SUPPORTING THE COGNITIVE WORK OF
INFORMATION ANALYSIS AND SYNTHESIS: A STUDY
OF THE MILITARY INTELLIGENCE DOMAIN

A Thesis

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ABSTRACT

Information Analysis and Synthesis (henceforth “IAS”) is a type of cognitive work that plays a key role in many high-performance, complex, and mission-critical domains. These can range from tactical military intelligence to scientific or technological forecasting, business and financial intelligence to national strategic counterterrorism, and include areas as disparate as geopolitical policy analysis to computer network intrusion detection. The specific subject of this study is the military intelligence domain as one instantiation of IAS. Several innovative ethnographic and cognitive task analysis methods were used to observe team-based distributed work done by actual domain practitioners. The main investigative effort took the form of a scaled-world study, leveraging a real world tactical intelligence training exercise as a natural laboratory for investigating the contrasts between weaker and stronger IAS. Specifically, we examined the role of instructors in providing broadening checks to the team analytic process, and mapped the findings to an existing framework.

To Emily and Turk, for keeping me mostly sane; and to my family, for giving me the foundation and support needed to succeed.

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CHAPTER 1

INTRODUCTION

Information Analysis and Synthesis (henceforth “IAS”) is a type of cognitive work that plays a key role in many high-performance, complex, and mission-critical domains. These can range from tactical military intelligence to scientific or technological forecasting, business and financial intelligence to national strategic counterterrorism, and include areas as disparate as geopolitical policy analysis to computer network intrusion detection. In essence, IAS is the inferential determination of the best explanation for uncertain, contradictory, and incomplete data (Patterson, Roth, & Woods, 2001). The tradecraft of IAS domains has been described as being both an art *and* a science, and can vary greatly from discipline to discipline. Despite this great diversity, research in cognitive systems engineering has demonstrated that the majority of these domains share a core set of underlying functions and characteristics (Elm et al., 2005; Patterson et al., 2001; D. D. Woods, Patterson, & Roth, 2002). The goal of this study is to deepen the understanding of the differences between weaker and stronger instances of IAS as a general form of cognitive work.

The specific subject of this study is the military intelligence domain as one instantiation of IAS. As a preliminary exploratory study, we performed elicitation with a diverse set of intelligence practitioners by using a “critiquing as cognitive task

analysis” methodology (Miller, Patterson, & Woods, 2001a). The purpose of this exploratory study was to identify cognitive vulnerabilities in the IAS process, familiarize ourselves with some of the domain complexities, and to calibrate our understanding of what made an intelligence assessment weaker or stronger. The main investigative effort, however, took the form of a scaled-world study (D. D. Woods, 1993; D. Woods, 2003; D. D. Woods & Hollnagel, 2006). In particular, we leveraged a real world tactical intelligence training exercise as a *natural laboratory* for investigating the contrasts between weaker and stronger IAS.

1.1 Why a natural laboratory?

“It is notoriously difficult to generalize [experimental] laboratory findings to real-world situations. The relationship between cognition seen as a solitary mental activity and cognition seen as an activity undertaken in social settings using various kinds of tools is not at all clear.”

(Hutchins, 1995a)

The above quote from Hutchins succinctly captures our motivation for studying the cognitive work of IAS in natural settings. Our generic empirical method is to stage and shape the conditions of observation in a scaled-world scenario, while employing ethnographic techniques of investigation. With this approach, it is crucial that the scenario authentically reflects the complexities of the real domain, while enabling the researcher to embed specific investigative probes into the environment (D. D. Woods & Hollnagel, 2006).

This particular scenario is a *found problem*; a tactical intelligence training exercise from the US Army Intelligence Center at Ft. Huachuca, AZ. Because of the pre-existing training goals of the exercise, we did not have explicit control over its design,

and therefore had to work within its inherent constraints. Fortunately, the training goals and the research goals mutually included the establishment of a sufficiently authentic and complex premise under which the analyst teams must operate.

To be further reflective of the real domain, this particular exercise is administered in a team-based, distributed work setting, much like how the work of IAS takes place in most disciplines. One advantage of studying distributed work is that typically internal cognitive processes must be externalized in some form to enable collaboration between multiple practitioners. This creates more opportunities for meaningful observations of the cognitive work

The analyst teams who participated in the scenario were composed of active military intelligence officers midway through a mandatory 20-week course intended to transition them into analytic leadership roles. As military intelligence captains, they serve as analysts and analyst supervisors with a bachelors level education and an average of four years of military service. The class of 40 captains is randomly divided into four independent teams for a fictional counter-insurgency scenario based in World War II era Great Britain. Each team simultaneously executes the same scenario under the supervision of an instructional training cadre. The training cadre is composed of more senior officers with significant intelligence experience, and play the roles of both commander (receiving analytic assessment briefings from the teams) and instructor, or mentor. The training cadre is also responsible for administering and pacing the exercise, and simulating interactivity.

1.2 How does the functionalist perspective help one understand complex domains?

Throughout this study, we adopt a functionally-abstract, system level perspective as a way to approach IAS as a joint cognitive system, as described by Potter (2002). This relies on the assumption that the work in the system is goal-directed. This perspective begins with a function-based goal-means decomposition of the system, which is a formalism for representing the cognitive work domain as an abstraction hierarchy or network:

“A work domain analysis is conducted to understand and document the goals to be achieved in the domain and the means available for achieving them (Vicente, 1999). The objective of performing this analysis is to develop a structure that links the purpose(s) of individual controllable entities with the overall purpose of the system. This includes knowledge of the system’s characteristics and the purposes or functions of the specific entities. The result of the first phase is a Functional Abstraction Hierarchy (FAH), a multilevel recursive means-ends representation of the structure of the work domain, that anchors the first span of the bridge.

The work domain analysis is performed based on extensive interactions with expert practitioners in the domain and includes face-to-face interviews with the experts, watching the experts work in the domain, verbal protocol techniques, and other CTA and Cognitive Work Analysis (CWA) methods (Potter, Roth, Woods, & Elm, 2000; Vicente, 1999). In practice, building an FAH is an iterative, progressively deepening process. It starts from an initial base of knowledge (often very limited) regarding the domain and how practitioners function within it. Then, complementary techniques are used to expand and enrich the base understanding and evolve a function-based model from which ideas for improved support can be generated. This process is highly opportunistic.

Researchers should ultimately discover an understanding of the goal-driven characteristics of the domain that will lead to an understanding of the decisions practitioners are faced with in the domain. One might start by reading available documents that provide background on the field of practice (e.g., training manuals, procedures); the knowledge gained will raise new questions or hypotheses to pursue that can then be addressed in interviews with domain experts, and it will also provide the background

for interpreting what the experts say. In turn, the results of interviews or exercises may point to complicating factors in the domain that need to be modeled in more detail in the FAH. This provides the necessary background to create scenarios to be used to observe practitioner performance under simulated conditions or to look for confirming example cases or interpret observations in naturalistic field studies.

The resulting FAH specifies the domain objectives and the functions that must be available and satisfied to achieve their goals. In turn, these functions may be abstract entities that need to have other, less abstract or less aggregated functions available and satisfied so that they might be achieved. This creates a decomposition network of objectives or purposes that are linked together from abstract goals to specific means to achieve these goals.

The FAH provides a framework for making explicit the goals to be achieved in the domain and the alternative means available for achieving those goals. High-level goals, such as impacting a critical function, are decomposed into supporting lower-level subgoals. This provides the basis for identifying - through subsequent steps in the analysis and design process - the cognitive activities that arise in the domain and the information needed to support those decisions. The FAH enables the designer to determine where decision making is likely to be difficult due to the fundamental characteristics of the domain. For example, the FAH helps convey places in problem space where objectives compete with each other (e.g., where choices have to be made that require some level of sacrificing of one objective to achieve another, perhaps more heavily weighted, objective), or otherwise constrain each other (e.g., where the satisfaction of multiple goals needs to be considered in determining the best course of action).

There are a growing number of examples of successful systems that have been developed based on a work domain analysis. Examples of functional abstraction hierarchies and how they were used to design new visualizations and Decision Support Systems (DSSs) can be found in (Roth, Lin, Kerch, Kenney, & Sugibayashi, 2001) and (Potter et al., 2000). Examples of the application of this approach to model cognition and collaboration and to develop new online support systems in time pressured tasks such as situation assessment, anomaly response, supervisory control, and dynamic replanning include domains such as military intelligence analysis (Potter, McKee, & Elm, 1997), military aeromedical evacuation planning (Cook, Woods, Walters, & Christoffersen, 1996; Potter, Ball, & Elm, 1996), military command and control (Chalmers, Easter, & Potter, 2000), railroad dispatching (Roth et al., 1998), and nuclear power plant emergencies (Roth et al., 2001)."

1.3 How does one understand the generic cognitive work of Information Analysis and Synthesis?

A useful way to understand a domain is to examine what makes the work of the domain difficult. Information Analysis and Synthesis is the process of analyzing (breaking apart) and synthesizing (putting together into a new whole) complex and disparate information to produce insight or assessments in support of a larger organizational goal or mission. It is subject to similar patterns in multi-threaded work that occur in many other diverse high-stakes domains (D. D. Woods & Hollnagel, 2006). Practitioners constantly have to cope with information overload. Distributed work environments mean that coordination challenges can arise. Interaction with clumsy automation impedes workflow. Time pressure can lead to prematurely-narrowed assessments. Practitioners must navigate organizational goal conflicts and double binds. In general, it is apt to characterize the domains of IAS as being highly complex.

As a reflective practitioner, Trent (2005) proposes a set of common cognitive vulnerabilities in military intelligence:

- * Mental Set
- * Recognition of Relevant Data
- * Fixation
- * Environmental Pressure
- * Trust
- * Tool Understanding
- * Sustained Attention
- * Adversarial Interaction
- * Learning

- * Inadequate Hypothesis Testing
- * Experience Viewed as Expertise

These vulnerabilities point to potential areas for future study in improving support to IAS.

Some of the unique characteristics of IAS domains, in particular intelligence, relate to the adversarial nature of its focus. Adversarial interaction with an adaptive opponent brings with it the cognitive complexity of detecting and understanding deliberate deception (Trent, 2005). In addition, special challenges to analytic workflow are introduced by operating in a security classified environment, as is frequently the case with IAS (Bodnar, 2003).

Cognitive systems engineering research has shown that at the functional level, many commonalities in cognitive work exist between the disparate domains where IAS takes place. An advantage to this is that uncovering leverage points of support for the cognitive work of IAS in one domain can usually lead to rapid advancements in understanding across other IAS domains. This functional perspective is useful because it is goal-oriented and captures the purposes of the IAS work, as well as the means available to achieve them (Hollnagel, Mancini, & Woods, 1988; Potter, Elm, Roth, Gualtieri, & Easter, 2002; D. D. Woods, 2003; D. D. Woods & Hollnagel, 2006). This perspective can also be represented as a simple framework to help make initial sense of observations.

1.3.1 What is convergence?

Success in IAS is characterized by the concept of *Convergence*, an iterative narrowing and broadening process. *Narrowing* is the process of seeking analytic closure

of the solution space. *Broadening* is the process of guided expansion of the solution space to incorporate multiple perspectives, and should be complementary to narrowing. Convergence upon an explanation is the desired end goal of a sufficiently rigorous, iterative narrowing and broadening process.

Successive cycles of narrowing and broadening produce convergence and avoid *Premature Narrowing*, a great risk of failure in IAS. A prematurely narrowed assessment is immature, brittle, and doesn't include a diversity of perspectives on the problem. The difference is that a convergent assessment balances narrowing processes in cognitive work with complementary broadening, while a prematurely narrowed assessment has insufficient broadening.

1.3.2 How does rigor aid the determination of process quality?

A successfully convergent analytic process supports the judgment of rigor of an assessment. High performance organizations depend upon highly-rigorous information analysis and synthesis. Organizations supported by highly-rigorous assessments are more resilient in the face of challenges or surprise, and are better able to adapt to the world. The sufficiency of an assessment's rigor is judged relative to the goals of the stakeholders and constraints of the environment. Many things impact this judgment, such as the process followed, sources used, peers consulted, quality of cross-checking, supporting materials, asset constraints, stakeholder expectations, and the quality of dissemination (Patterson et al., 2001; Hollnagel, Woods, & Leveson, 2006).

In the face of rapidly proliferating data availability - and the resulting data overload deluging IAS practitioners - the value of facilitating the judgement of rigor has

Figure 1.1: A simplified depiction of IAS as an iterative broadening and narrowing process of convergence, contrasted against an example of premature closure in IAS.

increased dramatically. Increasingly, the tendency to perceive the increased affordance of data accessibility as being resultant in good process makes it easy for novice practitioners to get trapped in shallow analysis. Having a better understanding of rigor is one analytic safeguard to be leveraged against this constant risk. This area is just beginning to be explored, and is ripe for future study (Zelik, Patterson, & Woods, 2007).

1.4 What is the support function model of Information Analysis and Synthesis?

The convergence conceptualization of IAS evolved into a Support Function Model for IAS. First, based on a synthesis of prior work (Miller, Patterson, & Woods, 2001b; Patterson et al., 2001), the Support Function Model is a model of interacting functions that comprise inferential analysis. This intelligence analysis model is an iterative broadening and narrowing convergent process. This model is a “closed loop” model of interacting functions (not a sequence of tasks), and includes three generic process areas: *Down Collect* functions are focused on collection of an essential, representative, “on analysis” sample from available data; *Conflict and Corroboration* functions are focused on the construction of accurate interpretations of the findings from the Down Collect process; and *Hypothesis Exploration* functions are focused on the construction of coherent stories or hypotheses to explain the interpretations of the findings. These functions were identified as the cornerstones for effective intelligence analysis. All of these functions are “narrowing” functions, in that they focus on a reduction of the problem toward “the answer”.

In between these three support function areas are phases of broadening checks (Elm et al., 2005). These serve as cross-checks against the predominantly narrowing

aspects of the primary functions. The natural tensions between broadening (to fully explore all options) and narrowing (to a finding) at each “edge” (between the three primary functions) defines success or failure in reaching the analytical conclusion. Convergence, then, is a stable balance between broadening and narrowing while premature closure (a typical characterization of analytical error) is a lack of broadening.

These transitional broadening areas include sets of requirements that support the interaction of a coupling or transition of the primary functions. These include:

- * *Down Collect to Conflict and Collaboration* broadening is focused on revising the down-collect results based on interpretations from the Conflict and Collaboration process as well as generating new interpretations from revised Down Collect results.

- * *Conflict and Collaboration to Hypothesis Exploration* broadening is focused on revising the interpretations based on alternative hypotheses under consideration as well as generating new hypotheses based on the interpretations.

- * *Hypothesis Exploration to Down Collect* broadening is focused on revising the down collect process based on alternative hypotheses under consideration as well as on generating new alternative hypotheses based on revised Down Collect results.

Elm’s hypothesis is that in order to be effective, support must be provided for explicit control of this convergent, broadening and narrowing process. Thus, the Support Function Model defines a system design goal decomposition model of support requirements for these functions. Requirements arise from two fundamentally different but complementary dimensions. First, there is the decomposition of system goals into sub-goals based on the framework defined by the convergent broadening and narrowing model of intelligence analysis. Second, that system goal decomposition

model is augmented with requirements specific to the design of a joint cognitive system.

Within each of the primary functions (Down Collect; Conflict and Corroboration; Hypothesis Exploration) is a specific set of support functions for accomplishing the primary function. This integration results in a unique set of system requirements that define the decision support requirements for IAS as well as support for effective human-automation interaction. This is a significant breakthrough in the application of lessons learned from many years of research on human interaction with complex systems.

Figure 1.2: A simplified depiction of a support function model for IAS. Copyright ManTech SMA - CSEC (used with permission)

1.5 How do instructor interventions serve as broadening checks?

Insights from the evolution of this model led to the concept of a *broadening check* as being a key safeguard against a common vulnerability of IAS, premature narrowing. Broadening checks are a critical aspect of expertise in IAS to avoid getting trapped

in shallow analysis. A broadening check is a special class of a cross-check. Cross-checks are a way to increase the diversity and integration of relevant perspectives into an assessment or decision. Cross-checking is a critical component of analytic *rigor* because it can enable detection of erroneous assessments or actions while negative consequences can be mitigated or eliminated. (Hutchins, 1995b; Patterson et al., 2001; Patterson, Woods, Cook, & Render, 2005; D. D. Woods, Johannesen, & Cook, 1994; D. D. Woods & Hollnagel, 2006).

This study specifically examines how broadening checks occur in practice. Because of the inexperienced nature of their background, the analyst teams in the exercise were frequently vulnerable to premature narrowing. To counter this, one of the common functions taken on by the instructors was to provide broadening checks. This manifested itself in periodic instructor interventions into the team analytic process. This created an observational benefit: interventions were easily-identifiable discrete events which could have their impact on the team analytic process traced in subsequent observations.

In general, instructor interventions are an interesting source of data because they speak to the goals of the training exercise, and illustrate one way expertise is passed down within an organization. Instructor interventions also give an indication of aggregated historical points of difficulty in the scenario, status and progress of teams, and common cognitive vulnerabilities in IAS.

The instructors played several interesting roles in the exercise. Their main role is to instruct the analyst teams in the doctrinal goals of the training. This includes tactics, techniques and procedures specific to appropriate areas of the scenario, reinforcement and clarification of previous training, and performance feedback.

The instructors also play an administrative and diagnostic role relative to maintaining team engagement in the scenario. This includes preventing analyst teams from getting “stuck” or diverting too far from the normative analytic goals in order to maintain the value of the exercise. This judgement requires diagnosis of team analytic diversion and anticipation of common scenario pitfalls and analytic vulnerabilities. Instructor steering and guidance in these areas provides insight and leverage into areas of weak and strong analytic process.

Related to scenario administration, instructors are also responsible for maintaining continuity across the multiple days of the scenario. This involves simulation of adversarial, command, and federated interactivity and control of the pacing, tempo, and tone of the exercise.

1.6 Why is a field study of the military intelligence domain an interesting laboratory for studying IAS in general?

Since the events of September 11, 2001, the intelligence community has been criticized for perceived “failures” in a predictably reactive response mode. This has led to a climate of aggressive transformation in tradecraft processes, doctrine, culture, and tools. Frequently in transformative efforts - and especially in the national defense arena - technology and automation are seen as the remedy to or savior of practitioners deemed too inefficient, inconsistent, or overextended to perform as desired.

Often, large software tool development efforts are undertaken without sufficient understanding of the core functions and characteristics of the work of the target domain or even a basic regard for the principles of joint cognitive system design. This usually results in tools that don’t adequately support - or worse, hinder - the cognitive work of the domain. In a large part, this is due to current software requirements

development and design processes being unable to adequately capture or represent the cognitive work of the domain. Practitioners are left to bridge the gaps in support themselves by instituting workarounds, and the particular tool quickly falls out of favor. This doesn't change the need for a particular type of support, and a new project is commissioned to rectify the shortcomings of the past, only to generally fail again in the same repeating pattern. In the end, throwing assets and technology at the problem only serves to aggravate the situational shortcomings without first having a domain-relevant and context-sensitive understanding of how success is achieved.

As a naturalistic observation-based study, this research attempts to capture an authentic domain understanding. Due to the aforementioned shift of strategic focus in the world, practitioners are increasingly being faced with doctrinally-unfamiliar situations with vaguely-defined goals. This period of adaptation produces changes in the supporting functions and goals of intelligence domains, and these changes provide a window into the meaningful underlying patterns of cognitive work in the domain. Understanding these patterns allows their use in guiding change and innovating new possibilities for cognitive support in concert with other stakeholders (D. D. Woods, 2003).

Several unique characteristics of this particular study help clarify potential complexities in understanding complex domains such as Information Analysis and Synthesis:

* The actual world being observed is a scaled world; a bounded version of the real world with enough shared characteristics and complexity so as to be perceived authentically by actual domain practitioners. The scaled nature of the world allows some control over the situations and consequences that the participants are faced with, giving a window into otherwise unpredictable or unobservable scenarios.

- * “Low tech” scenario work constraints make the analytic process more observable than a computerized, virtual workspace would be.

- * Four independent analyst teams working the same mission and scenario simultaneously allows for repeated, parallel observations to compare across.

- * Continuity of multiple (6) days gives opportunity for multiple cycles of analytic process to occur. This provides insight into how practitioners are managing continuous work in time and coping with multiple threads. Researchers get to see how they manage the work, how the integrated process fits together, and effects due to time pressure and pacers in the scenario.

- * The administration of tailored guidance and feedback from a consistent instructor cadre gives insight into both historical points of analytic vulnerability and specific team performance issues.

- * The scenario of the exercise evolves, escalates, precipitates, and reverberates, allowing to researchers to see interlinking between multiple cycles because of feedback from the world, as well as the role of adversarial interaction in the dynamics.

- * Feedback loops in the daily team briefings to commander (instructor) allow observation of opportunities for revision and replanning.

- * Observation of analytic teams building on previous assessments and/or revising shows the connection between analysis and replanning.

- * Cascading effects become evident in seeing how assessments get updated, and seeing revision process play out over multiple cycles as new events occur.

- * Natural pacers (tempo) occur both with the briefings as a tempo keyframe and the issuance of new reports or events in the scenario.

1.7 What are the general patterns in the multi-threaded work of IAS?

In addition to the aforementioned unique characteristics of this particular domain, several generic patterns in cognitive work also play out in this exercise:

1.7.1 Tempo

Tempo become relevant in how external events pace practitioner activities, and how periods of event driven activity are intermingled with periods of self-paced activity (D. D. Woods & Hollnagel, 2006).

1.7.2 Escalation

Escalation encompasses the process of how situations evolve from routine to exceptional, producing an increase in cognitive and coordinative demands, thereby making penalties of poor support for work more apparent (D. D. Woods & Hollnagel, 2006).

1.7.3 Coupling

Coupling is the degree of interconnections between parts of process - which influences the creation of side effects of an event or anomaly, resulting in challenges to coordination and resilience (D. D. Woods & Hollnagel, 2006).

1.7.4 Support Function Network as a tool for uncovering coupling

The IAS support function network helps map couplings across functional and physical levels of descriptions and captures how disrupting events can produce cascades of effects (D. D. Woods, 1994).

1.7.5 Premature Narrowing

Premature narrowing is the danger of becoming stuck in one assessment and being unable to revise even as new evidence presents itself or the situation changes (D. D. Woods, O'Brien, & Hanes, 1987). Strategies for avoiding this vulnerability can be seen as part of the development of expertise and coordinative mechanisms in a JCS

(Cook, Render, & Woods, 2000). Studies by Gettys et al., Patterson et al., and Elm et al. have shown that one of the key strategies for doing this is by broadening the set of possible explanations to be covered (cited in D. D. Woods & Hollnagel, 2006).

1.7.6 Reframing

In an ongoing situation, replacing a frame is harder than simply revising an assessment for practitioners. Data noticed about the world trigger frames that account for that data and trigger search for additional data. In parallel, framing orients the observer to the world, guiding what counts as data (D. D. Woods & Hollnagel, 2006).

1.7.7 Dilemmas

This includes goal conflicts and double binds, tradeoffs, and interactions (D. D. Woods et al., 1994).

1.7.8 Over-simplifications

This is the stripping away important nuance, detail, or meaning during an assessment.

CHAPTER 2

METHODOLOGY

“There is nothing quite like looking, if you want to find something. You certainly usually find something, if you look, but it is not always quite the something you were after.” - J.R.R. Tolkien

For this study, we used several complementary methods to generate a meaningful understanding of the work of IAS (Potter et al., 2000). We chose two classes of methods: a natural history technique, and a scaled-world study (D. D. Woods & Hollnagel, 2006). For the natural history technique, we employed a critique study method (Miller et al., 2001a; Miller, Patterson, & Woods, 2006) paired with unstructured elicitation. For the scaled-world study, we leveraged a scenario from an existing real-world training exercise as a natural laboratory.

2.1 Critique Study Method Paired With Elicitation

“The use of critiquing as a CTA methodology walks through a novice’s process on a task in order to serve as a probe for elicitation of expert commentary. This technique takes advantage of skill in critiquing, which is often conducted by more skilled practitioners in order to train less skilled practitioners, to provide insight into expertise. It is an alternative that can be used when it is not possible to observe work because of access restrictions, low frequency or unpredictability of target observation events, or difficulty in recruiting experts who wish to be evaluated on their task performance. It also allows for estimation of variability because multiple experts can critique a single novice’s process.” (Miller et al., 2001a)

We were interested in comparing perception of analytic rigor between expert analysts and novice analysts as a way to understand complexities and vulnerabilities in IAS. We found the critique method to be appropriate for this because of its facilitation of generating expert commentary. We introduced a slight variation by using the method with both expert and novice analysts as a point of comparison, and by having the analysts assume the persona of an “analyst supervisor” while giving the critique. Using both expert and novice analysts also allowed us to examine generational changes in analytic practice. In many cases, the sample analytic process being critiqued becomes an excellent artifact to base further elicitation around, trigger recall of related events in the practitioner’s experience, and give a frame of reference from which to base other relevant examples.

Our prior research with intelligence analysts had primarily been in the tactical/military domain, so a major goal for the critique study was to work with strategic/national domain analysts. This way, we hoped to gain a broader understanding of the cognitive work of IAS in general across domains, and also of the specific domain differences between tactical and strategic intelligence analysis.

In all, 3 highly-experienced and 2 less-experienced strategic analysts were interviewed, with an average of 2 hours per session. The less-experienced analysts were interviewed with an eye towards how they might best benefit from support to accelerate their analytic learning curve. The highly-experienced analysts came from a variety of strategic analytic specializations in order to provide broad coverage of the different types of work going on within the organization.

Because of the restricted access nature of most strategic intelligence work, the critiquing study elicitation technique is valuable for avoiding the constraint of obtaining

appropriate security clearance. Without this constraint, our desired approach would normally be to observe practitioners while they were working to understand their challenges in context. The use of the critique method facilitated the creation of a safe (unclassified) but authentically-relevant context for the practitioners to immerse themselves in that served as an adequate substitute for direct workspace observation. This allowed us to obtain good “grounded” data about what analysis is as a process without actually having the practitioners simulate or do the task themselves (which takes more effort, is hard to do in an unclassified way, and is usually less comfortable for subject matter experts).

In the inaugural use of the critiquing study method (prior to this study), a “first day” analyst (not yet cleared) from a military intelligence agency analyzed publicly-available reports about a foreign space agency’s recent rocket launch failure, while the researchers observed him prepare a briefing on the causes and impacts of the incident. The work context was a computerized information retrieval system containing a “canned” database of a few thousand documents. The analyst’s process and briefing was recorded and used as the critiqued case in subsequent deployments of the method with expert practitioners.

We used this same critiquing method in the current study with a group of strategic intelligence analysts, but in addition to asking them to critique the process that a novice used to analyze the incident, we also tried to explore differences between the example process, and the practitioner’s normal process. Participants were read the transcript from the novice analyst’s process of producing a briefing on topic, and asked to comment about how closely analogous the process was to their own. This included questions about tools, data types, reporting characteristics, and other

potential alternative unclassified scenarios that might be more representative of their work than the current example. This served to build up a corpus of cases for future study and to further enrich our understanding of different domain complexities and analytic vulnerabilities across IAS.

2.2 “Northernstar” Scenario Scaled-World Study

For the scaled-world study, we leveraged a scenario from an existing real-world training exercise as a natural laboratory. The scenario used in this “Northernstar” exercise is based on a hypothetical stability and support operation (SASO) in the tactical intelligence domain. Specifically, it focuses on intelligence in support of counter-insurgency operations. The premise is an alternate history of World War II, in which the German army successfully invades Great Britain. The participants are captain-level military intelligence officers, midway through a multiweek training course intended to transform them into analytic team leaders. They are split into four teams of 10-15 officers for the purposes of the exercise. The analyst team participants play the part of a mid-level German intelligence cell charged with quelling an insurgency. The instructor cadre is composed of high ranking, more experienced intelligence officers. However, they play three roles in the exercise - instructor, commander, and administration of the interactivity in the scenario.

Prior to the exercise, all teams were provided an overview briefing by the instructor cadre that described the general situation and constraints. Teams were then assigned to separate rooms, each equipped with dry erase boards, maps, overlay material and four computers with only Microsoft Office applications. The exercise was structured such that the four analyst teams were working independently and in parallel over

a 6 day period. This created opportunity for repeated, parallel observations across the teams. To begin, each team received a damaged collection of paper bits that was intended to replicate the remnants of information from the last intelligence cell - which had recently been “destroyed.” This served as a way to introduce them more realistically into joining an analysis in progress instead of starting from a blank slate. Teams were given an initial period of four hours to sort through their information, after which they received a new report, or serial, approximately every two hours. These serials represented a variety of events occurring in the world that the teams had to analyze and act on, triggering analytic windows of opportunity within which to make or revise assessments. Teams were to analyze the available data and task resources for further collection based on their assessments. At the end of each day, teams briefed their assessments to an instructor acting as the commander.

Each serial was designed to provide realistic reports of activity representative of a counterinsurgency in 1940s Great Britain. Because each report had certain normative interpretations and multiple other suboptimal interpretations, they served as embedded event probes with which to elicit behavior indicative of various analytical vulnerabilities. However, the ethnographic observation of this required that the observers had a nuanced understanding of both the scenario itself and the characteristics of the cognitive work of IAS.

Since all teams received the same probes at roughly the same time, they served as unique opportunities to observe repeated measures between the groups. However, this also produced an observational coordination bottleneck. Exercise continuity over multiple (six) days allowed the scenario and team analytic iterations to evolve and build upon previous assessments. In the same way, the teams were also presented with

opportunities to revise or throw out previous assessments. At various points in the scenario, the teams would receive instructional, analytical, and situational feedback from a member of the instructor cadre. A pattern of standing feedback loops arose from regular daily briefings to the lead instructor (in a commander role) and with scenario evolution, branching, and pacing. A final briefing on the last day led to a pass/fail rating for the exercise and extensive feedback from the instructors on their overall process.

Analyst teams started the six day exercise each day at 0830, working continuous 8 hour shifts. In the analytic team spaces, distributed observers sat out of the way of the group with laptop computers and notebooks, and connected wirelessly to the central command computer. Observers employed ethnographic observation methods and pre-calibrated behavior codings to record data. Going into the first day of observation, network and chat connections were established. Throughout the day's events, a single expert domain practitioner on the observation team (SME) and other observers in a "command center" could immediately clarify any questions or confusion as they arose. Throughout each day, chats, video, pictures, and audio were transferred to the central machine. Raw chat data was distributed and reviewed by each observer. General trends in the chat transcripts were monitored and specific changes were made across the groups. After each day of the exercise was over, the observation team met and revised the recording protocol based upon lessons learned during the day. Afterward each observer was responsible for integrating their data and summaries into a structured scenario map of the day's events, and the next day's observations, trends and procedures were reviewed.

The observations and supporting data were compiled into text logs and spreadsheets for further analysis. In this way, the focus of externalizing the cognitive work of the domain was achieved in a natural, plausible, and unobtrusive way, which could then be later analyzed with a process tracing protocol. For this particular study, episodes in the logs where the instructors had intervened in the team analytic process were extracted, and a process tracing protocol analysis was used to delineate seven categories for each analytic “window of opportunity”: Day/Time, Team Number, Mindset/Context Summary, Description of Intervention, Receptivity, Actions/Responses, and Mapping to Support Function Model node(s). This gave structure to the data and helped to isolate the effects of the instructor interventions.

2.2.1 Methodological Innovations

In the course of this study, several methodological innovations were instituted to help overcome the complexities of investigating distributed cognitive work.

2.2.2 Prior-Participant Observers

In order to observe this exercise, a team of six observers - not formally trained in intelligence analysis - were assembled to conduct the data collection. In order to familiarize the observers to the domain, operational semantics, scenario and anticipated work of the practitioners, the observation team took part in a two-day accelerated version of the same exercise. In this capacity, they performed the same functions and faced the same complexities as the analysts they were about to observe, while also allowing them to become intimately familiar with the scenario. This served to help cue anticipatory points of interest to focus on in the later observations, as well as pre-calibrating observational terminology and granularity.

In addition, the choice of a “low tech” historical setting for the scenario restricted most of the team analytic work to analog or paper products, with the only exceptions being the permitted use of a single personnel database and office productivity software. A great advantage to this externalized workflow was that it made the analytic process greatly more observable than it would be if the teams were working in a digital computerized medium.

2.2.3 Distributed Observation Teams

In order to observe all squads concurrently, one observer was assigned to each squad with two observers establishing a command and coordination post in an adjacent room from which to monitor and facilitate communication between observers. A domain practitioner able to act as a subject matter expert (SME) was present on the observational team, and retained the ability to physically move between the remote observers stationed with the squads and to communicate with remote observers via computer from the command post. This helped in clarifying different domain complexities that arose, and gave the observers near-instant access to domain expertise. This was useful for translating jargon, expanding acronyms, explaining doctrine and processes, and overcoming other numerous observational impediments.

An ad-hoc wireless network was deployed enabling communication between remote observers, the SME, and the command post. Each remote observer used a laptop (Windows and Macintosh platforms) to communicate with the command post over an ad-hoc wireless 802.11x connection. Observers took notes by having a chat “conversation” with the central command post using commercial off the shelf (COTS)

asynchronous instant messaging software (Adium, iChat, Trillian: all utilized the ZeroConfig/Bonjour protocol). Inside the command center two to three members of the observation team monitored each stream of incoming observer data. This real-time feedback allowed the command post to coordinate and redirect resources and attention constantly, and specifically at rich probe points in the scenario and to emergent analytic vulnerabilities and behavior. At the end of each day full transcripts of each team's chat logs were combined together with any supplementary multimedia. Each of the chat programs allowed observers to transfer multimedia and text files as well as initiate one-way and two-way audio and video connections with the command post, allowing more robust data collection and providing the command post with a directable remote presence.

The team of observers, while physically distributed, was able to efficiently and effectively observe the analyst teams perform distributed work. Simultaneously, the SME and command post observers coordinated observation teams as instructors introduced new serials, gave specific lessons based on individual team shortcomings, and received briefings. Rather than one observer being overwhelmed by trying to watch an entire team by themselves, we had the capability to have up to nine people observing and analyzing one team as resources or constraints dictated.

2.2.4 Instructor Interventions as Probes into Broadening Checks

This study specifically examines how broadening checks occur in practice. Because of the inexperienced nature of their background, the analyst teams in the exercise were frequently vulnerable to premature narrowing. To counter this, one of the common functions taken on by the training cadre was to provide broadening checks. This

manifested itself in periodic instructor interventions into the team analytic process. This created an observational benefit: interventions were easily-identifiable discrete events which could have their impact on a team's analytic process traced in subsequent observations.

In general, instructor interventions are an interesting source of data because they speak to the goals of the training exercise, and illustrate one way expertise is passed down within an organization. Instructor interventions also give an indication of aggregated historical points of difficulty in the scenario, status and progress of teams, and common cognitive vulnerabilities in IAS.

CHAPTER 3

FINDINGS

The combination of a rich scaled-world scenario, target domain practitioners as participants, and innovative observational techniques allowed for this exercise to become a fruitful natural laboratory for investigating the contrasts between weaker and stronger information analysis and synthesis. In order to trace the analytic processes, analytic windows of opportunity for revision had to be identified. These windows typically were triggered by new events or feedback from the world, as well as from previous instructor interventions (as broadening checks). Teams who risked missing a specific window for revision - either due to a poor analytic process or a particularly hard portion of the scenario - then received an instructor intervention, intended to be a “teachable moment” or divergent course correction in the scenario. From identifying these windows, two major investigatory themes became salient in the resulting data. The first theme dealt with the nature of the instructor interventions within each analytic window, and its relationship to broader IAS support functions. The second theme was concerned with the team’s receptivity to the intervention, and their resulting performance.

Figure 3.1: A timeline depicting analytic windows of opportunity for revision within the scenario.

3.1 Mapping Instructor Interventions to the Support Function Model

We examined the nature of several specifically interesting interventions that served as broadening checks to the team analytic process, and mapped the findings to the aforementioned Support Function Model. The most evident aggregate finding from this mapping was the overwhelming focus that the interventions placed on the *hypothesis exploration* and *conflict and corroboration* support function areas. These results could be useful to inform the design of analytic support tools, which currently tend

to gravitate in contrast more towards the *down collect* support function area. The importance of providing functional support for the “critical thinking” activities in the *conflict and corroboration* and *hypothesis exploration* areas is a key research and application area for future development and exploration.

Comparing data from the critiquing study, we noticed a few differences between the domain of the national or strategic analysts and the observed domain of the military or tactical analysts. Time pressure and action-feedback loop coupling tend to be tighter at the tactical level. Expected levels of product refinement and analytic rigor tend to be higher at the strategic level. The opportunity to directly task collection platforms tends to be greater in tactical intelligence. Strategic level tasking and mission tends to be more ambiguous or open-ended, while tactical tasking is more closely tied to actionable recommendations. In general, however, the cognitive work of the two domains mostly converges, and the findings strongly reinforce the applicability of the Support Function Model as a relevant general framework for understanding IAS.

3.1.1 Interventions 1-2: Scenario Initialization and Workflow Establishment

These interventions dealt with getting the analytic team initially up to speed to join an analysis-in-progress. Specific topics include: TTP for setting up the TOC, workflow, products, awareness of ISR assets, briefing/rigor expectations, building model of adversary from actions and constraints.

*Intervention 1: (day 1 briefing) TTP for setting up the TOC, workflow, products

Team	Mindset/Context	Cues/Interventions	Receptivity	Actions/Responses	Mapping to Model
1	Team is still trying to establish initial analytic momentum and team workflow, and is open to feedback and initial framing/structure.	Instructors place emphasis on externalizing and sharing working information and framing evidence as indicators for supporting or disconfirming hypotheses. *To initiate hypothesis generation, start with "Most Dangerous" and "Most Probable" and expand from there. Compare these initial hypotheses with the operating environment to make specific recommendations of actions or countermeasures.* *Structure the information environment so that indicators that support or disconfirm hypotheses are able to catalyze reassessment activities.* *Use categories as a loose structure for your indicators - capabilities; how, where, when and with what; frequency they operate; feasibility/likelihood; targeting; sophistication; deception; personnel requirements; favored terrain; logistical requirements; and goals.*	Generally high - due to initial scenario momentum and lack of competing established workflow.	Team tries to follow instructor advice, instituting new team analytic workflow and beginning to document previously verbal interactions.	Mostly Hypothesis Exploration narrowing functions. Some broadening between Conflict & Corroboration and Hypothesis Exploration, and between Hypothesis Exploration and Down Collect. 3.5.1 Support the observability of relationships between findings and hypotheses. 3.4 Support the observability of other analysts' hypothesis exploration process. 3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure). 2.7.2 Use the discovery of "trigger" indicator to stimulate new hypothesis generation
<i>sidebar: MI doctrinal expectation of analysts to rapidly develop an adversarial COA pushes them into early hypothesis commitment without necessarily encouraging revision later, and could produce premature closure framing effects.</i>					
2	Analysts are anxious to create structure in the data.	Instructors urge analysts not to start with too many assumptions about the adversary (mirror bias). Try to determine capabilities based on actions instead of fitting adversary to pre-existing structure.	Mixed - team is fixated on how to create normal doctrinal products instead of thinking about whether adversary force structure supports the normal products.	Team drops product fixation, but doesn't pursue analytic window readily.	2 Support the construction of accurate interpretations of the findings. 2.4 Support diversity in the interpretations of data.
3	Team begins working in space as it is presented to them, instead of adapting it to their needs and to facilitate organization and workflow.	Instructors show analysts how to set up physical workspace to support process and product flow.	Generally high - due to initial scenario momentum and lack of competing established workflow.	Team revises TOC setup.	Support cooperative, multi-human-multi-machine coordinated intelligence analysis 1.4 Support the observability of other analysts' down-collect activities 2.4.1 Support the observability of conflicts and corroboration. 3.4 Support the observability of other analysts' hypothesis exploration process.
4	x	x		x	x

Table 3.1: Process tracing tables for intervention 1 on day 1.

***Intervention 2: (day 2 morning) Awareness of ISR assets, briefing rigor expectations, building model of adversary from actions and constraints**

Team	Mindset/Context	Cues/Interventions	Receptivity	Actions/Responses	Mapping to Model
1	<p>Team is unable to integrate analysis of reported events into a picture of the adversary.</p> <p>Team wants to use their own operational symbology for briefing to commanders.</p>	<p>Essentially the instructor teaches the team how to do a functional analysis of an adversary, based on their tactics, capabilities, types of targets, constraints, and intercepted materials and personnel. Then he gives an example of how to turn that analysis into countermeasures. The specific focus of this particular analysis is to determine likely adversarial means of transportation and their corresponding operational range. By applying this range radially to prior attack sites, analysts can designate rough geographical areas of interest that contain suspected adversarial direct action groups.</p> <p>Instructor maintain a separate focus on operational symbology (self-defined) and symbology for presentation to superior (standardized military). Much importance is placed on achieving a high degree of "professional" appearance for briefing products. This may be a reflection of a military (or human) tendency to use visual appearance as a cue to the implicit rigor of an analytic product.</p>	Low - due to perceived criticism from instructor, and workload increase from suggested revision.	<p>The team thought that the instructor hated their OP graphics.</p> <p>There was lots of resistance to the instructor's analysis of radar, but they seemed to realize that he was trying to lead them by the nose, so they accepted the 10k cell radius suggestion. They disliked having to redo their original radar because they disagreed with the instructor's assumption of local action only with transport limited to walking.</p> <p>However, the team began to apply 10k radii to incidents on the map. Team partially revises their picture of the adversary. The team also accepted the instructor's hint about previous status of the killed adversary, and generated an RPT to ID the body.</p>	3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).
2	<p>Team wants to monitor wireless transmission in the area but is unaware of their collection assets.</p> <p>Team is having trouble structuring their collection to help them differentiate support for competing hypotheses.</p>	<p>Instructor shows how an organized, externalized plan for down collect assets - along with their assignments, capabilities, and limitations (ISR plan) - can help reduce inappropriate tasking and increase awareness and observability. Instructor gives the team briefing expectations: need an update on any changes in terrain, weather, significance of recent events. The expected format is outlined, along with a clear request for both long term and short term COA's, ISR plans, and PR recommendations.</p> <p>Instructor urges them to look at what patterns are created by the behavior of the adversary. The instructor teaches the team how to do a functional analysis of an adversary, based on their tactics, capabilities, types of targets, constraints, and intercepted materials and personnel. Then he gives an example of how to turn that analysis into countermeasures. The specific focus of this particular analysis is to determine likely adversarial means of transportation and their corresponding operational range. By applying this range radially to prior attack sites, analysts can designate rough geographical areas of interest that contain suspected adversarial direct action groups. Instructor shows team how to interpret data to discriminate specific hypotheses being supported over others. Instructor stresses the importance of conducting a full exploitation of any information already acquired.</p>	Mixed - due to some resistance to overturn current mindset.	<p>Team partially revises their picture of the adversary.</p>	<p>3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).</p> <p>1.5 Support the observability of the down-collect process</p> <p>1.4 Support the observability of other analysts' down-collect activities</p> <p>2.2.1.2 Support domain-relevant pattern recognition in the data.</p> <p>3.2.1 Support the observability of relationships between interpretations and hypotheses.</p>
3	<p>Team has an overinflated sense of the adversary's capabilities and structure.</p>	<p>The instructor teaches the team how to do a functional analysis of an adversary, based on their tactics, capabilities, types of targets, constraints, and intercepted materials and personnel. Then he gives an example of how to turn that analysis into countermeasures. The specific focus of this particular analysis is to determine likely adversarial means of transportation and their corresponding operational range. By applying this range radially to prior attack sites, analysts can designate rough geographical areas of interest that contain suspected adversarial direct action groups.</p> <p>Instructor shows how to choose and employ appropriate tools for offering kinds of pattern detection and analysis of adversary activity. Specifically, shows how plotwheel tool is well-suited for seeing patterns by time of day, but not patterns over longer periods of time. Instructor teaches about an alternate calendar-like tool to detect longer-term cyclical patterns, (radial charting vs. grid charting of events). One analyst connects technique with similar tool he had created in a spreadsheet on an earlier deployment into an active theater. He had use the contextual annotation feature of the spreadsheet, and a customized symbology, to analyze longer-term adversary activity with rich accompanying background data.</p>	Mixed - due to some resistance to overturn current mindset.	<p>Team partially revises their picture of the adversary.</p>	<p>3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).</p> <p>1.5.1 Support the understanding of events with respect to time.</p> <p>2.2.1 Support the detection and recognition of events.</p> <p>2.2.1.2 Support domain-relevant pattern recognition in the data.</p>
4	<p>Team is not successfully building an operational picture of the adversary from the constraints in the world and their actions.</p>	<p>Instructor H says "you must look for deeper info, its not all going to be handed to you on a plate." The instructor teaches the team how to do a functional analysis of an adversary, based on their tactics, capabilities, types of targets, constraints, and intercepted materials and personnel. Then he gives an example of how to turn that analysis into countermeasures. The specific focus of this particular analysis is to determine likely adversarial means of transportation and their corresponding operational range. By applying this range radially to prior attack sites, analysts can designate rough geographical areas of interest that contain suspected adversarial direct action groups.</p>	Mixed/Low - due to perceived criticism from instructor leading to realization of poor prior performance.	<p>Team sitting around looks a bit depressed, very pensive, like they've just had the rug pulled out from under them. Team partially revises their picture of the adversary.</p>	3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).

Table 3.2: Process tracing tables for intervention 2 on day 2.

3.1.2 Intervention 3: Examining Physical Evidence and Exploiting Intercepted Materials

This intervention was meant as a broadening check regarding the level of detail the teams exercised when examining physical artifacts. Specific topics include: examining physical evidence and then exploiting the intercepted materials afterwards for intelligence value.

*Intervention 3: (day 2 afternoon) examining physical evidence & exploiting intercepted materials

Team	Mindset/Context	Cues/Interventions	Receptivity	Actions/Responses	Mapping to Model
1	Team prematurely narrowed in assessment of recently intercepted materials as not holding significant meaning. Team is unaware that the objects hold indirect data.	Instructor encourages more thorough investigation of physical artifacts - for instance considering how an object was used by an adversary, in addition to examining its physical attributes.	High - due to engagement level in scenario	Team examines items closer and finds several usage marks, and hidden meaning/messages. They generate some new hypotheses of possible uses for recovered items, leading to more hypotheses about adversary COAs.	1.3 Support the determination of source value (i.e., where to look).
2	Team is considering different ways how a recovered object can carry meaning. Brainstorming session and hypothesis discussion reveals an attempt to avoid premature closure on one course. At same time, they do conclude fairly quickly that commandos must be involved somehow, question turns to how to distinguish between commandos acting in a direct action fashion versus acting along with or in support of trained locals.	Instructor encourages more thorough investigation of physical artifacts - for instance considering how an object was used by an adversary, in addition to examining its physical attributes. Instructor pushes them to continue to consider how to distinguish between h1 (commandos as DA) and h2 (commandos as training cadre for locals)	Low/Mixed - due to resistance to overturn current mindset.	Team identifies potential discriminatory evidence between the two hypotheses - weapons used is seen as key, almost to the extent that it is viewed as the only key piece of evidence. The team discusses the need for the commandos to somehow communicate with local groups (hyp. 2), but this isn't focused on nearly as much on as the weapons evidence is by the time of the instructor intervention. Team has settled on hypothesis of a single commando cell and a single insurgent cell. Commando cell operating in DA operations across the countryside and occasionally linking up with locals for joint ops. Team is teetering on edge of premature closure - they are hypothesis testing, but have 'concluded' already that there are 2 groups and are now just trying to discriminate two different ways these groups might be acting - with commandos as trainers or commandos primarily as DA assets.	3.3.1 Support the observability of the hypothesis SET and how they relate (complete or correlate). 3.5.1 Support the observability of relationships between findings and hypotheses. 3.2.1 Support the observability of relationships between interpretations and hypotheses. 1 Support the extraction of essential, representative, 'on analysis' sample from available data. 1.10 Support collection 'outside the focus' (to stimulate broadening).
3	Team is trying to uncover insight into recovered items from adversarial interaction.	Instructor encourages more thorough investigation of physical artifacts - for instance considering how an object was used by an adversary, in addition to examining its physical attributes. "don't just look at the map, examine it" Instructor pushes team to consider how the recovered tennis ball could be used to pass messages.	High - due to engagement level with scenario.	Team forms hypothesis that tennis balls are used for dead drop message system. Team generates new collection tasking based on exploitation of the usage artifacts left on the recovered map. Team generates recommendation for specific countermeasures based on one interpretation of the message in the tennis ball. Team hypothesizes about reasons for the tennis ball courier committing suicide. Team sets up competing hypothesis framework to compare evidence supporting competing interpretations of the recovered message.	1 Support the extraction of essential, representative, 'on analysis' sample from available data. 1.10 Support collection 'outside the focus' (to stimulate broadening). 2.6 Support revised C & C efforts based on alternative hypotheses and holes in the hypothesis set. 1.1.2 Support refocusing the collection process based on revised hypotheses.
4	Team is trying to exploit recovered map.	Instructor points out interesting characteristics, and encourages closer examination.	High - due to engagement level with scenario.	Team examines items closer and finds several usage marks, and hypothesizes about the reason for them being there.	1 Support the extraction of essential, representative, 'on analysis' sample from available data. 2 Support the construction of accurate interpretations of the findings.

Table 3.3: Process tracing table for intervention 3 on day 2 afternoon.

3.1.3 Intervention 4: Surprise Briefing Demand by “Angry” Superior Officer

This intervention was different than the others. The instructors had a guest officer play the part of an emotional, angry german colonel who has just learned his family was killed by the insurgents. He bursts into the workspace yelling, and demands an immediate assessment of insurgent sites to raid. The team is put in a precipitous situation under time and resource pressure, leading to a breakdown in synthesis from earlier assessments. Specifically, a common tactic of the insurgent attacks was to leave booby traps behind. The team did not provide this warning to the angry officer, and as a result his strike force suffered massive casualties at the raid site. The intervention portion of this interaction takes place as an after-action review, a few minutes after the team is forced to make a snap assessment. The instructor runs through the importance of always being able to brief, and to not get locked into production cycles, amongst other topics.

*Intervention 4: (day 2 afternoon) Surprise Briefing - Angry Superior Officer Demanding Recommendations for Immediate Action

Team	Mindset/Context	Cues/Interventions	Receptivity	Actions/Responses	Mapping to Model
1	Overwhelmed with emotionally charged demand for immediate actionable intelligence from an angry senior officer. Extreme time pressure forces a rush to make recommendations of an adversary target to hit.	Senior officer comes in clearly upset over (fictionalized) loss of his family members to adversary action. Demands immediate briefing from analyst team's leader on targets to hit. (This is a planned measure to increase the realism and level of engagement of the exercise.)	High - due to engagement level of scenario in emotionally charged situation.	Team hastily recommends some sites to strike, but doesn't pass along warnings about possibility of booby traps (from earlier analysis of adversary capabilities). This failure to synthesize previous analyses results in massive casualties to the strike force. The angry officer returns, and demotes the analyst team's leader for the lack of warning. After some time, the senior officer and the rest of the instructional cadre return for an after-action review (teachable moment). They discuss the role of the rest of the team in supporting the team's leader (cross-checking for resilience), and the need to synthesize and connect from previous analyses.	1.5.4 Support the awareness of down-collect history. (History in current analysis vs. past analyses) 1.6.1 Support the determination of relevance of past analyses (e.g. staleness, context) 2.2.1.2 Support domain-relevant pattern recognition in the data. 3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).
2					
3	Overwhelmed with emotionally charged demand for immediate actionable intelligence from an angry senior officer. Extreme time pressure forces a rush to make recommendations of an adversary target to hit.	Senior officer comes in clearly upset over (fictionalized) loss of his family members to adversary action. Demands immediate briefing from analyst team's leader on targets to hit. (This is a planned measure to increase the realism and level of engagement of the exercise.)	High - due to engagement level of scenario in emotionally charged situation.	I team hastily recommends some sites to strike, but doesn't pass along warnings about possibility of booby traps (from earlier analysis of adversary capabilities). This failure to synthesize previous analyses results in massive casualties to the strike force. The angry officer returns, and demotes the analyst team's leader for the lack of warning. After some time, the senior officer and the rest of the instructional cadre return for an after-action review (teachable moment). They discuss the role of the rest of the team in supporting the team's leader (cross-checking for resilience), and the need to synthesize and connect from previous analyses.	1.5.4 support the awareness of down-collect history. (History in current analysis vs. past analyses) 1.6.1 Support the determination of relevance of past analyses (e.g. staleness, context) 2.2.1.2 Support domain-relevant pattern recognition in the data. 3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).
4	Overwhelmed with emotionally charged demand for immediate actionable intelligence from an angry senior officer. Extreme time pressure forces a rush to make recommendations of an adversary target to hit.	Senior officer comes in clearly upset over (fictionalized) loss of his family members to adversary action. Demands immediate briefing from analyst team's leader on targets to hit. (This is a planned measure to increase the realism and level of engagement of the exercise.)	Mixed-High - due to engagement level of scenario in emotionally charged situation. Team doesn't respond within window, but consequences still occur as default scenario response.	Team refuses to make unassessed recommendation and won't name any sites to strike, and also doesn't pass along warnings about possibility of booby traps (from earlier analysis of adversary capabilities). Angry officer sends strike force anyways. The failure to synthesize previous analyses results in massive casualties to the strike force. The angry officer returns, and demotes the analyst team's leader for the lack of warning. After some time, the senior officer and the rest of the instructional cadre return for an after-action review (teachable moment). They discuss the role of the rest of the team in supporting the team's leader (cross-checking for resilience), and the need to synthesize and connect from previous analyses.	1.5.4 Support the awareness of down-collect history. (History in current analysis vs. past analyses) 1.6.1 Support the determination of relevance of past analyses (e.g. staleness, context) 2.2.1.2 Support domain-relevant pattern recognition in the data. 3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).

Table 3.4: Process tracing table for intervention 4 on day 2 afternoon.

3.1.4 Intervention 7: Exploitation of Recovered Cache Items

This intervention deals with the exploitation of recovered insurgent cache items, specifically as a way to understand the normal operating procedures and constraints of the adversary.

*Intervention 7: (day 3 midday) Exploitation of Recovered Cache Items

Team	Mindset/Context	Cues/Interventions	Receptivity	Actions/Responses	Mapping to Model
1	<p>Team is trying to analyze physical collection artifacts that were intercepted at adversary cache site.</p> <p>Team seems to be artificially constraining themselves to only consider explanations bounded within their own defined geospatial area of operations (AO) - Imposing their own structure on the world.</p> <p>Team is still trying to assess number and operational area of insurgent cells.</p>	<p>Instructor leads team through examination techniques for exploitation of physical items. This resembles earlier intervention where possible uses (quasi-functional analysis) are considered. Encourages team to structure each thought as a competing hypothesis led to indicators of support.</p>	Low/Fixed - team doesn't seem to grasp competing hypothesis concept.	<p>Team seems to ignore instructor suggestions mostly, however they do revise their assessment of likely adversary operational area.</p>	<p>1 Support the extraction of essential, representative, 'on analysis' sample from available data.</p> <p>1.5.3 Support the understanding of down-collect results with respect to spatio-temporal characteristics.</p> <p>1.10 Support collection 'outside the focus' (to stimulate broadening).</p> <p>2 Support the construction of accurate interpretations of the findings.</p> <p>2.4.1 Support the observability of conflicts and corroboration.</p> <p>3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).</p> <p>3.2.1 Support the observability of relationships between interpretations and hypotheses.</p> <p>3.3.1 Support the observability of the hypothesis SET and how they relate (compete or correlate).</p>
2	<p>Team is trying to analyze physical collection artifacts that were intercepted at adversary cache site.</p> <p>Team is dropping generated hypothesis threads before testing them.</p> <p>Team is favoring enduring hypothesis that special forces are directly involved or training dollars for the insurgency.</p>	<p>Instructor leads team through examination techniques for exploitation of physical items. This resembles earlier intervention where possible uses (quasi-functional analysis) are considered. Instructor pushes on the presence of training manuals in the cache site as a way to help identify the adversary. Has team consider whether the level of training indicated is reflective of new trainees or experienced soldiers as a way to connect evidence to hypotheses.</p> <p>Instructor encourages team to follow up more on hypotheses generated during brainstorming by creating competing hypothesis sets and presenting them during briefings as well as trying to be more explanatory about why events were happening. Instructor helps team generate hypotheses to test about why recovered items were originally from outside of the team's defined area of operations (AO).</p>	High - team begins to integrate, synthesize, and test from earlier assessments as taught in intervention.	<p>Team starts to become more sophisticated in their analysis, and synthesizes connections between earlier reports of adversary activity outside of their AO, and recovered items from inside of their AO.</p> <p>Team is starting to turn assessments into action recommendations.</p> <p>Team incorporates earlier lessons learned into current recommendations and warnings.</p> <p>Team is beginning to form more detailed picture of the adversary to test.</p>	<p>1 Support the extraction of essential, representative, 'on analysis' sample from available data.</p> <p>1.1.2 Support refocusing the collection process based on revised hypotheses.</p> <p>1.5.3 Support the understanding of down-collect results with respect to spatio-temporal characteristics.</p> <p>2.2.1.2 Support domain-relevant pattern recognition in the data.</p> <p>2.7.4 Use differing explanations to trigger search for conflicting evidence.</p> <p>3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).</p> <p>3.2.1 Support the observability of relationships between interpretations and hypotheses.</p> <p>3.3.1 Support the observability of the hypothesis SET and how they relate (compete or correlate).</p>
3	<p>Team makes request to have a suspected insurgent detained, and to raid some suspected sites.</p> <p>Team hasn't fully connected the recovery of stolen uniforms to an event outside of their area of operations.</p> <p>Team is not integrating their proposed hypotheses across all members, some segmentation has occurred.</p> <p>Team is trying to set up indicators to differentiate between proposed structure of insurgents.</p>	<p>"Missing uniforms, missing weapons, you're coming up with all these great theories, but you don't write them down, what are the elements that indicate they are correct or not? We get new information in, what does it indicate? Put your theories up so you can all see them, you're running yourselves up in little groups, and you don't have a big picture"</p> <p>Instructor leads team through examination techniques for exploitation of physical items. This resembles earlier intervention where possible uses (quasi-functional analysis) are considered.</p> <p>Instructor helps team generate hypotheses to test about why recovered items were originally from outside of the team's defined area of operations (AO).</p>	High - team begins to integrate, synthesize, and test from earlier assessments as taught in intervention.	<p>Team starts to become more sophisticated in their analysis, and synthesizes connections between earlier reports of adversary activity outside of their AO, and recovered items from inside of their AO.</p> <p>Team is more fluently generating action recommendations.</p>	<p>1.1.2 Support refocusing the collection process based on revised hypotheses.</p> <p>1.5.3 Support the understanding of down-collect results with respect to spatio-temporal characteristics.</p> <p>2.2.1.2 Support domain-relevant pattern recognition in the data.</p> <p>2.7.4 Use differing explanations to trigger search for conflicting evidence.</p> <p>3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).</p> <p>3.2.1 Support the observability of relationships between interpretations and hypotheses.</p> <p>3.3.1 Support the observability of the hypothesis SET and how they relate (compete or correlate).</p>
4	<p>Team is trying to analyze physical collection artifacts that were intercepted at adversary cache site.</p>	<p>Instructor walks through each item's potential uses with the team, and encourages them to set up competing hypotheses with supporting indicators to differentiate. Instructor urges team to make the list of competing hypotheses observable to other team members, and to incorporate it into the briefings.</p>	High - team begins to integrate, synthesize, and test from earlier assessments as taught in intervention.	<p>Team derives indicator of support for hypothesis of adversary force being trained and set up prior to German invasion.</p> <p>Team is starting to turn assessments into more fluent action recommendations.</p> <p>Team incorporates earlier lessons learned into current recommendations and warnings.</p>	<p>1.5.3 Support the understanding of down-collect results with respect to spatio-temporal characteristics.</p> <p>2.2.1.2 Support domain-relevant pattern recognition in the data.</p> <p>2.7.4 Use differing explanations to trigger search for conflicting evidence.</p> <p>3.1 Support the construction of an inferential model of the target domain (understanding the key functions and organizational structure).</p> <p>3.2.1 Support the observability of relationships between interpretations and hypotheses.</p> <p>3.3.1 Support the observability of the hypothesis SET and how they relate (compete or correlate).</p>

Table 3.5: Process tracing table for intervention 7 on day 3 midday.

3.1.5 Intervention 11: Functional Analysis of Adversary Modus Operandi

This intervention deals with a tactic for discerning the operational range of a specific insurgent cell based on human limitations and tracing back constraints in the world. Specifically, using a calculated range based on walking speed, and an attack window based on periods of low illumination at night, the instructors showed the teams how to map out potential safehouses, cache sites, and target sets for the adversary.

*Intervention 11: (day 4 afternoon) - causal reasoning and functional operating analysis of adversary (safehouse, cache, target model), exploitation analysis of cache items, competing hypotheses, TTP on transforming intel into action recommendations to generate more intel

Team	Mindset/Context	Cues/Interventions	Receptivity	Actions/Responses	Mapping to Model
1	Team is having trouble forming a data-supported model of how the adversary operates.	Instructor does functional analysis of adversary's modus operandi. Covers basic requirements for operations - cache, safehouse, and target - and the constraints (walking speed during low illumination) that govern how far apart each site can realistically be. Using human constraints allows actual distance values to be placed on the map to find operational ranges and patterns of activity. Instructor then runs through use analysis of physical artifacts recovered from an adversary cache site, forming an even clearer picture of the adversary for targeting purposes. Eventually most of the unresolved analytic threads of the scenario are touched upon.	Mixed - team is having difficulty applying the concepts introduced skillfully, but attempts to make revisions.	Teams attempts to implement instructor suggestions.	
2	Team is having trouble forming a data-supported model of how the adversary operates.	Instructor does functional analysis of adversary's modus operandi. Covers basic requirements for operations - cache, safehouse, and target - and the constraints (walking speed during low illumination) that govern how far apart each site can realistically be. Using human constraints allows actual distance values to be placed on the map to find operational ranges and patterns of activity. Instructor then runs through use analysis of physical artifacts recovered from an adversary cache site, forming an even clearer picture of the adversary.	Low - Some suspicion of instructor deception or "gaming" still manifests occasionally. Team resists revision to their "grand theory" mindset.	Team talks about certain revisions but doesn't seriously evaluate or institute any. Increasingly, their "grand theory" hypothesis is that the home guard/aux are acting in support of commandos and that the other links they are developing are support.	
3	Team is having trouble forming a data-supported model of how the adversary operates.	Instructor does functional analysis of adversary's modus operandi. Covers basic requirements for operations - cache, safehouse, and target - and the constraints (walking speed during low illumination) that govern how far apart each site can realistically be. Using human constraints allows actual distance values to be placed on the map to find operational ranges and patterns of activity. Instructor then runs through use analysis of physical artifacts recovered from an adversary cache site, forming an even clearer picture of the adversary.	High - team attempts to institute instructor suggestions.	Team revises current hypothesized operational areas radii into smaller size based on intervention regarding human constraints.	
4	Team is unable to form a data-supported model of how the adversary operates.	With assistance of instructor, they note that cutting operational radii from 8 km to 5 km, the operating area of a cell is cut from 64pi to 25pi. Earlier intervention was the critical event. Team prior to that point had attempted almost no revision of day 3 hypotheses.	Low - due to level of engagement with scenario.	Team is working on drawing possible cache radii circles based from attacks. Current approach does not seem to be working- doesn't draw any conclusions because the areas pointed to are nondescript. Intervention yesterday led to updating the products with attempted info on attack radii- but not looking below the surface of info or asking what it means - no formal hypotheses laid out. People seem to be waiting around to be told what to do, or for a brief, not much effort today. People are generally sitting around - lack of motivation.	

Table 3.6: Process tracing table for intervention 11 on day 4 afternoon.

3.1.6 Intervention 13: Stolen Torpedo Hypothesis Brainstorming and ACH Methodology

This intervention dealt with several methods for doing hypothesis exploration, specifically brainstorming and analysis by competing hypotheses. The object of the intervention was to use a teachable moment to show the team how to figure out possibilities for the use and transport of a stolen torpedo warhead.

*Intervention 13: (day 5 morning) Torpedo Hypothesis/Brainstorming/ACH
Methodology

Team	Mindset/Context	Cues/Interventions	Receptivity	Actions/Responses	Mapping to Model
1	Team is working a number of disparate threads.	No significant intervention - instructor encourages them to brainstorm to generate multiple competing hypotheses about how the adversary will use the torpedo they seized.	Mixed - team is busy and doesn't want the interruption affecting workflow.	No data.	3.3 Support the generation and exploration of alternative hypotheses. 3.3.1 Support the observability of the hypothesis SET and how they relate (compete or correlate).
2	Team displays periodic manifestations of distrust of the instructors' guidance - team thinks they are being led astray. Team is trying to hypothesize uses for the torpedo. Team tends to accept hypotheses once they generate them, rather than testing them rigorously.	Instructor encourages team to make their assumptions and supporting evidence explicit. Instructor shows how generative techniques like brainstorming are more suited to creating hypotheses, and the firing of supportive or disconfirming evidence is more suited for testing hypotheses. Instructor helps team test different hypotheses surrounding the s-boat attack. Tries to instill some methodical testing strategies. Instructor gives lesson on cryptography	Low - team periodically thinks instructor is "gaming" them to lead them astray.	Team initially doesn't pursue hypothesis testing very vigorously, but begins to attempt to structure competing hypotheses to figure out most likely use for the stolen torpedo.	3.5 Support the generation of alternative hypotheses from new findings. (broadening) 3.3.1 Support the observability of the hypothesis SET and how they relate (compete or correlate). 3.3 Support the generation and exploration of alternative hypotheses. 3.2.1 Support the observability of relationships between interpretations and hypotheses. 2.7.4 Use differing explanations to trigger search for conflicting evidence
3	Team is preparing for individual briefs, getting everyone on the same common ground understanding of the group assessment. Team is trying to figure out how the stolen torpedo was transported and its intended use.	Instructor in encouraging brainstorming as a way to generate enemy COAs and competing hypotheses. Instructor begins by tracing backwards how insurgents could move the torpedo, using a perspective grounded in the operational constraints of the adversary.	High - team grasps use of technique being instructed.	Team generates several hypotheses for the movement of the torpedo, and the instructor helps them disconfirm most of them by reasoning through the constraints. At the end of the intervention they instructor tries to lead them to the conclusion that they should arrest a particular insurgent, but the team had already requested that person be detained earlier.	3.2.1 Support the observability of relationships between interpretations and hypotheses. 3.3 Support the generation and exploration of alternative hypotheses. 3.5.1 Support the observability of relationships between findings and hypotheses. 1.1.3 Support refocusing the selection process based on revised hypotheses.
4	Team is trying to figure out the adversary's intent with the stolen torpedo.	"Do we fully understand brainstorming? It allows you to do COA development and competing hypotheses tests. Don't wait until a theory becomes truth- use warnings and indicators to prove and disprove a course of action." Instructor leads a brainstorming session on generating hypotheses about the intended use and transportation of the stolen torpedo. Encourages thought and brainstorming beyond the individual pieces of information, trying to connect things together.	Low - engagement level with the scenario is down, team doesn't rigorously pursue analytic threads.	Team doesn't seem to internalize much at this point, there seems to be some engagement problems. The only part of the intervention yesterday that they took to heart is updating the products with attempted info on adversary's operational area - they are still not looking below the surface of information or asking what it means when deriving enemy MCD or intentions - no formal hypotheses have been laid out and tested.	3.2.1 Support the observability of relationships between interpretations and hypotheses. 3.3 Support the generation and exploration of alternative hypotheses. 3.5.1 Support the observability of relationships between findings and hypotheses. 1.1.3 Support refocusing the selection process based on revised hypotheses.

Table 3.7: Process tracing table for intervention 13 on day 5 morning.

3.1.7 Intervention 14: Cryptography Lesson, Exploiting Crypto and ELINT

This intervention was more technical in nature, cover topics dealing with basic cryptograph and electronic intelligence intercepts (ELINT). The focus was on teaching one way to encode or decode a secret message, and then once the message was decoded, how to exploit it for intelligence value.

*Intervention 14: (day 5 midday) Crypto Lesson, Exploiting Crypto/ELINT

Team	Mindset/Context	Cues/Interventions	Receptivity	Actions/Responses	Mapping to Model
1	Team is having difficulty decrypting intercepted message, and is frustrated that their formal RFIs aren't producing any information or results (requests for information - simulated interactivity with rest of military)	Instructor gives lesson about how the format or wording of the RFI can influence its ability to be acted on. Encourages team to carefully consider constraints when forming RFIs. Instructor leads lesson on decryption, basically shows them how to decode the message.	Low - due to level of engagement with scenario, difficulty of task, and lack of desired interactivity.	Team is losing engagement with the exercise. Team decodes message, but only with very explicit help.	1.1.2 Support refocusing the collection process based on revised hypotheses. 1.1.2.2 Support refocusing the collection process based on new interpretations.
2	X	X	X	X	X
3	Team is having difficulty decrypting intercepted message.	Instructor gives some significant hints regarding the coded message. A bit later, instructor gives full lesson on decrypting the message. After decrypting the message (regarding radio frequencies), instructor presses team to capitalize on it by retasking collection assets (radio direction-finding equipment). Instructor explains how to iteratively refine talking to triangulate in on transmission source, and common adversary deception practices to account for.	High - team was having trouble with task difficulty level, but after intervention moved quickly into synthesis and recommendations.	Team decrypts message after hints, and immediately forms a most likely hypothesis regarding its meaning. The decoded message is externalized in a shareable way. Team isn't able to immediately exploit message meaning, but begins process of locating potential radio transmission sites to investigate.	1.1.2 Support refocusing the collection process based on revised hypotheses. 1.5.3 Support the understanding of down-collect results with respect to spatio-temporal characteristics. 1.7 Support an iterative, detectable, very diverse down-collect process 1.1.1 Support the generation of new interpretations from revised down-collect results 1.1.2 Support revised down-collect based on new interpretations. 1.1.2.2 Support refocusing the collection process based on new interpretations.
4	Team has reached an impasse trying to decode the intercepted message.	Instructor leads lesson on decryption, basically shows them how to decode the message. Afterwards, encourages team to translate the decoded meaning into new RFIs or tasking of assets. Instructor explains how to iteratively refine talking to triangulate in on transmission source, and common adversary deception practices to account for. Instructor encourage team to think about the physical constraints of radio transmission, and to search for environmental features that were relevant to those constraints.	High - team attempts to synthesize, with instructor assistance.	Team issues RFIs to search list of sites in decoded message, but isn't able to locate sites within their area of operations in order to attach grid coordinates to retasking order. After instructor hint, team is able to find grid locations on the map for the site they want to investigate. Team generates corollary hypothesis that the intercepted tennis ball message couriers are used to transport content to the radio sites for retransmission.	1.1.2 Support refocusing the collection process based on revised hypotheses. 1.5.3 Support the understanding of down-collect results with respect to spatio-temporal characteristics. 1.7 Support an iterative, detectable, very diverse down-collect process 1.1.1 Support the generation of new interpretations from revised down-collect results 1.1.2 Support revised down-collect based on new interpretations. 1.1.2.2 Support refocusing the collection process based on new interpretations. 3.5 Support the generation of alternative hypotheses from new findings. (broadening)

Table 3.8: Process tracing table for intervention 14 on day 5 midday.

3.2 Analyst Team Receptivity to Instructor Interventions

The role of instructor interventions as a broadening check against premature narrowing bore mixed results with respect to the team analytic process. On one hand, the instructors had designed the scenario purposefully with embedded hazards for the analytic teams to fall prey to. Teams were placed into precipitous situations under time and resources pressures while forced to make recommendations or assessments. The intent of this was to force mistakes, then draw upon the experience of the instructors and intervene in the analytic process to teach against a particular vulnerability. Overall, this shaping gave an excellent view into what expert practitioners felt were common or particularly vexing analytic vulnerabilities of the domain.

However, teams were not always responsive to these interventions, and in some cases perceived them as even intended to deceive them into choosing an incorrect course of action, or as part of the “fog of war” in the scenario.

In their final evaluations, two of the four teams were given a passing grade, and two a failing grade, who then had to redo their final briefing until it was satisfactory. Interestingly, the two failing teams corresponded most often with the least receptive or revisionary behavior in the protocol analysis relative to instructor interventions.

Further work needs to be done to explore this relationship between broadening checks and stronger analytic process. We feel, however, that this data offers additional support for the idea that broadening checks are a critical component of process resilience, as suggested in earlier findings in this area (Zelik et al., 2007).

receptivity:	team 1	team2	team 3	team 4
intervention 1	high	mixed	high	n/a
intervention 2	low	mixed	mixed	mixed/low
intervention 3	high	low/mixed	high	high
intervention 4	high	n/a	high	mixed/high
intervention 7	low/mixed	high	high	high
intervention 11	mixed	low	high	low
intervention 13	mixed	low	high	low
intervention 14	low	n/a	high	high
grade:	pass	fail	pass	fail

Table 3.9: Summary table of analytic team receptivity to instructor interventions.

CHAPTER 4

DISCUSSION

When mapped from the process tracing onto the support function network, the instructor interventions tended to cluster around the “Hypothesis Exploration” area. This exercise employed a low-tech scenario and analytic operating environment for the purpose of focusing on core analytic technique instead of learning (tech-based) support tools. This helped simplify observations, and made the training goals of the exercise more apparent. From earlier work, a survey of analytic visualization tools were evaluated for support and mapped to the support function network. In that case, most of the tools tended to map onto the down collect area of support functions. This suggests a disconnect between what the instructors desire the analysts to learn and employ, and what support tools are available to them in deployment.

4.1 Scenario Design

Because it was a low tech scenario, issues like data overload weren’t as prevalent. This could also have some effect on the minimization of down collect support functions by the instructors.

The three roles of the instructors were not uniformly performed (instruct, command, administer) throughout the scenario. Typically, the instruct and admin roles

Finding the Decision Support

Figure 4.1: A version of the Support Function Model with Instructor Interventions mapped to it.

were played with a much lower quality or fidelity. In addition, there were some variations between instructors in the instruct role. Particularly, some instructors lead the teams by the nose, while others had more tolerance for divergence and let the teams make mistakes.

4.2 Role of Broadening Checks

One potential application of this research would be to teach junior analysts the techniques of doing/teaching broadening checks, especially if they are going to be leading their own analytic shops. Being able to recognize and facilitate broadening checks would be one way for them to instill more resilience in their analytic team.

In many cases, interventions made the teams back up or completely drop their current work thread, possibly to the detriment of continuity. In practice, or instantiated in a support tool, knowing how to balance a broadening function with maintaining continuity would be a very valuable line of future research.

4.3 Synthesis of Findings

A general analytical finding was that teams displayed a consistent vulnerability of only perceiving meaning in textual information, instead of examining the full physical properties of intercepted artifacts. Similarly, teams also displayed a vulnerability in all-source intelligence by tending to analyze only direct information instead of the attributes of information medium.

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