative Problem Solving in Environmental Protection on the Inland Waterways, Transportation Research Record (1998)

¹¹ IBID

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According to those interviewed, even when a security operation is focused on a known set of “bad guys” deterrence is mostly an after-thought or taken for granted. One of those interviewed with the Defense Operations Program stated, “During all my time planning and executing tactical operations, I can’t remember ever consciously thinking about deterrence.”

The Maritime Law Enforcement Program, the Maritime Security Operations Program, the Defense Operations Program, and the Maritime Prevention Program, especially through its Ports, Waterways, and Coastal Security operations, are the principal means of organizing the US Coast Guard’s security mission. These Coast Guard programs give explicit attention to deterrence and sometimes even call it deterrence. The Maritime Security Operations Program Management Plan refers to deterrence a total of twenty-one times. For example:

The Maritime Security Operations program encompasses activities conducted to detect, deter, prevent, and disrupt terrorist attacks, and other criminal acts in the maritime domain. It includes the execution of antiterrorism, response and recovery operations, and related preparedness activities such as the establishment and oversight of a maritime security regime and maritime domain awareness. Through this program, the Coast Guard complies with and leverages the Maritime Operational Threat Response Plan, which ensures coordinated U.S. government response to threats against the United States, its Marine Transportation System, and its interests in the maritime domain, by establishing roles and responsibilities, which enable the government to respond quickly and decisively. This program links to the National Infrastructure Protection Plan which identifies critical infrastructure elements, key resources, and systems. The Coast Guard is designated the Sector Specific Agency for Maritime Transportation Systems in the National Infrastructure Protection Plan. Through Maritime Security Operations, the Coast Guard mitigates the overall risk to maritime critical infrastructure and key resources. In the context of the National Infrastructure Protection Plan, this includes actions to deter the threat, mitigate vulnerabilities, or minimize the consequences associated with a terrorist attack or other incident.¹²

Per the compliance framework outlined by Randall (Figure 1), these approaches to deterrence are mostly restricted to “effectiveness of enforcement.”

3 THREE THEORIES RELEVANT TO DETERRENCE

Interviews with Coast Guard personnel and academic research demonstrate the Coast Guard is very active in a wide-range of deterrence activities. But these activities have emerged from tradition and practical problem-solving, not from theory or strategy. As a result, the activities are fractured and may not even be recognized as related to deterrence. The activities are typically narrowly effective, but they lack strategic amplification and direction.

The current situation is reminiscent of Sun Tzu’s admonition: “Strategy without tactics is the slowest route to victory. Tactics without strategy is the noise before defeat.”

The US Coast Guard is not alone in this lack of an effective deterrence strategy. During the Cold War, deterrence of communist expansion by threatening massive retaliation was the *grand* strategy of the United States. This narrow concept of deterrence -- massive retaliation -- so dominated strategic theory that other aspects of deterrence were largely neglected for nearly two generations. There are a number of efforts

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currently underway to retrieve other concepts of deterrence and redefine deterrence for post-Cold War realities.¹²

Based on the interviews and research completed, three prominent economic theories seem especially well-suited for informing and organizing a Coast Guard strategy of deterrence:

Rational Choice Theory – In sociology, economics, political science and other fields it is posited that humans are strongly motivated to want more rather than less of a good. Risk is quantified mathematically as expected utility or gain. Rational people attempt to maximize positive outcomes (expected gain) and minimize negative outcomes (expected loss). Based on this understanding the behavior of “rational actors” can be observed, measured, predicted, and thereby influenced. This theory is especially associated with Gary Becker, an economist and sociologist at the University of Chicago. In 1992 Becker received the Nobel Prize in Economics.

Cumulative Prospect Theory (CPT) – This is a model for predicting decisions made under uncertainty. This theory originated with Amos Tversky (deceased) a psychologist at Hebrew and Stanford Universities and Daniel Kahneman, a psychologist at Princeton. Prospect theory essentially says that a person’s perception of risk depends on the person’s frame of reference. In some cases, a person will become risk-averse, while in other cases the person will become risk-seeking. For example, people who do not buy health insurance are likely risk-accepting, while people who pay high insurance premiums are considered risk-averse. Kahneman was awarded the Nobel Prize in Economics in 2002.

Socio-Ecological Systems Theory (SES) – This comparatively new theory has emerged from the study of how common pool resources (such as fisheries and watersheds) are managed. The theory incorporates aspects of complexity, adaptation, emergence, and how human systems interact with each other and the natural environment. Of particular interest in this model are the goals of sustainability, connectivity, and the role of externalities in complex evolving systems. Elinor Ostrom, a political economist at Indiana University, has made major contributions to SES. Ostrom shared the Nobel Prize for Economics in 2009.

While it is more nuanced than a simple progression, these three theories are related to each other. As the sequence of Nobel prizes – 1992, 2002, and 2009 – may suggest, Cumulative Prospect Theory depended on the foundational work of Rational Choice Theory, and SES incorporates the insights of CPT. Together they reflect more than a half-century of progress in understanding, modeling, and predicting human behavior. Below are brief overviews of each theory.

3.1 Rational Choice Theory

In 1968 Gary Becker, then on the faculty of Columbia University, published *Crime and Punishment: An Economic Approach*. This is widely cited in a range of fields related to deterrence and regularly appears in the Research Bibliography available in the Annex.

According to Becker, “The analysis assumes that individuals maximize [their] welfare...Their behavior is forward-looking, and it is also consistent over time. In particular, they try as best they can to anticipate the uncertain consequences of their actions.”¹³

¹² For example see : Schmitt, Eric and Shanker, Thom, *Counterstrike*, Times Books (2011) or Pavel, Berry and Kroenig, Matthew, [Unilaterally Assured Destruction](#), Council on Foreign Relations (2011)

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As individuals seek to “maximize welfare” they may engage in behavior the Coast Guard is charged to minimize. The individual’s immediate perception of welfare may involve boating while intoxicated, delaying needed maintenance, exceeding fishing harvest quotas, or illegal entry to the United States among many other actions. Over time these behaviors may involve others, potentially many others, and become predilections or habits unless an effective deterrence strategy is applied.

Increasing the certainty, speed or severity of punishment can reduce the expected utility associated with an action. But Becker's deterrence theory suggests the effectiveness of any prospective punishment is conditional upon individual attitudes towards risk. Risk-accepting individuals are deterred more by higher probabilities of arrest and conviction than by the prospect of more severe punishment. A mandatory death sentence has little effect if the likelihood of detection or interdiction is perceived as low.

Rational Choice Theory highlights how actors calculate – and as important, anticipate – the extrinsic costs involved in getting something they want. What *potential* costs are acceptable under what conditions and for what benefit?

This may seem to be little more than common sense, but Becker also expressed these behavioral understandings in a series of mathematical formulae. (Please see Annex for the formulae included in *Crime and Punishment: An Economic Approach*.) This provided a provocative framework for gathering, mathematically manipulating, and analyzing behavioral observations. Over time the quality of the data and the accuracy of the mathematical modeling could be compared to actual outcomes. This resulted in tweaks to both data collection and the model, which incrementally became more and more accurate.

The interviews found that Coast Guard personnel tend to categorize actors as “good” or “bad”. A wide range of deterrence tactics are currently applied to those who are perceived as good. Fewer options are deployed against bad actors. Rational Choice Theory would encourage the Coast Guard to view everyone as “welfare maximizing” and deploy the full spectrum of deterrence tactics at the biggest threats to mission achievement.

The Coast Guard applies Rational Choice Theory (knowingly or not), when it increases perceived probabilities of arrest and conviction. A number of field studies of Rational Choice Theory have found a consistent deterrent effect from this intervention. The field studies have also demonstrated that rewarding cooperative behavior effectively deters unwanted behavior.

3.2 Cumulative Prospect Theory

Field studies and modeling of Rational Choice Theory discovered, however, that many actors are not always “rational”, at least not in terms of what economists and other “outsiders” originally perceived as maximizing self-interest. As behavioral data were accumulated, recurring occasions of actors making choices at odds with outsider expectations of welfare maximization were observed. This is at odds with Becker’s model.

¹³ Becker, Gary, S. Nobel Prize Speech, Royal Bank of Sweden, 1992

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In the late 1970s Tversky and Kahneman (and others) demonstrated that these seemingly illogical outcomes could be explained by how actors choose between perceived probabilities to evaluate potential gains and losses. This initial work found the actor's reference point (typically the status quo) was crucial to perception of risk. Most actors prefer to avoid potential loss, compared to the reference point, rather than seek potential gains. One brief explanation: "We have an irrational tendency to be less willing to gamble with profits than with losses".¹⁴

An implication potentially important to the Coast Guard: those who perceive they have little to lose will "maximize welfare" in ways very different from those who are oriented to keep what they have. Poachers, for example, may seek risk (poaching) if they perceive it as highly likely to succeed, or avoid risk, if they perceive success as unlikely.

By the late 1980s Tversky and Kahneman advanced their work with Cumulative Prospect Theory, demonstrating how choices are framed can have a dramatic impact on how risk is perceived. There is, in particular, a very strong cognitive tendency to over-weight extreme possibilities. In a magazine interview Kahneman explained,

Our innovation was that we identified some categories of risk that were the result of certain cognitive illusions. That was a novelty and that got people excited. But it's only part of the picture. There is an alternative way of looking at this that is becoming much more fashionable. There's a paper that I really like a lot. The title of it says the whole story: "Risk as Feeling." The idea is that the first thing that happens to you is you're afraid, and from your fear you feel risk. So the view of risk is becoming less cognitive....

What actually happens with fear is that probability doesn't matter very much. That is, once I have raised the possibility that something terrible can happen to your child, even though the possibility is remote, you may find it very difficult to think of anything else....

Emotion becomes dominant. And emotion is dominated primarily by the possibility, by what might happen, and not so much by the probability. The more emotional the event is, the less sensible people are. So there is a big gap... We say that people have overweighted the low probability. But the prospect of the worst case has so much more emotional oomph behind it.¹⁵

Overestimating risk (risk-avoidance) or underestimating risk (risk-seeking) depends on the individual's frame of reference. Thus, a poor person is motivated to buy health insurance more than a wealthy person, simply because of their respective frames of reference. Similarly, a person "with nothing to lose" will underestimate risk of being caught than someone with "a lot to lose". The Coast Guard can leverage frames of reference, and perhaps even change actors' frames of reference to shift a potential offender's behavior from risk-accepting to risk-averse.

As with Becker, the key insights of CPT are expressed through mathematical modeling. This modeling has had remarkable success predicting human behavior in a variety of otherwise ambiguous contexts. The demonstrated effectiveness of CPT in these other contexts encourages testing its efficacy in the maritime domain in relation to Coast Guard missions.

¹⁴ Tvede, Lars, 1999. *The Psychology of Finance*. Chichester: Wiley, p. 94.

¹⁵ [Daniel Kahneman: The Thoughtleader Interview](#), Strategy and Business, February 28, 2006

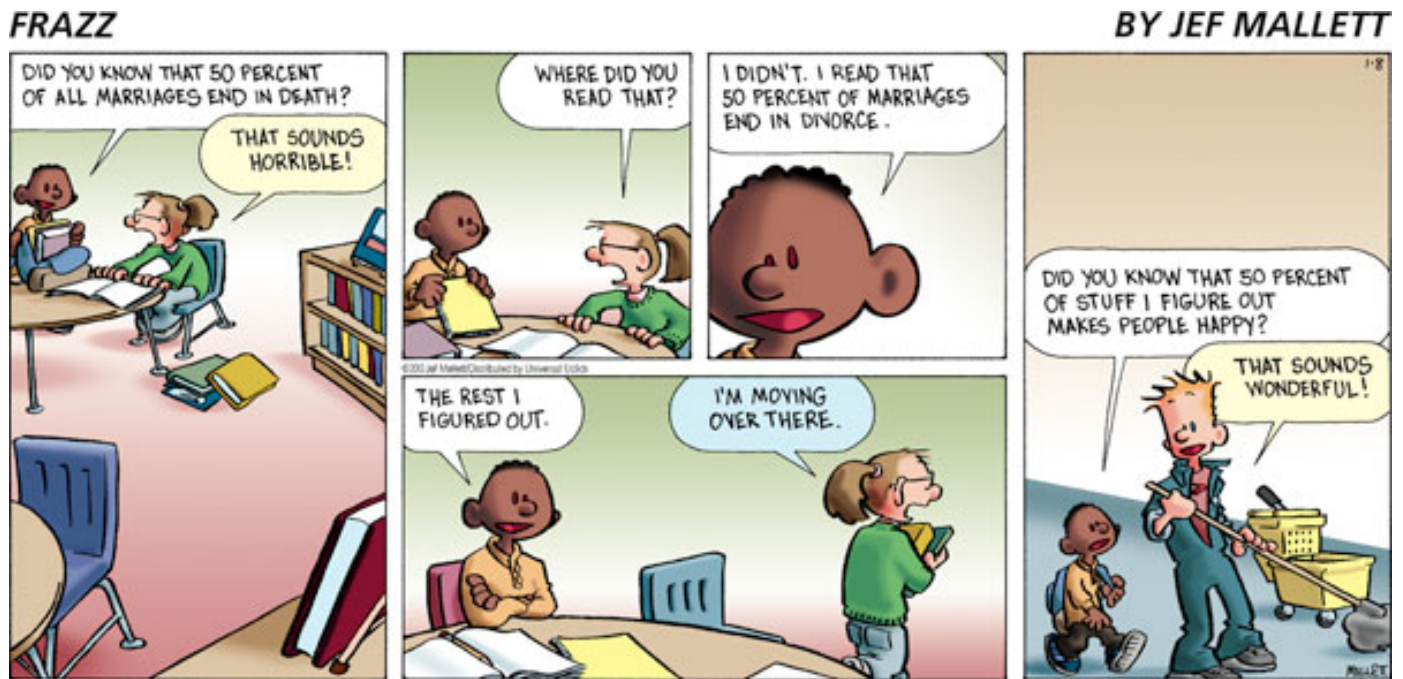


Figure 2. Cumulative Prospect Theory in practice.

3.3 Socio-Ecological System Theory

Both Becker and Tversky/Kahneman tended to focus on individual actors. Yet it is clear that predilections, habits, and choices are influenced by the groups with which humans identify and other groups with which we must interact (Social Identity Groups).

Socio-Ecological System Theory translates key insights from Rational Choice Theory and Cumulative Prospect Theory into the social context.

In the interview above Kahneman gives an example of how one person's risk perspective can be transformed by the possibility of a perceived threat to another (a child, in his example). The actor's perception and/or prospect of pain or pleasure is potentially transformed through his or her relationship with the other person, or a particular place, or cherished belief, or some other sense of relationship or value that is essential to the self-identity of the actor. The threat – whether real or not – is in any case indirect. It can still have a powerful impact. This same phenomenon can often be observed in relationships with neighbors, friends, extended family, tribal connections, co-religionists, and a wide array of other connections.

Beginning in the 1960s with detailed field studies of municipal water systems, followed in the 1970s by even more extensive studies of metropolitan police systems, and subsequent research into a wide range of common pool resources, Elinor Ostrom and her colleagues have pioneered the careful empirical analysis of welfare maximization by social groups. Among their key findings is that several sorts of government interventions designed to deter bad behavior can actually encourage bad behavior. Dr. Ostrom explains in her 2009 Nobel Prize Lecture:

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Humans have a more complex motivational structure and more capability to solve social dilemmas than posited in earlier rational-choice theory. Designing institutions to force (or nudge) entirely self-interested individuals to achieve better outcomes has been the major goal posited by policy analysts for governments to accomplish for much of the past half century. Extensive empirical research leads me to argue that instead, a core goal of public policy should be to facilitate the development of institutions that bring out the best in humans. We need to ask how diverse polycentric institutions help or hinder the innovativeness, learning, adapting, trustworthiness, levels of cooperation of participants, and the achievement of more effective, equitable, and sustainable outcomes at multiple scales.

Avoidance of pain is not the only inducement to good behavior. The pursuit of pleasure also plays an important role. Among the most significant sources of pleasure for most humans is sustained social engagement and acceptance. After a half-century of giving much more attention to pain, the late 20th Century and early 21st Century saw pleasure reemerging in the deterrence calculus. Ostrom observed that pleasure is also linked to acceptance from one's peers.

Nowhere has this been more conspicuous than in the US military's Counter-Insurgency (COIN) strategy. Widely considered a success in turning around US fortunes in Iraq, the strategy began to be implemented in 2007. According to Field Manual 3-24:

Successful conduct of COIN operations depends on thoroughly understanding the society and culture within which they are being conducted. Soldiers and Marines must understand the following about the population in the AO (Area of Operations):

- *Organization of key groups in the society.*
- *Relationships and tensions among the groups.*
- *Ideologies and narratives that resonate with groups.*
- *Values of groups (including tribes), interests, and motivations.*
- *Means by which groups (including tribes) communicate.*
- *The society's leadership system...*

The interconnected, politico-military nature of insurgency and COIN requires immersion in the people and their lives to achieve victory.

The COIN Field Manual continues:

The integration of civilian and military efforts is crucial to COIN operations. All efforts focus on supporting the local populace and HN (host nation) government. Political, social, and economic programs are usually more valuable than conventional military operations in addressing the root causes of conflict and undermining an insurgency.

In many coastal and port communities the Coast Guard is deeply embedded in the social fabric. For generations the Coast Guard has regularly engaged these communities in ways that, in the words of Ostrom, "bring out the best in humans." The Coast Guard has learned this is a pragmatic means of achieving its safety and stewardship missions. In some ways theory and tools have finally caught up with the Coast Guard. It is now possible to apply these tactics more systematically, strategically, and in a way that can be improved over time.



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To deter unwanted behavior the Coast Guard must be able to influence perceptions, habits, predilections, and choices. These three theories – and their related mathematical models – give the Coast Guard important tools for understanding and engaging the “battlespace.”

4 FUSING THEORY AND PRACTICE

The theories articulated by Randall, Becker, Tversky/Kahneman, and Ostrom have been tested, in some cases found to be inaccurate, adjusted, and in many cases confirmed as accurately predicting future reality. Yet selected elements of these theories provide a foundation for fusing theory and practice.

These theories of human behavior do not have the predictive certainty of Newton’s Three Laws of Motion, but they are helpful abstractions of reality that expose behavioral patterns to enhanced observation and potentially enhanced understanding.

Twenty years ago – perhaps even ten years ago – these theories might have been intellectually interesting to the Coast Guard, but their influence on strategy, operations, and tactics would necessarily have been slight. Because of advances in computational capability, reduction in cost, and explosion of accessibility to information technology these theories can now be harnessed to integrate cutting edge strategic theory to field level tactics and practice.

The Statement of Work authorizing this study includes the following:

Coast Guard force structure and utilization is, in part, based upon providing a certain amount of enforcement presence in a given area that is predicted to have a level of activity of interest to the federal government (ex: Bering Sea & fisheries, Straits of Florida & illegal immigration, southern Caribbean, Eastern Pacific & narcotics trafficking, Port state control inspectors w/in US ports, etc.) Part of the value of providing presence in each of these areas is quantified by violations detected and enforcement actions taken. However, leaders believe that the greatest value of providing presence is in the illicit activity that is deterred. Fishing vessels adhere to quota, traffickers go elsewhere or delay, commercial vessels ensure they comply with safety and environmental regulations, etc., all motivated (perhaps just in part) by the real possibility of a government sanction. The underlying principle of human psychology is probably the same as the one that causes an obvious plywood replica of a police cruiser propped on the side of a highway to effect a noticeable reduction in the average speed of traffic.

This scenario includes a bit of Becker and even more Kahneman.¹⁶ According to Kahneman the fake police cruiser is a cognitive anchor reminding drivers of previous emotionally fraught encounters with the police. As such, even when it is recognized as a plywood replica it has a deterrent effect on all but the most risk-tolerant (or risk-seeking) actors. The scenario as outlined does not reflect Ostrom. But Coast Guard practice – especially in fisheries management – is very consistent with Ostrom’s findings.

¹⁶ Amos Tversky, the long-time partner of Daniel Kahneman died in 1996. Kahneman has continued their work including a book published in late 2011 entitled *Thinking, Fast and Slow* which gives more detail on the cognitive foundations behind effective deterrence and non-deterrence.

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Several studies in the Research Bibliography demonstrate that compliance – perhaps more accurately cooperation – with the Coast Guard in fisheries management is the outcome of a complex combination of factors¹⁷ including the threat of government sanctions, but go well beyond that single variable.

The literature identifies the following factors as determining compliance: potential illegal gain, severity and certainty of sanctions, individual moral development and standards of personal morality, individuals’ perceptions of how just and moral are rules being enforced, and social environmental influences... human economic motivation (is) multidimensional, arguing psychic well-being is based on acting morally and receiving the approval of others, as well as enhancing wealth. 18

4.1 Multidimensional Presence

Especially in advancing stewardship and safety, the Coast Guard engages problems and opportunities from **multiple dimensions**. For example, the Coast Guard works with the maritime community to develop vessel safety standards and procedures, positive support and acceptance of these standards and procedures are provided through Coast Guard training and certification programs, and the Coast Guard enforces the standards and procedures through inspection and sanctions.

4.1.1 A Few Examples of Multidimensional Presence

	Social	Normative	Instrumental
Safety	Towing Vessel Bridging Program, Commercial Fishing Safety Advisory Committee, MMIT	MMSeas, MITO, CAMI, National Recreational Boating Safety Program	Advance Notice of Arrivals, Inspections and Interdictions
Stewardship	Sea Partners, Regional and Area Contingency Plan Committees, Regional Fisheries Management Councils, Interagency Coordinating Committee for Oil Pollution Research, Arctic Council	Unannounced Exercise Instruction, MER program, Reoccurring Support Base for ICCOPR, Arctic National Center of Expertise, various certification programs.	Inspections and Interdictions
Security	PWCS inquiries, Port Maritime Security Comm.	AMSP, MTSA, ITDS, Port Security Plans	Advance Notice of Arrivals, Inspections and Interdictions

Figure 3. Examples of current Coast Guard “Multidimensional Presence.”

¹⁷ See especially:

¹⁸ Kuperan, K. and Sustinen, Jon, *Blue Water Crime: Deterrence, Legitimacy, and Compliance in Fisheries*, Law & Society Review, Vol. 32, No. 2 (1998) Page 313

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Several of those interviewed from the Maritime Prevention Program emphasized that the Coast Guard role in safety and stewardship is enhanced, in the words of one interviewee, by being both “enforcers” and “saviors.” Many maritime communities are comparatively small. The same Coast Guard officer who sanctions a safety violation today may risk his life to save you tomorrow. “This gives the Coast Guard unique authority,” another interviewee commented.

This multidimensional approach has been found to be effective outside the maritime domain. The same community-oriented, relationship-focused, transparent strategies are at the heart of effective community-oriented policing and counter-insurgency operations. As long recognized by the Coast Guard, “relationships deter.”

Relationships deter because when rich and meaningful relationships are in place there is a wide range of force-multipliers for both positive encouragement and negative sanction. The whole community participates in rewarding cooperative behavior and punishing non-cooperative behavior.

Coast Guard programs facilitate these relationships across the whole community. Both Coast Guard practice and emerging scholarship demonstrate that the social and normative dimensions are critically important to the effectiveness of instrumental enforcement. Theory and practice each suggest that “enforcement presence” (or instrumental presence) is reinforced by “normative presence” and “social presence.” When Multidimensional Presence is operational there is evidence for a reduction of illicit activity and an increase in cooperative activity. But the evidence is not yet sufficient to understand what mix of instrumental, normative, and social factors is most effective and especially most cost-effective. This is where big data comes in.

How can the strategic insight of Multidimensional Presence be operationally systematized and tactically streamlined? How can Coast Guard decision-makers target their investment of resources to maximize deterrence? What works best given certain conditions and specific objectives?

This is analogous to the earliest days of community-oriented policing. When community-oriented policing or evidence-based policing or data-driven law enforcement was first implemented, it was mostly a matter of gathering data on a range of trial-and-error experiments.¹⁹

Is the “broken window” or expired license plate or loitering the better precursor of bigger problems? Only over time and across many places did patterns begin to emerge from the data that allowed for more efficient application of resources. This is consistent with the experience of data-driven decision-making – called big data – in a variety of fields.

4.2 Measuring the Deterrent Effect of Multidimensional Presence

Measurement is a challenge for many social outcomes. In fact, many claim deterrence cannot be measured. The challenge is exacerbated by the perceived need to measure the absence of certain behaviors.

¹⁹ Thurman, Quint C. Contemporary Policing in a Community Era (From Crime & Justice in America: Present Realities and Future Prospects, Second Edition, P 111-121, 2002, Wilson R. Palacios, Paul F. Cromwell, et al., eds.) *“For police agencies committed to the concepts of community policing, its implementation will be time-consuming, filled with trial-and-error, and forged through the lengthy process of designing and evaluating programs. Programs that are effective must then be sustained through appropriate personnel training and structural reform.”*

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But we can collect information over time, looking for patterns over time. We can also collect information in one place and compare it to the same information gathered in a different place, looking for variation between places. We can examine the data for coincidence, correlation, and covariance, considering the statistical probabilities that specific variables or combinations of variables contribute to demonstrated outcomes. As we accumulate more data over time and for more places, we can have increasing confidence in any statistical patterns that may emerge.

The Coast Guard already collects data on various kinds of non-compliance. Data is also collected on many instrumental enforcement activities (as defined by Randall). Much less data is collected on social and normative activities, but it should be possible to collect such data. This is not to suggest that the data collected will be comprehensive. Choosing meaningful proxy indicators for a range of instrumental, social, and normative variables is crucial. In dealing with social behaviors Elinor Ostrom writes,

Performance measurement depends... upon estimates in which indicators or proxy measures are used as estimates of performance. But utilizing multiple indicators, weak measures of performance can be developed even though direct measures of output are not feasible.²⁰

The Government Accountability Office has provided guidance on the development and use of indicators:

*An **indicator** is a quantitative measure that describes an economic, social, or environmental condition over time. The unemployment rate, infant mortality rates, and air quality indexes are a few examples of indicators. Indicators are measures that are focused on changes in conditions. Some indicators may be direct in that they measure what they say they do. For example, the unemployment rate is a direct indicator. Other indicators may be indirect or “proxy” indicators. For example, the number of patents granted may be used as a proxy for measuring the degree of inventiveness.*

*An **indicator system** is a systematic effort to assemble and disseminate, through various products and services, a group of indicators that satisfy the needs of intended audiences and together tell a story about the condition and progress of a jurisdiction or jurisdictions.²¹*

When indicators are selected thoughtfully and an indicator system is reasonably applied, the GAO has encouraged the use of such measures.

Figure 4 suggests some indicators that may be recorded and collected into a big data database for analysis. Metrics such as probability of detection, levels of penalty, and anticipated gains may be easier to quantify than legitimacy, morality, justice, social pressure, equity, and behavior of others. Thus, defining and quantifying observed metrics (or indicators) remains a challenge. Furthermore, the interaction between and among influences as defined in Randall’s ISN model remains to be developed. An integrated model that combines the theories of Randall, Ostrom, and others with big data is needed to make the deterrence strategy operational.

²⁰ Ostrom, Elinor and Ostrom, Vincent, Public Goods and Public Choices, Workshop in Political Theory and Analysis, Indiana University

²¹ *Key Indicator Systems*, US Government Accountability Office, March 2011 (GAO11-396)

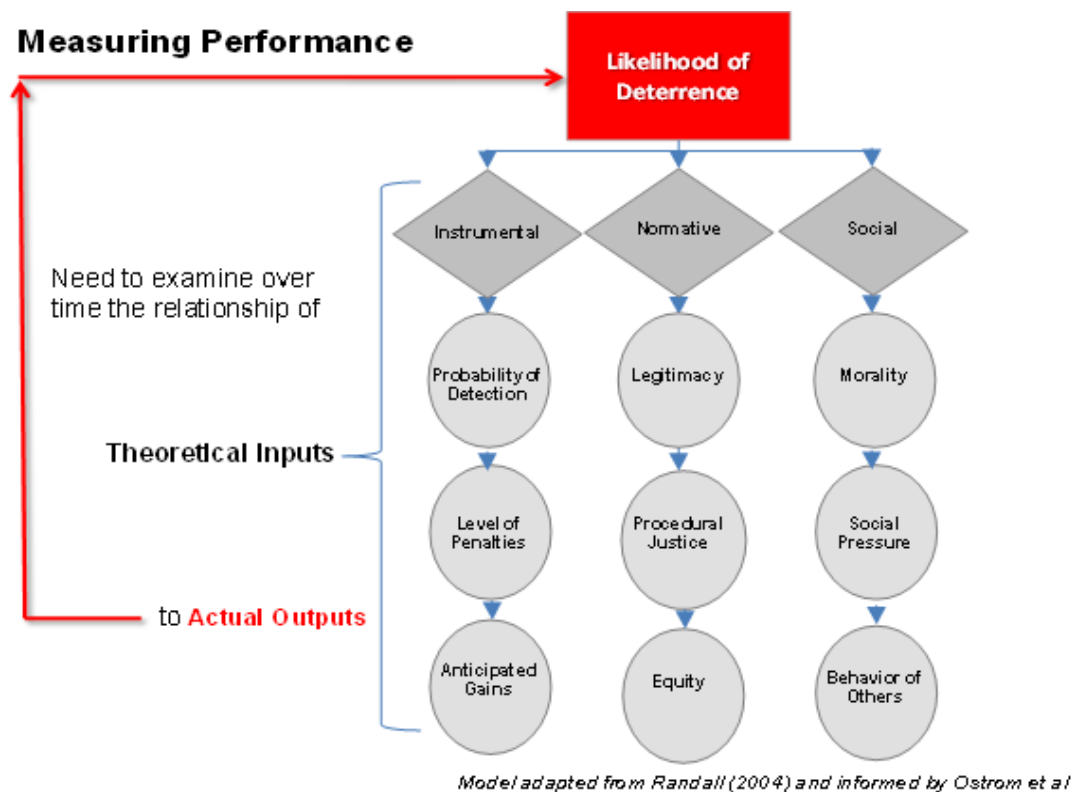


Figure 4. Conceptual relationships involved in ISN influence model.

5 DIME: AN INTEGRATED MODEL OF DETERRENCE

At the core of the proposed approach is the development of the *Deterrence Integration Modeling Environment* (DIME). DIME combines the theoretical models described previously into an operational model that can inform decisions to increase deterrence likelihood.

When implemented as a computer program, DIME becomes part of a continuous improvement feedback loop (See Figure 5) whereby Coast Guard actions are performed, influences recorded, deterrence measured, and future actions informed.

The effect of deterrence actions are measured, recorded, and processed to find correlations and patterns across different time-frames and spaces. These outputs are processed as outlined below. The DIME model formats and displays a “battlespace” as a map with overlays, each overlay providing a decision maker a more detailed view of tactical options and their projected strategic outcomes.

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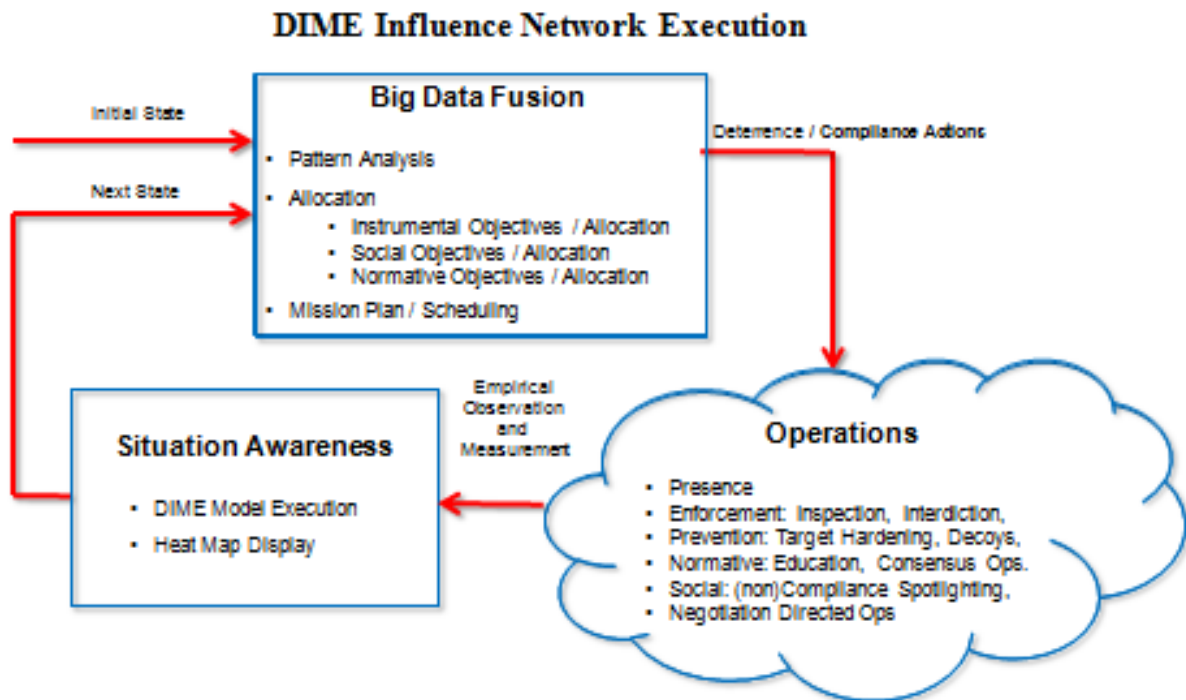


Figure 5. DIME strategic feedback loop with notional data inputs.

The DIME software tool will provide decision-support for the Coast Guard by integrating and displaying to decision makers four key **indicators** of human behavior:

Indicators of how instrumental, social, and normative (ISN) factors interact to influence the likelihood of deterrence effectiveness; answering the question: Do Coast Guard missions deter unwanted behavior?

Indicators of how decision-making patterns under risk influence the likelihood of deterrence effectiveness: Which operations have the best payoff?

Indicators of how population patterns – or network behavior – influence the likelihood of deterrence effectiveness: Are there “hidden” patterns in the data that can be leveraged?

Indicators of how the preceding relationships and patterns present themselves in time and space – and can thereby be predicted and influenced by Coast Guard activities: What is the best allocation of limited resources to achieve the maximum impact?

By integrating these indicators and making explicit the interdependencies and relationships among the indicators, COAST GUARD decision-makers will be able to explore, experiment with, and measure a wide variety of strategic and tactical options to enhance deterrence likelihood. Which COAST GUARD actions – which aspects of Multidimensional Presence – have the biggest payoff? DIME provides the COAST GUARD with an empirically-based operational tool for predicting and choosing how to influence human behavior.

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5.1 Big Data

In the last few years a revolution has begun in accessing and analyzing “Big Data”. In this new paradigm a broad range of seemingly unrelated data-sets are trawled for correlations and connections. Retailers have discovered unexpected relationships in consumer behavior. The weather service has exploited subtle connections to enhance weather forecasting. Online behaviors by large populations are used to predict public health patterns.

According to a recent report in the New York Times:

Data is not only becoming more available but also more understandable to computers. Most of the Big Data surge is data in the wild — unruly stuff like words, images and video on the Web and those streams of sensor data. It is called unstructured data and is not typically grist for traditional databases.

But the computer tools for gleaning knowledge and insights from the Internet era’s vast trove of unstructured data are fast gaining ground. At the forefront are the rapidly advancing techniques of artificial intelligence like natural-language processing, pattern recognition and machine learning.²²

The Coast Guard collects a vast array of data, much of it unstructured and not previously examined for correlations and patterns. When combined through “Big Data fusion” the COAST GUARD data sets will offer decision-makers a much more complete view of reality and the sub-rosa relationships that spawn reality. By being able to purposefully direct Coast Guard interventions at these sub-rosa relationships, the likelihood of deterrence can be increased.

A decade ago the computational power – and related cost -- needed to implement DIME would have been a serious impediment. Today the issue is not so much information technology as effective design, access to data, and meaningful analysis.

5.2 DIME Influence Network

The DIME Influence Network is the heart of DIME’s Big Data design. This influence network combines the theories of Randall, Ostrom, and others, as described above.

The DIME Influence Network captures both the primary influences defined within the literature as well as implied logical relations between the various contributing influences. Randall’s ISN Influence Model – which emerged from the maritime domain – is considered an especially good foundation for developing the DIME Influence Network, see Figure 6 on the next page.

In Figure 6, nodes capture instrumental, social, or normative attributes held by an actor. The influence of one node on another is indicated by a link pointing from one to the other. A plus sign indicates a positive influence, while a negative sign indicates a negative influence.

The items below are indexed to the numbered boxes on the diagram (See Figure 6), starting at the bottom of the diagram.

²² Lohr, Steve, [The Age of Big Data](#), The New York Times, February 11, 2012

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1. The actor's regulatory compliance behavior is *independently* influenced by two kinds of perceptual/cognitive states:
 - a. Her perception of the value of compliance for her community (2)
 - b. Her belief in the value of compliance for herself (11)
2. Her perceived value of compliance to her community is collectively influenced by:
 - a. Her own 'moral development' (the extent to which she identifies with her community) (3)
 - b. Her perception of the 'legitimacy' of the regulation (4)
3. Moral Development is assumed to be:
 - a. Difficult to influence amongst adults over intervals of modest duration
 - b. *Necessary* for a perception of communal compliance value
4. Her perception of the legitimacy of the regulation is collectively influenced by:
 - a. Her perception that the regulation will produce (long term) value to her community (5)
 - b. Her perception that the regulation can be enforced fairly, i.e., be of value to all of her community (9)
5. Her perception of the value of the regulation to her community is influenced by:
 - a. What she believes that her community believes is the value of the regulation (6)
 - b. How well *she* understands and believes in the value of the regulation (10)
6. Her perception of her community's assessment of the regulation's communal value is assumed to be collectively influenced:
 - a. What she hears of her communities expression on the regulation's value (7)
 - b. The social standing of the person expressing those thoughts (8)
7. Her perception of the values being expressed is in turn (not represented) influenced by:
 - a. The values that are held by her community
 - b. The value that are successfully communicated to her (i.e. perceived by her).
8. Her perception of the 'social standing' of the speaker's expressing opinion is in turn (not represented above) collectively influenced by:
 - a. Their past actions in conformance with community values
 - b. The extent to which she is aware of those actions
9. Her perception of the perceived fairness of the regulation is influenced by:
 - a. The extent to which she has been informed of how fairness will be achieved (10)
 - b. Her perception that the regulation enforcement is in fact fair (14)
10. The effectiveness of Regulation Educational Programs is influence by a (not represented) factors including:
 - a. Frequency, content, speaker 'charisma' ...
11. The actor's belief in the value of compliance to herself is assumed to be [consistent with Prospect Theory] influenced by:
 - a. The expected value of compliance relative to her current situation (12)
 - b. The expected value of non-compliance relative to her current situation (13)

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12. The Expected Value of compliance is influenced by:
 - a. The personal (non-communal) believed value of compliance (not explicitly represented)
 - b. What she perceives her community/competitors are doing (or will do) that influences that value (14)
 - c. How she perceives of her current (default) behavioral situation (15)
13. The Expected Value of non-compliance is influenced by:
 - a. The personal (non-communal) believed value of non-compliance (not explicitly represented)
 - b. What she perceives her community/competitors are doing (or will do) that influences that value (14)
 - c. How she perceives of her current (default) behavioral situation (15)
14. The influences on how she perceives her community as being compliant is (not explicitly represented) is assumed to be influenced by:
 - a. How compliant her community is
 - b. The extent to which she is made aware of compliant and non-compliant behavior
15. How she frames her current situation is influenced by a variety of (not explicitly represented factors) including:
 - a. How she frames the question (as in the cartoon example)
 - b. How she hears other frame the question

The '+' on a link represents a positively correlated influence on the strength (or certainty) of its target node. An increase in the strength of a source node increases the influence on the target node. The '-' relation represents a negatively correlated influence on the target node such that an increase in the strength of a source node generates a decrease in the influence on the target node.

The 'and' relation in this model represents the logical AND where both antecedents are necessary for the consequent. That is, all influences must be present to exert an influence on the target node. The 'or' relation represents the logical OR where either antecedent is sufficient for the consequent. In other words, one or more influences are sufficient to exert an influence on a target node.

The 'leaf' nodes of the diagram represent leverage points where external influences can be applied. **In a sense, these are "levers" to be "pulled" by the Coast Guard to exercise deterrence.** Each lever is one aspect of Multidimensional Presence. It should also be noted the model includes influences sufficiently far back in the 'causal' chain so as to capture some actions that generate influences on multiple nodes within the *network*.

More importantly the diagram captures several instances of 'social' influences stemming from the actions and/or expressed beliefs of other agents that generate influences on the modeled agent. These nodes (and similar nodes in expanded versions of this model) define the multi-agent social network linkages that we'll subsequently exploit to capture the social network dynamics.

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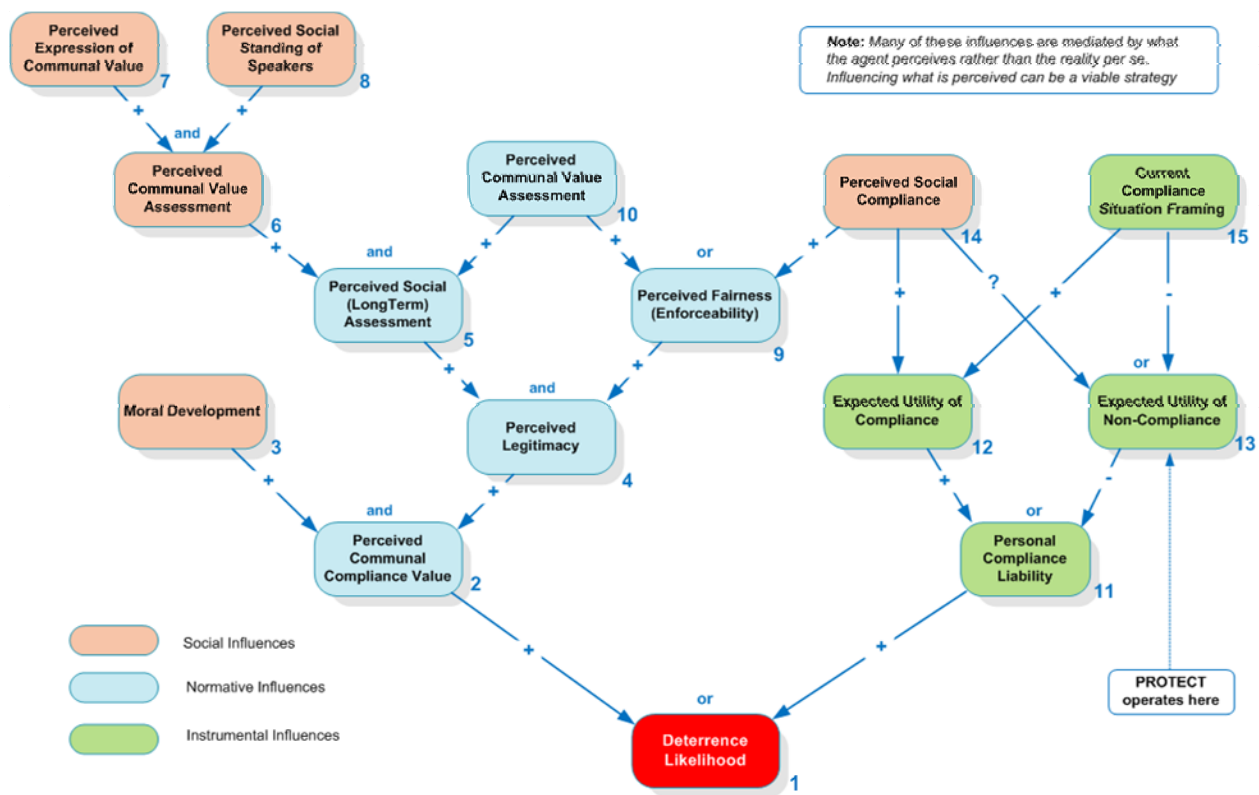


Figure 6. DIME influence model.

By populating DIME with field data from the maritime domain – selected to represent real Coast Guard problems – and applying appropriate algorithms to the model (many of these algorithms selected from or influenced by prior work by Becker, Tversky/Kahneman, Ostrom, and others), Coast Guard decision-makers will be given a tool to examine and explore how different tactics in different combinations and sequences can enhance deterrence. How can Multidimensional Presence be most effectively and efficiently applied?

5.3 DIME as an Operational Model

To be useful to the Coast Guard, DIME must become an operational model. It must be able to process large data sets – Big Data – and extract meaning from patterns detected within these data sets. The meaning must reflect actual human behavior related to actions relevant to the Coast Guard’s mission. This could be achieved through a spatial-temporal model that combines the DIME Influence Network of individual behavior with spatial-temporal frameworks that track Social Identity Groups and other population sets consisting of many actors (groups).

A heat map approach is proposed whereby the DIME Influence Network is embedded into a spatial-temporal heat map situational awareness system. A heat map is a graphical representation of data where individual values are represented as colors. In this example, each color reflects a different influence (as in figure 6 where instrumental, social, and normative influences are color coded). One of the authors of this report developed a proof-of-concept example of one possible DIME implementation; see Figure 7 on the next page.

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The proof-of-concept (called ‘COAST GUARD Predator Heatmaps’) successfully integrates and demonstrates a number of key features that will become a part of the operational DIME system.

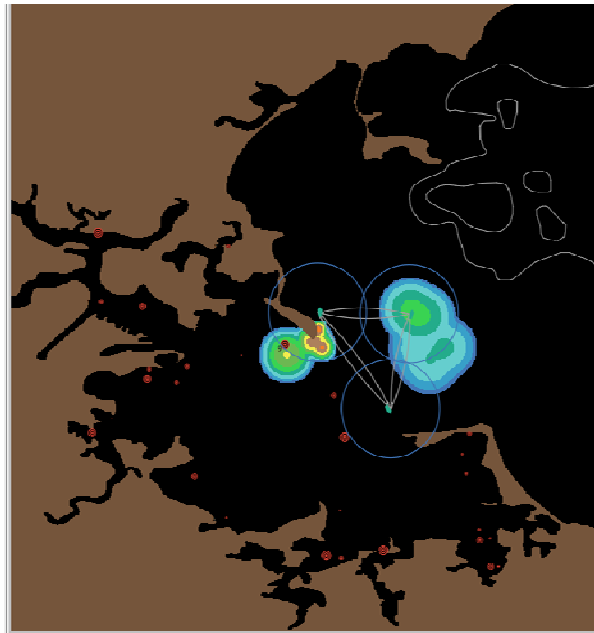


Figure 7. A Proof-of-Concept 'Heat Map Model of Habitual Tendencies'

The scenario in Figure 7 shows the decision making context as a heat map of Boston Harbor. In its fully operational form the visualization will be generated dynamically from field data – either historical or real-time – representing the particular place at particular times. The objective is to defend multiple targets (of variable value) by deterring an adversary from attacking any of the multiple targets.

Some of the key features of Coast Guard Predator are listed here:

- Multiple adversarial threats are modeled in time and space
- Multiple defensive assets are modeled
- GIS-based ‘heat maps’ are dynamically updated to indicate adversarial ingress
- Successful interdictions produce spatiotemporal dynamic ‘avoidance zones’
- Defensive assets deploy to exploit adversarial precognitive ‘avoidance zones’
- Defensive assets dynamically coordinate interdiction strategy based on evolving spatiotemporal conditions using decentralized techniques

The COAST GUARD Predator proof-of-concept successfully demonstrated the viability of using dynamic spatiotemporal GIS as an integration foundation for incorporation of precognitive tendency formation and effects modeling.

5.4 Modeling Emergent Behaviors from Simple Habits

Traditionally many military modeling and simulation efforts have relied on the use of validated globally-oriented, system dynamics models. This works perfectly well when the target of the behavior is reasonably well understood as a theory and capable of being modeled as a linear system. Lanchester Equation-based models are prime example of this class.

The class of systems modeled here are much different, because the behavior of the overall system is neither well understood nor in many cases fully understandable. The many feedback loops produce non-equilibrium behavior and sensitivity to input conditions. Thus the goal of modeling and simulation takes on a slightly different objective. Essentially the objective is to explore and consequently better understand the possible range of collective behaviors and their likely probabilities of occurrence and sensitivities to various input conditions. The objective is to deploy Multidimensional Presence to purposefully increase the *likelihood* of deterrence. The approach is to mine big data to uncover non-obvious patterns.

Important classes of collective behaviors (patterns) to be discovered are often referred to as *emergent behaviors* – global patterns that emerge from local behaviors. Emergent behaviors are often (at least initially) unanticipated and often stable only under a narrow range of input conditions. They may also function either beneficially or detrimentally vis-à-vis defined objectives.

Simple habitual behaviors at the (local) agent level can produce flexible and adaptive emergent behaviors at the (global) collective level. The objective of DIME is to identify the levers that guide emergent behaviors in a desirable direction. Which levers yield positive behavior and which ones lead to negative behavior?

The key initial objective of the DIME development effort is an integrated *deterrence operations* planning and analysis tool which incorporates state-of-the-art knowledge of deterrence theory so as to maximize the effectiveness of financial and operational resources.

The result is the sort of “indicator system” endorsed by the GAO. Given the complexities of human behavior no one expects this sort of indicator system to operate independent of human experience and judgment. But the indicator system can reinforce human judgment with options, challenges, and unintended consequences that might otherwise not be considered. Combined with human judgment the indicator system can provide overtime a rich resource for considering a range of strategic options and investments.

6 CONDUCTING A PILOT TO ASSESS PROJECTED COSTS AND BENEFITS

A fully operational and effective Deterrence Integration Modeling Environment (DIME) would provide the Coast Guard a planning, operational, and measurement tool uniquely able to enhance the likelihood of deterrence in safety, stewardship and security missions. Tactical options could be evaluated before taking action. The impact of tactical decisions could be measured. Future tactical decisions could be improved. A mission-wide strategy of deterrence could be advanced. Investments could be targeted and justified.

The benefits of DIME could be quite significant, but the costs are largely unknown. Particularly unknown is the current availability of Coast Guard-specific data to populate the relational elements noted above.

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To confirm the potential benefits and more accurately anticipate the potential cost, a pilot study of the DIME Influence Network should be conducted.

It is recommended that a pilot analysis effort be performed on a specific COAST GUARD mission area involving a constrained area of responsibility such as a Coast Guard Sector or Station.

The pilot should consider the cost of the following design inputs and assess the value of the resulting outputs.

- Does DIME as outlined, reasonably represent actual Coast Guard practices?
- Does the Coast Guard currently collect data on practices matching DIME's assumptions?
- Where such data exist, what is necessary to access and translate the data to be input into DIME?
- What is the cost of accessing and translating?
- If such data – or specific elements of data – are not currently collected, what would be operationally required to collect such data?
- What would be the cost of collecting such data?

The pilot study's findings would inform a decision to continue or not with proof-of-concept model development. An operational proof-of-concept would collect the data, run the algorithms, and display the results to support operational and investment decisions, and evaluate strategic effectiveness of deterrence for the pilot site. Key questions for the second phase include:

- Using historical data, does DIME accurately predict behavior?
- Does DIME provide actionable options for Coast Guard decision-makers to apply to influence behavior?
- When the Coast Guard models interventions using DIME, can consequences be projected with reasonable statistical confidence?
- Is the DIME proof-of-concept operationally practical for designing and planning implementation of a deterrence strategy?
- What would be the cost in terms of time and money to train Coast Guard personnel to appropriately use DIME? Would this service need to be outsourced?
- Does the DIME proof-of-concept provide meaningful data for evaluating the effectiveness of measures to increase the likelihood of deterrence?
- Are the development and maintenance costs of DIME justified by the strategic benefits of using the system?

The answers to these questions will determine if the pilot results justify full development of DIME.

7 SUMMARY

The US Coast Guard has inherited and preserved a practice of deterrence that reflects cutting edge theory and scholarship. Integrating practice and theory with a data-driven operational model could transform the strategic effectiveness of Coast Guard deterrence practice, generating significant operational and financial benefits. Assessing the costs required to generate these benefits may be a reasonable next step.

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APPENDIX B. MORPHOLOGY OF “DETERRENCE” IN THE ENGLISH LANGUAGE

By Philip J. Palin

The modern meaning of “deterrence” has emerged in the last sixty years. Contemporary English-speakers may be in the process of retrieving the term’s more expansive original meaning.

The December 2011 Online Oxford English Dictionary defines deterrence as:

Detering or preventing by fear. *spec.*, the reduction of the likelihood of war by the fear that nuclear weapons will be used against an aggressor; so graduated deterrence (see quot.1966):

U. SCHWARZ & L. HADIK [*Strategic Terminol.*](#) 59 *Graduated deterrence*, a strategy threatening a whole range of countermoves, each of which is designed not so much to punish the enemy and to destroy his war-making capacity or to change the local balance of power, as to demonstrate the will to inflict greater punitive damage, to escalate the conflict, in the hope of convincing the enemy to refrain from pursuing his objective.

The Latin origin of deterrence (de-terrere) suggests emotional impact that discourages or averts. Used alone, *terrere* is usually translated as terrorize or frighten. But *detertere* is more nuanced.

In Cicero’s *Impeachment of Verres* we read, “... testis praesertim , timidos homines et adfflictos, non solum auctoritate *detertere*, sed etiam consulari metu, et duorum praetorum potestate.” A reasonable translation: “... witness in particular, timid and oppressed men, hindered not only by your own private influence, but fear of the consul, and the power of two praetors.” The explicit distinction between *detertere* (hindered) and *metu* (fear) is meaningful.

In the late 16th Century deter entered the English language reflecting this classical meaning. Here is an early example:

*Rather your dauntless virtue, whom the pain
Of death denounced, whatever thing Death be,
Deterred not from achieving what might lead
To happier life, knowledge of Good and Evil?
Of good, how just! Of evil-if what is evil
Be real, why not known, since easier shunned?*

John Milton, *Paradise Lost* (l. Bk. IX, l) 1667

Dauntless virtue being not discouraged or not hindered is more coherent with the tone than “not terrorized.”

In 1764 Cesare Beccaria published *Dei delitti e delle pene* (On Crime and Punishments) in which he argued for a systematic approach to what we would now call deterrence.

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It is better to prevent crimes than to punish them. This is the fundamental principle of good legislation, which is the art of conducting men to the maximum of happiness, and to the minimum of misery, if we may apply this mathematical expression to the good and evil of life. But the means hitherto employed for that purpose are generally inadequate, or contrary to the end proposed. It is impossible to reduce the tumultuous activity of mankind to absolute regularity; for, amidst the various and opposite attractions of pleasure and pain, human laws are not sufficient entirely to prevent disorders in society.²³

To effectively prevent crime Beccaria recommended swift, consistent, and just punishment of proven wrongs combined with education, rewards, and application of science to encourage desired behavior. In a 1767 English translation of Beccaria “deter” was used where Beccaria had used the Italian “prevenire”.

The English philosopher Jeremy Bentham built on Beccaria’s foundation and gave considerable attention to the efficacy of punishment to prevent unwanted behavior. But Bentham notes a distinction between longer-term prevention and near-term interdiction.

All punishment has a certain tendency to deter from the commission of offences; but if the delinquent, after he has been punished, is only deterred by fear from the repetition of his offence, he is not reformed. Reformation implies a change of character and moral dispositions.²⁴

Bentham is credited for introducing “deterrent” into the English language. In the Rationale of Punishment (1829) Bentham writes, “No deterrent is more effective than a punishment which is sure, speedy, and severe.”²⁵ But he used the neologism sparingly, more often referring to prevention, encouragement, discouragement or other more common terms.

Bentham was a champion for the Thames River Police, specifically organized as a “preventive police.” While the term deter was applied infrequently and deterrence was not yet used,²⁶ the notion was clearly in play. Here’s a contemporary explanation of the Thames River Police:

It was a new experiment to overawe delinquents, by convincing them that in the system which was established, there existed a sufficient portion both of vigilance to detect, and of strength and resolution to seize every person detected in, or charged with the commission of crimes, and to convey them instantly before the Magistrate, whose powers are well-known to every culprit. From the constant perambulation of the Police Boats, both by night and day, with power to seize and apprehend the delinquents conveying stolen Property, they speedily began to see their danger. The strength opposed to them was systematic and regular. Firmness and perseverance were the leading characteristics of the design.²⁷

²³ Beccaria, Cesare, *Dei delitti e delle pene*, Milan (1764)

²⁴ Bentham, Jeremy, *Principles of Morals and Legislation: Expense of Punishment*, Edinburgh (1843)

²⁵ *Rationale of Punishment* was published in 1830 by Robert Heward, Wellington Street, the Strand, London. As is explained in the “Advertisement”, the English version is actually a translation from the French work of Dumont, *La Théorie des Peines* (1811), as corrected from the original manuscripts of Bentham that were the basis of the Dumont work, the which manuscripts were written in the mid 1770’s. Bentham was famous for seldom completing his manuscripts. Dumont, a friend, translated the unfinished works for European distribution.

²⁶ Some etymological sources credit Bentham as the first to use “deterrent” in an 1829 publication. Deterrence has been sourced to 1861.

²⁷ Colquhoun, Patrick, *A Treatise on the Commerce and Police of the River Thames*, London (1800)



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Bentham perceived the Thames River Police to deter through fear of detection, detention, and punishment. A more permanent form of prevention would, he argued at length, emerge from engaging the prospect of pleasure. By understanding the fear of pain and the prospect of pleasure, Bentham perceived society can be constructively shaped:

Nature has placed mankind under the governance of two sovereign masters, pain and pleasure. It is for them alone to point out what we ought to do, as well as to determine what we shall do. On the one hand the standard of right and wrong, on the other the chain of causes and effects, are fastened to their throne. They govern us in all we do, in all we say, in all we think: every effort we can make to throw off our subjection, will serve but to demonstrate and confirm it.²⁸

For Bentham the prospect of punishment surely deters, but is not the only deterrent.

The term “deterrence” first appeared in written English in an 1861 text by the English lawyer and reformer T.B.L. Baker. In *War with Crime*, Baker argued, “That punishment is to be preferred which combines the greatest deterrence with the least pain.”

The classical utilitarian perspective – especially the focus on avoidance of pain – has continued to influence conceptions of deterrence. In 1968 the economist Gary S. Becker referenced both Beccaria and Bentham in his seminal paper, *Crime and Punishment: An Economic Approach*.

In 1992 when Dr. Becker was awarded the Nobel Prize for economics, the Bank of Sweden explained,

Gary Becker has applied the theory of rational behavior and human capital as "crime and punishment". A criminal, with the exception of a limited number of psychopaths, is assumed to react to different stimuli in a predictable ("rational") way, both with respect to returns and costs, such as in the form of expected punishment. Instead of regarding criminal activity as irrational behavior associated with the specific psychological and social status of an offender, criminality is analyzed as rational behavior under uncertainty.

Becker builds on Beccaria and Bentham. For the purpose of the US Coast Guard, Becker’s work is especially relevant in regard to “risk preferrers” and “uncertainty.”

As much as possible, Beccaria and Bentham attempted to remove uncertainty from their notions of deterrence. In contrast Becker accepts that uncertainty is persistent. He treats uncertainty itself as an influence on rational choice. In his Nobel lecture, Becker explains,

The analysis assumes that individuals maximize welfare as they conceive it, whether they be selfish, altruistic, loyal, spiteful, or masochistic. Their behavior is forward-looking, and it is also consistent over time. In particular, they try as best they can to anticipate the uncertain consequences of their actions. Forward-looking behavior, however, may still be rooted in the past, for the past can exert a long shadow on attitudes and values.

In the process of being forward looking – attempting to deal with uncertainty – Becker argues for a continuum from risk avoiders to risk preferrers.

²⁸ Bentham, OP CIT

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Becker's work has had a profound impact on modern scholarship and practice regarding deterrence. But especially given his recognized dependence on Beccaria and Bentham, the focus on negative influence – certainty and severity of punishment – is interesting. In his 1968 paper Becker noted that meaningful attention to positive reinforcement is a “lacuna” in modern thinking on crime and punishment.

From 1861, when deterrence first appeared in the English language, until the mid-Twentieth century the most common usage of the word related to issues of criminology. In this domain deterrence included the prospect of both punishment and reward. Following World War II deterrence was increasingly associated with military strategy and, particularly, the nuclear doctrine of Mutual Assurance Destruction.

In 1953 J. Robert Oppenheimer summarized – and critiqued – what was not yet called Mutual Assured Destruction:

The prevailing view is that we are probably faced with a long period of cold war in which conflict, tension and armaments are to be with us. The trouble then is just this: during this period the atomic clock ticks faster and faster. We may anticipate a state of affairs in which two Great Powers will each be in a position to put an end to the civilization and life of the other, though not without risking its own. We may be likened to two scorpions in a bottle, each capable of killing the other, but only at the risk of his own life.²⁹

The Cold War concept of nuclear deterrence was a unique historical phenomenon. The ancient Roman author Rhenus famously quipped, *Si vis pacem, para bellum* or "If you wish for peace, prepare for war." Military strength and an effective defense have long been perceived as having what we would now call a deterrent effect. But this pre-modern form of deterrence was something much different from the massive retaliation of the nuclear era.

In his classic work, *On War*, Clausewitz does not use a German word that any responsible translator has rendered as “deterrence.” He does, however, refer to preventive measures directed at the mind of an adversary or potential adversary.

If, therefore, we imagine to ourselves a defensive, such as it should be, we must suppose it with every possible preparation of all means, with an army fit for, and inured to, war, with a general who does not wait for his adversary with anxiety from an embarrassing feeling of uncertainty, but from his own free choice, with cool presence of mind, with fortresses which do not dread a siege, and lastly, with a loyal people who fear the enemy as little as he fears them. With such attributes the defensive will act no such contemptible part in opposition to the offensive, and the latter will not appear such an easy and certain form of war, as it does in the gloomy imaginations of those who can only see in the offensive courage, strength of will, and energy; in the defensive, helplessness and apathy.³⁰

Strategic deterrence before the Cold War, even if going by other names, was not about massive retaliation, but about military readiness and a purposeful – and projected – ability of the whole nation to respond effectively and resiliently to any adversary. A half-century of Mutual Assured Destruction diminished both our thinking and experience with other approaches to *strategic* deterrence.

²⁹ Oppenheimer, J. Robert, *Atomic Weapons and American Policy*, Foreign Affairs (1953)

³⁰ Clausewitz, Carl Von, *On War*, Berlin (1832)

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The meaning of deterrence, in a military and strategic context, shifted significantly in the 1950s. A decisive shift can be traced to a January 1954 speech by the Secretary of State, John Foster Dulles:

We need allies and collective security. Our purpose is to make these relations more effective, less costly. This can be done by placing more reliance on deterrent power and less dependence on local defensive power.

This is accepted practice so far as local communities are concerned. We keep locks on our doors, but we do not have an armed guard in every home. We rely principally on a community security system so well equipped to punish any who break in and steal that, in fact, would-be aggressors are generally deterred. That is the modern way of getting maximum protection at a bearable cost. What the Eisenhower administration seeks is a similar international security system. We want, for ourselves and the other free nations, a maximum deterrent at a bearable cost.

Local defense will always be important. But there is no local defense which alone will contain the mighty landpower of the Communist world. Local defenses must be reinforced by the further deterrent of massive retaliatory power. A potential aggressor must know that he cannot always prescribe battle conditions that suit him. Otherwise, for example, a potential aggressor, who is glutted with manpower, might be tempted to attack in confidence that resistance would be confined to manpower. He might be tempted to attack in places where his superiority was decisive.

The way to deter aggression is for the free community to be willing and able to respond vigorously at places and with means of its own choosing...³¹

As the Dulles doctrine of massive retaliation increasingly defined Cold War political and military strategy, other aspects of deterrence atrophied as objects of serious strategic consideration. A more flexible understanding of deterrence continued to characterize criminology, but even here attention to pain *and pleasure*, as advocated by Beccaria, Bentham, and others was narrowed to a calculus of certainty, celerity, and severity of punishment. While probably impossible to prove, this narrowing was almost certainly influenced by the key role in elite opinion and the popular psyche of nuclear deterrence and massive retaliation.

The impact of Dulles on the general understanding of deterrence was so significant that it persisted well-past the end of the Cold War. In a 2002 speech at West Point, President Bush argued, “Deterrence—the promise of massive retaliation against nations—means nothing against shadowy terrorist networks with no nation or citizens to defend.” In the same speech, focusing on terrorist adversaries, the President said, “new threats also require new thinking.”

New thinking has begun to emerge, including attention to what is sometimes called the “new deterrence.” While a revised consensus has not yet emerged, the meaning of the term is clearly undergoing a change.

³¹ Dulles, John Foster, State Department Bulletin, Speech to the Council on Foreign Relations, January 4, 1954



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APPENDIX C. THREE KEY MONOGRAPHS

Following are three texts that have had a seminal influence on this study.

Becker, Gary, "Crime and Punishment: An Economic Approach," *The Journal of Political Economy*, Vol. 76, No. 2. (Mar. - Apr., 1968), pp. 169-217.

Tversky, Amos and Kahneman, Daniel, "Advances in Prospect Theory: Cumulative Representation of Uncertainty," *Journal of Risk and Uncertainty*, Volume 5 (1992), pp 297-323.

Ostrom, Elinor, "Building Trust to Solve Commons Dilemmas: Taking Small Steps to Test an Evolving Theory of Collective Action," *Workshop in Political Theory and Policy Analysis*, Indiana University (2008)



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APPENDIX D. BRIEF BIOGRAPHIES OF RESEARCH TEAM

STEVEN B. HALL, Ph.D.

Steven B Hall (Steve) is currently a Research Professor at the Naval Postgraduate School where he conducts research on complex adaptive systems, multi-agent systems and human-culture behavior systems. Prior to accepting an appointment at the NPS in 2011 he served as a Principal Scientist at Lockheed Martin's Advanced Technology Center where he led the company's system-of-systems modeling and simulation efforts for many years. During his tenure at Lockheed Martin he played a significant role in winning multiple contracts including, in recent years, contracts with DARPA and the Department of Homeland Security. He has published 25+ papers in technical journals and proceedings.

**SUMMARY OF
QUALIFICATIONS**

Experience: analysis, design and development of innovative tools that help architects, analysts, decisions makers and war fighters do their job better.

Competencies: Complexity Science, Modeling/Simulation, Artificial Intelligence, Cognitive Science, Agent Based Modeling, Operations Analysis, Project Management.

EDUCATION

Ph.D., Cognitive Science, UC Irvine, 1983.

Certified Group Facilitator Instructor Training, 2011

Ongoing self-education and attendance at a variety of Conferences

Santa Fe Institute's Complexity Science Summer School, June 2008

Management Strategies Program, LM Institute for Leadership Excellence and Carnegie Mellon University, Sept 8-13, 2002.

ILOG Solver and Scheduler, ILOG Educational Services, 1997.

Object Oriented Design/Analysis Using OMT, ACC, 1996.

Object Oriented Programming from a Modeling and Simulation Perspective (CS 249), Stanford University (SITN), 1995.

Autonomous Agents (CS322), Stanford University (SITN), 1989.

Knowledge Engineering Environment (KEE) training, 1986.

Automated Reasoning Tool (ART) training, Inference Corporation, 1985.

**PROFESSIONAL
EXPERIENCE**

1985 - Lockheed Martin Advanced Technology Center.

(Principal Scientist)

Principal Investigator and technical lead of an advanced technology group responsible for the development of advanced software algorithms and technologies. Primary focus in recent years was been on the use of Complexity Science derived technologies to improve the design and analysis of multi-agent based (swarming) systems of systems.

This work makes extensive use of recent developments in GIS systems, modeling and simulation, operations analysis, artificial intelligence, cognitive science and the core elements of Complexity Science (nonlinear control, agent based programming and network theory). Three of his successfully completed projects include:

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C4ISR Architecture: Created a substantial agent-based modeling and simulation environment supporting the design and analysis of innovative C4ISR (command/control and data gathering/fusion) architectures including both ‘optimal’ force size/mix and centralized vs. decentralized (and adaptive hybrid) organizational resource management.

Urban Swarms: Designed ‘swarming’ architectures for next generation micro/nano platforms operating in the urban indoors and outdoor environments optimized to support ‘mission success’.

Mine Search System: Developed the autonomous mission control and operator interface for an underwater vehicle(s) engineered to find and map the location of underwater mines.

1984 - 85 Abacus Programming Corp (Knowledge/Language Engineer)

Designed and led the development of an expert system that interprets ‘unanticipated events’ generated by the Space Shuttle software system. The system includes a natural language interface based on semantic parsing techniques. Implemented in LISP/ART.

1982 - 84 Cognitive Assessment & Rehabilitation Systems. (Principle)

Designed and implemented an expert system to diagnose deficiencies in human problem solving capability, identify the probable source and then design/deliver a rehabilitation program.

1975 - 82 University of California Irvine. (Teaching Assistant)

Taught and assisted in the deliver of courses in Cognitive Science, natural language processing, human and research methodologies.



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PHILIP J. PALIN

Philip J. Palin (Phil) is currently Director for Private Sector Integration with the Center for Homeland Defense and Security at the Naval Postgraduate School. He also serves as coordinator of the Supply Chain Resilience Project of the Mid-Atlantic Regional Catastrophic Preparedness Grant Program. Mr. Palin is a regular contributor to Homeland Security Watch (www.hlswatch.com), a blog listed and linked by the New York Times for its expertise.

Mr. Palin is the principal author of the Catastrophe Preparation and Prevention series from McGraw-Hill. Other major publications include *Consequence Management and Threat, Vulnerability, Consequence, Risk*. The Homeland Security Affairs Journal has published several of Mr. Palin's monographs, including "Resilience: The Grand Strategy". A new text, *Catastrophe: Definitions, Characteristics, and Possible Principles of Good Practice* will be published in 2012.

During the 2008 presidential election Mr. Palin was one of two Republicans who served on candidate Barack Obama's Homeland Security Advisory Council where he chaired the Prevention and Preparedness Working Group. He is the principal author of "A Proposed Homeland Security Strategy for the New Administration," published by the National Institute for Strategic Preparedness. He has testified before the Committee on Homeland Security of the U.S. House of Representatives.

Mr. Palin has been an instructor at the Naval Postgraduate School, with the California Peace Officers Standards and Training curriculum, and at the Institute for Preventive Strategies, among other schools and programs.

From 1998-2008 Mr. Palin served as Chief Executive Officer of Teleologic Learning Company, an enterprise specializing in strategic development of human resources. He was a co-founder of the firm. While with Teleologic he co-authored *Architect for Learning*, a textbook on effective design of educational experiences.

From 1991-1998 Mr. Palin served as Managing Director and Chairman of the Board of The Laurasian Institution, a not-for-profit educational foundation focused on cross-cultural issues involving Asia, Europe, and North America. From 1989-1991 Mr. Palin was the President of Tokyo International College, a liberal arts institution serving an international student body in Japan. From 1983-1988 he was the founding Director of the Ronald W. Reagan Scholarship Program at Eureka College, the President's alma mater.

Early in his career Mr. Palin served as a higher education administrator in a variety of roles and as a consultant to the energy industry including Marathon Oil Company, Arizona Public Service, Texas Utilities, Columbia Gas Transmission Company, Puerto Rico Electric Power Authority, and others.

Mr. Palin grew up in Illinois. He graduated from Eureka College (Illinois) and The American University (Washington D.C.). Mr. Palin has been married to his wife Jean for over thirty years. They have two adult children raised in Japan and the Blue Ridge Mountains of Virginia.

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Professor of Computer Science and Executive Director, Center for Homeland Defense and Security, Naval Postgraduate School, Monterey, CA.

Visiting Professor of National Security Affairs and Executive Director, Center for Homeland Security, Naval Postgraduate School, Monterey, CA.

EXPERIENCE

Senior Vice President of Eastman Kodak

10/00 – 2/02 Director, Digital Business Development and Sr. VP of Eastman Kodak. Participated in Kodak's digital strategy formation, managed \$100M/yr strategic investment fund, and created spin-outs from Kodak R&D. Managed 1 person in London, 2 people in Rochester NY, and 4 people in San Jose, CA. Investments spanned Kodak's business units, ranging from video transfer services, entertainment & digital cinema, organic display technology, online photo sites, wireless photography, to proteomics and nano-technology applied to consumer product development.

President and CEO of DaimlerChrysler Research and Technology, North America, Inc.

10/99 – 10/00 DaimlerChrysler RTNA is an R&D subsidiary of the larger DaimlerChrysler Holding Company, located in Palo Alto, CA. I was financially responsible for the subsidiary, and Director of the R&D Labs located in Portland, OR and Palo Alto, CA. In addition to directing a group of about 50 researchers, I created a \$100M investment fund as an adjunct to the Business Development Group located in Stuttgart, Germany. The focus of the R&D and investment strategy was telematics – automobile navigation, Internet, and in-car concierge services.

Consultant for Technology Assessment Group, Monterey, CA.

10/97 – 10/99 Freelance consultant to hi-tech companies in the areas of business strategy, information technology, and training (short courses). Technology Assessment Group is my sole proprietorship. Major customer was DaimlerChrysler RTNA (see above). Others: IBM, Hitachi, Samsung, Bay Networks (now Nortel Networks), the governments of Taiwan, Egypt, Mexico, and Italy in the areas of economic development and technology development parks; an expert witness for Wilson, Sonsini, Goodrich & Rosati, of Palo Alto, CA.

Chairman of Computer Science, Naval Postgraduate School, Monterey, CA

07/93 – 10/97 Chairman & Professor of Computer Science Department consisting of 45 professors and staff, and approximately 100 graduate students from NATO countries. Principle technical focus on parallel processing, software engineering, information technology management, and graphics.

Professor of Computer Science at Oregon State University, Corvallis, OR

09/76 – 07/93 In addition to teaching and directing graduate student dissertations, I as Director of OACIS (1987-1990) - a University-Industry Research Center created to transfer technology from research into products.

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EDUCATION

Ph.D. Computer Science, Washington State University 1971.
MS Computer Science, Washington State University 1970
BS Mathematics from Oregon State University 1966.

BOARDS & EDITORSHIPS

Co-Editor-in-Chief of IEEE Computer Magazine, 1979-1981.
Software Review Editor of IEEE Software Magazine, 1983-1987.
Editor-in-Chief of IEEE Software Magazine, 1987-1990.
Elected to Board of Governors, 1987-91, again in 1996-1999.
Co-Founded the IEEE Transactions on Parallel and Distributed Systems.
Co-Founded the IEEE Parallel & Distributed Technology magazine.
Editorial Board of IEEE SPECTRUM Magazine, 1990-present.
Editor-in-Chief of COMPUTER, 1993-94
Editorial Board Member of Computer, 1996 - present
Co-Founded IEEE Internet Computing 1996 and served as Associate Editor, 1996-1998.

PUBLICATIONS

Recent Publications: Lewis has a 30-year publication record consisting of over 100 refereed and non-refereed publications - far too many for this brief bio. The sample below lists only the most recent books, only.

Books

The Friction-Free Economy, HarperCollins, 1997, 256 pp.

Introduction to Parallel & Distributed Computing, (with Hesham El-Rewini), Prentice-Hall, 1998, 450 pp.

Microsoft Rising, and other tales of Silicon Valley, published by IEEE Computer Society Press, 1999, 324pp.

Critical Infrastructure Protection in Homeland Security: Defending a Networked Nation, John Wiley & Sons, 500pp., 2006.

Network Science: Theory and Applications, John Wiley & Sons, 500pp., 2009.

Bak's Sand Pile, AgilePress, 2011.



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GRETA E. MARLATT

Greta Marlatt is the Outreach and Collection Development Manager for the Naval Postgraduate School's Dudley Knox Library and the Content Manager for the Homeland Security Digital Library (HSDL). She has over 30 years of experience working in libraries in various capacities.

She is a member of both the Special Libraries Association (SLA) and the American Library Association (ALA), has had held several leadership positions in both organizations and has served on several government and private sector advisory groups. She is currently a member of the Homeland Security Affairs journal Editorial Review Board.

Ms. Marlatt has published several articles and is the author of a number of bibliographies and help guides for topics relating to Intelligence, Information Warfare, Special Operations, Homeland Security, Mine Warfare, Directed Energy Weapons, NBC Terrorism and more. She has given numerous presentations on topics related to conducting research in the homeland security and military arenas.

Ms. Marlatt holds a Bachelor of Arts degree in English from Arizona State University, a Master of Library Science degree from the University of Arizona and a Master of Arts degree in National Security Studies from California State University, San Bernardino.

