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**MARITIME MILITARY DECISION MAKING IN
ENVIRONMENTS OF EXTREME INFORMATION
AMBIGUITY: AN INITIAL EXPLORATION**

by

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September 2005

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EXTREME INFORMATION AMBIGUITY: AN INITIAL EXPLORATION**

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requirements for the degree of

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ABSTRACT

This thesis examines the following hypothesis: Through the combined use of common training and collaborative planning, a decision maker may sufficiently alleviate the harmful effects of an environment of information so that he/she can continue to make effective decisions. An environment of extreme information ambiguity, a dependent variable, is one of the most difficult components of a battle where the decision maker may reach a confusing and debilitating point where surviving seems less and less likely. Common training, an independent variable, purports that everyone who is relevant to the situation in the battlespace has similar skills, education, doctrine, and standards of performance coupled with comparable experiences. Collaborative planning, an independent variable, connotes a sharing of ideas; synchronization of assets, use of information technology, global real-time mission planning, face-to-face meetings, and other information sharing techniques for situations of collective concern.

This thesis is a unique and in depth exploration of the relation of these three variables. Until now, no other research has looked at the relation of common training and collaborative planning with respect to decision making in environments of extreme information ambiguity. In order to explore the model the researcher analyzed two historical military battles: the Battle of Trafalgar and the Battle of Midway. Detailed research using a case study method was conducted to determine if the battles substantiated the thesis model. Research results indicate that for the maritime battles studied, the model appears to be a useful tool for interpretation and description of events and their outcomes. However, future studies should also increase the number and type of battles and other factors such as time and leadership should be considered.

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I. INTRODUCTION

War is a matter of vital importance to the state; a matter of life or death, the road either to survival or to ruin. Hence, it is imperative that it be studied thoroughly.¹

A. INTRODUCTION

An environment of extreme information ambiguity is one of the most difficult components of a battle. In such an environment, the decision maker may reach a confusing and debilitating point where surviving seems less and less likely. Furthermore, the decision maker's senses and capacity to continue functioning are so overwhelmed, there is sometimes a tendency towards paralysis and an inability to function. In addition to an environment of extreme information ambiguity, the dependent variable in this thesis, this study will also focus on two independent variables, common training and collaborative planning.

Briefly, common training purports that everyone who is relevant to the situation in a battlespace has similar skills and standards of performance coupled with comparable experiences. Collaborative planning connotes a sharing of ideas; synchronization of assets; use of information technology; global real-time mission planning among units, of all types, in all the services; face-to-face meetings; and other information sharing techniques. In-depth explanations of each variable are presented in the definitions section of this chapter.

The fundamental goal of this thesis is to illustrate the relationship between these three variables and to demonstrate that, through the combined use of common training and collaborative planning, a decision maker may sufficiently alleviate the harmful effects of an environment of extreme information ambiguity so that he/she can continue to make effective decisions.² These variables are important and related to military decision making and the success or defeat of a commander on the battlefield. Through the use of common training and collaborative planning, the decision maker must ensure:

¹ Sun-Tzu.

² Military decision making is often conceived of as involving the process of forming probability estimates of events and using them to choose between different courses of action in battle.

1. Subordinates know what needs to be done.
2. Subordinates can carry out his orders.
3. Subordinates actually carry out his orders.
4. How well subordinates carried out his orders.

As shall be discussed and argued, common training and collaborative planning relate directly and unavoidably to effective military decision making. Making the correct decisions in today's modern combat is imperative. Another reason this topic is of great importance is because, until now, no other research has looked at the relationship between common training and collaborative planning with respect to decision making in environments of extreme information ambiguity. This thesis is a unique and in-depth initial exploration of the relation of these three variables.

B. DEFINITIONS:

1. Environments of Extreme Information Ambiguity

In the process of researching, developing, and finalizing a description of an environment of extreme information ambiguity, the researcher must concede that, more or less, such an environment is oftentimes characterized as the fog of war. Having conceded that, there is significance in using a unique term for this research. With the creation of this term, the researcher has sought to distinguish or emphasize a very particular element of the fog of war -- the *information domain*. To that end, great effort has been made to demonstrate how intensely ambiguous the information domain inevitably becomes in battle. Furthermore, this definition serves to help the reader encapsulate what a decision maker feels when caught up in such an environment. Lastly, for those that already understand the term, fog of war, this definition of an environment of extreme information ambiguity should serve as a refresher for the key aspects of the fog of war as they pertain to decision making, the information domain, and the thesis model.

To further illustrate the complexity and significance of this new term, Appendix B offers a visual conceptualization of Colonel John Boyd's OODA "Loop." This comprehensive and multipart diagram reinforces the complexity of the decision making process/cycle. Additionally, the diagram underlines that fact that the decision loop does not move from one step to the next and only in one direction at a time. Rather, all

elements (Observe, Orient, Decide, and Act) proceed concurrently and in both directions (note the directions of the arrows). Further detail on the OODA loop is beyond the scope of this research.

Table 1 displays the characteristics of, and reactions to, an environment of extreme information ambiguity. The first part of the table details five general characteristics of an environment of extreme information ambiguity. These five characteristics are friction, ambiguity, time pressure, delayed action-feedback loops, and high stakes. The subsequent three parts of Table 1 detail reactions to these characteristics and are organized in to three categories -- senses, cognition, and affect.

An environment of extreme information ambiguity is by definition a complex system. A complex system is a system whose characteristics are not fully understood by a comprehension of its individual parts. Complex systems contain a great number of mutually interacting and interwoven parts, entities or agents. Furthermore, complex systems are open systems. Energy and information are incessantly imported and exported across system borders. Because of all this activity, complex systems are often far from equilibrium -- even though there is continuous change there is also the look of stability. Complex systems are also nested systems. Yet another key aspect of complex adaptive systems is that the components of the system, usually referred to as agents, are themselves complex adaptive systems. For instance, “an economy is made up of organizations, which are made up of people, who are systems of organs controlled by their nervous systems and endocrine systems, which are made up of cells - all of which, at each level in the hierarchy, are complex adaptive systems.”³

From this, it is not a far stretch to see that an environment of extreme information ambiguity is, in itself, complexity. Taking this concept one step further, one can see how a navy (e.g., the United States Navy) should always try to create complexity for an adversary. In developing and using forces, including the future United States Naval Fleet, the ability to complicate warfare for an enemy is an important consideration (i.e., the ability to effect his environment of information ambiguity.) In maritime operations, elements that may complicate the operational problems facing an adversary include:

³ < http://en.wikipedia.org/wiki/Complex_system >Last accessed September 16th, 2005.

forcing the enemy to deal with large numbers of combat entities; a variety of platforms with which to the enemy must contend; speed and maneuverability; different combinations of forces; distribution of forces across large areas; and ambiguity as to the mission and abilities of a given platform.⁴

⁴ Stuart E. Johnson and Arthur K. Cebrowski, *Alternative Fleet Architecture Design*, Center for Technology and National Security Policy National Defense University, August 2005, iii.

Table 1. External Characteristics of and Reactions to Environments of Extreme Information Ambiguity - Senses, Affect, Cognitive

#	Factor	Description
Characteristics of Environments of Extreme Information Ambiguity		
1	Friction	1. External events: Imposed by enemy actions, the terrain, weather, or chance.
		2. Self-induced: Caused by such factors as lack of a clearly defined goal, lack of coordination, unclear or complicated plans, complex task organizations or command relationships, or complicated technologies.
		3. Whatever form it takes, because war is a human enterprise, friction will always have a psychological as well as a physical impact.
2	Ambiguity	A. Ambiguous data: Imperfect sensors provide less than 100% accurate data due to elements such as weather, atmospherics, and system design limitations.
		B. Correlation of data: May lead to several different possible threat assessment solutions.
		C. Rules of engagement: ROE may not cover all situations or may be confusing. There are often different levels of ROE for dealing with different targets and countries which complicates responses.
		D. Vague Commander's Intent: Written/stated so mission priorities are not clear to subordinates.
3	Time Pressure	Forces the decision maker to make decisions and take action when he/she does not have all the necessary information.
4	Delayed Action-Feedback Loops	Warfighter may not receive feedback or battle damage assessment for many hours. May not know whether actions have been successful or not.
5	High Stakes	Making high stakes, life and death decisions, that may impact subordinates or even the future of the nation.

Reactions to Environments of Extreme Information Ambiguity		
SENSES		
6	Touch/Taste deadened	Mouth may be dry / loss of taste
7	Sight affected	Sight becomes poor or non-existent. Sight of blood, dust, smoke, fire, body parts, splintering wood, or shrapnel, or the death of comrades may trigger these sensual reactions.
8	Smell affected	Experiences smell of burning vegetation, flesh, decaying bodies, burning wood, gunpowder, or the aftermath of an exploding bomb.
9	Hearing reduced or made impossible.	Ceaseless, deafening sounds such as machine gun fire, artillery & bombs exploding, and the screams of the wounded or killed. Communications difficult or impossible.

COGNITION		
10	Decision Maker Ability to Think	Confusing and debilitating point at which surviving seems less and less likely. Senses overwhelmed, debilitated, and tending towards paralysis. Decision maker is increasingly less able to function.
11	Cognitive Tunnel Vision	The decision maker experiences a narrowing of attention. Situation where, due to cognitive overload, the decision maker cannot process all the information, which in turn may bias the decision-making process.
12	Information Overload	Often times difficult to discern the situation from inaccurate, missing, or ambiguous data in this inherently ambiguous environment. ⁵

AFFECT		
13	Fear	1. Fear of dying: Decision maker may be affected by a fear of death.
		2. Fear of making bad decisions: Decision maker may fear the consequences of bad decisions.
		3. Fear of not understanding a situation: Decision maker may feel incapable of completely understanding a situation or of misinterpreting a situation.
		4. Fear of friendly fire: Decision maker may fear the possibility, or reality of, fire that injures or kills a fellow serviceman or an ally.

Characteristics of Environments of Extreme Information Ambiguity

a. Friction

For the description of friction, this research simply relies on the original source of the term friction as it pertains to war. Clausewitz said, "Friction is that force which separates real war from war on paper. The difficulties accumulate and end by producing a kind of friction that is inconceivable unless one has experienced war."⁶ The United States Marine Corps takes it one step farther with their Marine Corps Doctrinal Publication 1 (MCDP 1),

Friction may be external, imposed by enemy action, the terrain, weather, or mere chance. Friction may be self-induced, caused by such factors as lack of a clearly defined goal, lack of coordination, unclear or complicated

⁵ Moore, 2.

⁶ Carl Von Clausewitz, *On War*, (Princeton: Princeton University Press, 1976), Edited and Translated by Michael Howard and Peter Paret.

plans, complex task organizations or command relationships, or complicated technologies. Whatever form it takes, because war is a human enterprise, friction will always have a psychological as well as a physical impact.⁷

b. *Ambiguity*

Ambiguity can take many forms. First, imperfect sensors provide less than 100% accurate data due to elements such as weather, atmospheric, and system design limitations. For example, if a decision maker is dealing with an enemy like an insurgency group who is trying to be stealthy, deliberately deceptive, or misleading, it may be difficult to obtain accurate information. Second, correlation of data may lead to several different possible threat assessment solutions. For instance, a commander may be receiving information from many sources or subordinates at the same time, and those inputs may be suggesting different courses of action. Third, rules of engagement may not cover all situations or may be confusing. There are often different levels of ROE for dealing with different targets and countries which complicates responses. Lastly, vague commander's intent may be written/stated so mission priorities are not clear to subordinates.

c. *Time Pressure*

Time pressure forces the decision maker to make decisions and take action when he/she does not have all the necessary information. For example, during World War II at the Battle of Midway, both the Japanese Royal Navy and the United States Navy commanders experienced time pressure on June 4th, 1942, as they pondered their decision on when to launch their respective attacks on one another, all the while feeling they had little time to spare.⁸

d. *Delayed Action-Feedback Loops*

Action-feedback loops may become delayed. Warfighters may not receive feedback or battle damage assessment for many hours. What is more, they may not know whether actions have been successful or not. This lack of accurate information adds further ambiguity to an already inherently ambiguous environment.

⁷ Marine Corps Doctrinal Publication 1, *Warfighting*, 5-6.

⁸ Thomas B. Buell, *The Quiet Warrior: A Biography of Admiral Raymond A. Spruance*, (Annapolis: Naval Institute Press), 1987, 145. Ronald H. Spector, *Eagle Against the Sun: The American War with Japan*, (New York: Vintage Books, 1985), 171.

e. High Stakes

Commanders often times must make high stakes, life and death decisions that may impact subordinates or even the future of the nation. Returning to the example of the Battle of Midway, Admiral Nagumo, commander of the Japanese carrier strike force, in making the decision to delay the launch of his carrier planes in favor of waiting and preparing for a “full scale” attack, doomed thousands of his men to death, lost four carriers, lost the Battle of Midway, and arguably changed the entire course of the war.⁹ Nagumo was the epitomy of a commander forced to make a high stakes decisions.

All of the characteristics of environments of extreme information ambiguity tend to create nerve-racking environments and strain for the decision maker which in turn causes particular personal reactions which frequently impact his/her thought process and decision strategies. Accordingly, environments of extreme information ambiguity can be further understood by describing how the five senses, cognition, and affect factor into a decision maker’s ability or inability to make effective decisions in this overwhelming environment. In short, the next few sections answer the question of what are the decision maker’s reactions to environments of extreme information ambiguity.

Reactions to Environments of Extreme Information Ambiguity

f. Senses – Touch, Taste, Sight, Smell, Hearing

At the height of an ambiguous situation, touch and taste may become deadened or perhaps the decision maker will experience dry mouth. Similarly a sense such as sight can be poor, unpleasant, or non-existent. The sight of blood, dust, smoke, fire, body parts, or the horrific death of comrades may trigger these sensual reactions. Regarding the sense of smell, imagine the smell of burning vegetation or flesh; rotting bodies; the harsh smell of burning gasoline; or the aftermath of exploding bombs. There may be ceaseless, deafening sounds coming from every direction. For instance, imagine blaring radio communications on the bridge of ship, machine gun fire, artillery rounds,

⁹ Spector, 172.

bombs exploding, or the screams of buddies being wounded or killed. Inevitably, the ability to hear is significantly reduced or made extremely difficult due to the noise of the battlefield, so much so, that even communicating with someone nearby is often times nearly impossible.

g. Cognition

An understanding of the cognitive component of an environment of extreme information ambiguity and how it impacts the warfighter's decision making and thought processes is critically important. The following elements of cognitive decision making are discussed: decision maker's ability to think, cognitive tunnel vision, and information overload.

h. Decision Maker Ability to Think

An organization is composed of people, each of whom, under the right conditions, can become a decision maker. A military decision maker is often confronted with environments of extreme information ambiguity. At the most confusing point of a battle, while operating in such an uncertain environment, the decision maker reaches a point at which surviving seems less and less likely. Tending towards paralysis, one's senses and capacity to continue functioning become increasingly overwhelmed and degraded. Despite this confusion, a decision maker who is equipped to deal with such an environment endeavors to diminish the environment's dangerous effects and WILL continue to function and orchestrate the operation or campaign.

Of note, it is essential to continually reinforce the idea that the effects of an environment of extreme information ambiguity can only be mitigated and not eliminated completely. Furthermore, a decision maker that tries to eliminate the injurious effects of this type of environment will expend a disproportionate amount of energy, resources, and time for little to no gain. For clarification, the reader should distinguish between an environment and the "effects" an environment has on a person or thing. One cannot eliminate an environment per se, but one can lessen or tone down the "effects" of an environment.

i. Cognitive Tunnel vision

Another such reaction is cognitive tunnel vision. Cognitive tunnel vision refers to a situation where the decision maker cannot process all the information and

biases which impact the decision-making process.¹⁰ The decision maker experiences a narrowing of attention and a situation where, due to cognitive overload, he/she cannot process all the information, which in turn may bias the decision-making process.

j. Information Overload

Information overload occurs when it becomes difficult for the decision maker to discern the situation because of inaccurate, missing, or ambiguous data.¹¹ Information overload also speaks to the condition of having too much information to make a decision or remain informed about the ongoing situation/battle. For example, large amounts of currently available information, a high rate of new information being added, contradictions in available information, and inefficient methods for comparing and processing different kinds of information can all contribute to this effect. Essentially, information overload comes from having more information on hand than the individual or organization can readily assimilate.¹²

k. Affect

Affect is an emotion (an emotional response to a situation) or a subjectively experienced feeling. Emotion is an aspect of a person's mental state of being, normally based in or tied to the person's internal (physical) and external (social) sensory feeling.¹³ Fear is one example of affect that has particular relevance to this discussion on decision making in environments of extreme information ambiguity. "Fear is an unpleasant feeling of perceived risk or danger, real or not."¹⁴ For example, a decision maker may be affected by a fear of death or a fear of making bad decisions (e.g., Decision maker may fear the consequences of bad decisions.). Additionally, there may be a fear of not understanding a situation. For instance, he/she may feel incapable of completely understanding a situation or of misinterpreting a set of circumstances. Lastly,

¹⁰ Susan G. Hutchins, William G. Kemple, Ron Adamo, and Dan Boger, *Knowledge Management and Collaboration in an Effects-Based Operations*, Graduate School of Operations and Information Sciences Naval Postgraduate School, May 1, 2002, 1-2.

¹¹ Ronald A. Moore, *Intelligent Aided Communication (ia C) in a Command and Control Environment*, Pacific Science & Engineering Group, Inc., 2.

¹² <http://en.wikipedia.org/wiki/Information_overload> Last accessed September 8, 2005.

¹³ <<http://en.wikipedia.org/wiki/Emotion>> Last accessed September 9, 2005.

¹⁴ <<http://en.wikipedia.org/wiki/Fear>> Last accessed September 9, 2005.

one may experience a fear of friendly fire to the extent that the decision maker may fear the possibility, or reality of, fire that injures or kills a fellow serviceman or an ally.

2. Common Training

This section on common training, akin to the previous section, is reinforced by a table divided into two parts, i.e., characteristics of common training and products of receiving common training (see Table 2 next page).

Table 2. Characteristics and Products of Receiving Common Training

Characteristics of Common Training		
#	Factor	Description
1	Similar Training, Education, Doctrine	Friendly commanders, at similar levels of command and rank, have similar training, education, and doctrine and have all rehearsed before an actual battle takes place. (e.g., Officer Training: Naval Academy, Officer Candidate School, Reserve Officer Training Corps. Enlisted Training: Basic Training.
2	Vigorous Training and Rehearsal	Vigorous training is necessary before actual battle. The result is a force that is freer to execute its mission without being bogged down by the requirement for explicit communication from the chain of command.
3	Mission-Oriented Command (Auftragstaktik)	German military leadership principle. It is a decentralized leadership and command philosophy that pushes decisions and actions down to the lowest level where there exists an intimate knowledge of the most intimate details of the circumstances and of the commander's objectives. The mission order is a technique utilized to implement and execute mission-oriented commands.
4	Moltke System	"This Prussian system institutionalized combat efficiency by ensuring that in a given situation different staff officers, educated to a common fighting doctrine, would arrive at approximately the same solution to employ the available forces most effectively. In addition to personnel, this system depended on conformity to a common fighting doctrine and common operational procedures." ¹⁵
Products of Receiving Common Training		
5	Similar Skills	Everyone who is relevant to the situation in the battlespace has similar skills and standards of performance coupled with similar experiences.
6	Similar Perception and Reaction	May share similar perception and reaction to any given event. Friendly commanders, at similar levels of command and rank, have similar training and doctrine and have all rehearsed before an actual battle takes place.
7	Alignment amongst Commanders	Alignment of friendly battlespace commanders in the battlespace which minimizes the need for complete dependence on command, control, and communications.
8	Harmony, or focus and direction, in operations	There exists a "a harmony, or focus and direction, in operations (which) is created by the bonds of communication and trust that evolve as a consequence of the similar mental images or impressions each individual creates and commits to memory by repeatedly sharing the same variety of experiences in the same ways." ¹⁶
9	Implicit connections and bonds	The soldiers and commanders have implicit connections and bonds; an understanding which is unstated or is not communicated to one another.

¹⁵ Gunther Rothenburg, "Moltke and Schlieffen" in Peter Paret, ed., *Makers of Modern Strategy*, (Princeton, New Jersey: Princeton University Press, 1986).

¹⁶ Boyd, 18.

Characteristics of Common Training

a. Similar Training, Education, and Doctrine

The primary characteristic of common training is similar training, education, and doctrine. More precisely, all friendly commanders, at similar levels of command and rank, have similar training, doctrine, and all have rehearsed before an actual battle takes place. A friendly commander on one side of the battle field has training comparable to a friendly commander on the other side of the battlefield (in training, doctrine, and basic military training, i.e., Naval Academy, Officer Candidate School, and Reserve Officers Training Corps).

b. Vigorous Training and Rehearsal

Common training necessitates a lot of vigorous training and rehearsal before actual battle, but the result is a force that is freer to execute its mission without being bogged down by the requirement for explicit communication from the chain of command.¹⁷

c. Mission-Oriented Command (Auftragstaktik)

One cannot fully appreciate the many merits of common training without a basic understanding of the concept of mission-oriented command, or Auftragstaktik, a leadership principle the German military has been employing for two hundred years.¹⁸ Evolved in the nineteenth and twentieth century, Auftragstaktik is a command and control principle developed primarily by former Field Marshal Helmut von Moltke, Chief of the General Staff of the Prussian Army from 1857 to 1888. It is a decentralized leadership and command philosophy that pushes decisions and actions down to the lowest level where there exists first-hand knowledge of the most intimate details of the circumstances and of the commander's objectives. The mission order is a technique utilized to implement and execute mission oriented commands.

¹⁷Lieutenant Colonel John L. Silva, *Infantry - Auftragstaktik – Its Origin and Development*, September-October 1989, 6-9.

¹⁸ Robert M. Citino, *Blitzkrieg to Desert Storm: The Evolution of Operational Warfare*, (2004), 18-25. Auftragstaktik, although an important element of German tactics, was by no means the only tactic they used. The Germans trained as an army to be well-rounded and balanced. They looked very unfavorably on and tried hard to avoid Einseitigkeit (one-sidedness) in their discourse. In reality, Auftragstaktik is really an Americanization of certain mission-oriented tactics used by the Germans, and is word the Germans seldom used.

Mission-oriented command is based on the principle that initiative and creativity in execution and completion of the mission is done without fear of retribution by higher command in the case of a possible mistake by a junior. Simply stated, the subordinate is trained and expected to act. There are several components of mission-oriented command: mutual trust among leaders based on each person's thorough knowledge of the other person's capabilities; training and organization in everything the army does to reinforce the importance of the man at the scene (decentralization); and lastly; simple, commonly accepted and understood operations concepts. The success of battle with Auftragstaktik depends on the initiative of junior leaders and their willingness to act in support of their commander's intent. This is key.

The mission-oriented control practiced by the German Army from 1800 to 1945 accepted a centralized lack of control over all events on the battlefield. More important than being in total control of each junior's actions, the Germans felt it was more essential for their people to act, especially in the absence of orders. The Germans wanted to know their fighting forces would contribute to completing the mission instead of waiting around for orders so they could do the "right" thing. Auftragstaktik provides a way for a soldier at the front to act in the spirit of a particular mission.

Lastly, inaction, not wrong action, is the cardinal sin of Auftragstaktik. Mission-oriented command is based on the concept of trust between a superior and his personnel. Further, mission-oriented command condemns undue criticism of the person on the scene because it is them, and them alone (in the confused and dangerous situation) who has the best command of which actions to take to complete the mission. Auftragstaktik is a command and control system where explicit communications are not the only way to get things done. Commanders are able to exploit lower level initiative because their troops know what to do -- things happen, and decisions are made.

d. Moltke System

The following quote from Gunther Rothenburg's book, "Moltke and Schleiffen," compliments the discussion on mission-oriented command and is a characteristic which epitomizes the concept of common training.

This Prussian system institutionalized combat efficiency by ensuring that in a given situation different staff officers, educated to a common fighting

doctrine, would arrive at approximately the same solution to employ the available forces most effectively. In addition to personnel, this system depended on conformity to a common fighting doctrine and common operational procedures.¹⁹

Products of Receiving Common Training

e. Similar Skills

The discussion proceeds with a description of the products of receiving common training. Ideally, common training means everyone who is relevant to the situation in the battlespace has similar skills and standards of performance coupled with similar experience.

f. Similar Perceptions and Reactions

Commanders may share similar perception and reaction to any given event. For instance, when a Captain at sea sees a column of enemy destroyers come over the horizon, he reacts in a way analogous to the Captain of a friendly ship twenty miles away without calling on the radio. It just happens. In an ideal world, every action is common: thinking, training, education, actions.

g. Alignment amongst Commanders

Once in battle, once friction begins to increase, common training enables one friendly battlefield commander to be in all but complete alignment with another friendly battlefield commander to successfully navigate on to victory. Alignment enables a friendly battlespace commander to be familiar with other friendly commanders in the battlespace, and it minimizes the need for complete dependence on command, control, and communications.

h. Harmony, or Focus and Direction, in Operations

The types of conditions produced by an environment of extreme information ambiguity require commanders to observe and orient themselves simultaneously to the situation at hand so that effective decisions can be made in support of the objective. Colonel John Boyd, inventor of the OODA loop, says that in environments such as these, “a harmony, or focus and direction, in operations is created by the bonds of communication and trust that evolve as a consequence of the similar

¹⁹ Gunther Rothenburg, “Moltke and Schlieffen” in Peter Paret, ed., *Makers of Modern Strategy*, (Princeton: Princeton University Press, 1986), 53.

mental images or impressions each individual creates and commits to memory by repeatedly sharing the same variety of experiences in the same ways.”²⁰ This is the essence of common training.

i. Implicit Connections and Bonds

Referring back to the discussion of mission-oriented command, military forces (i.e., commanders/decision makers and the men and women they command) have implicit connections and bonds; an understanding which is unstated or not communicated to one another. As a result, the commander’s intent is fulfilled and he has more time to do other things.²¹

3. Collaborative Planning

Collaboration offers great potential to better enable warfighters to plan, monitor, execute, and assess activities across the spectrum of joint functional areas.²²

The term collaborative planning describes the challenging process of how to deal with situations of collective concern. These situations arise from the problems and opportunities of relational groups in shared spaces, most often sharing very different priorities and ways of looking at things. Through shared comprehension of the issues, open communication, reciprocal trust, and acceptance of differing points of view, collaborative planning facilitates a capability for joint planning, shared resources, and joint resource management en route to developing solutions and solving differences.²³

Put another way, “it involves people working together for solutions that maximize the gains for all parties”²⁴ in and around the battlespace. Resolving conflict from the perspective of collaboration depends on a fundamental principal identified by Chrislip and Larson (1994), “implicit trust that diverse people engaged in constructive ways and provided with the necessary information to make good decisions can be relied upon to

²⁰ Colonel John R. Boyd, *Discourse on Winning and Losing*, s.n. 1987, 18.

²¹ Boyd, 18.

²² Hutchins, Kemple, Adamo, and Boger, 1-2.

²³ <<http://www.nceev.org/resources/terms.html>> Last accessed on September 9, 2005.

²⁴ Myra Warren Isenhardt/Michael Spangle, *Collaborative Approaches to Resolving Conflict*, Sage Publications Inc., 2000, Chapter 2, pg. 23.

create appropriate answers to the most pressing problems.”²⁵ The characteristics and products of participating in collaborative planning are listed in Table 3.

²⁵ Chrislip, D. & Larson, C., Collaborative Leadership, San Francisco: Jossey-Bass, 1994, pg. 14.

Table 3. Characteristics and By-Products of Receiving Collaborative Planning

Characteristics of Collaborative Planning		
#	Factor	Description
1	Sharing Ideas	Sharing ideas and actions among people, machines, and joint coalition forces. ²⁶
2	Synchronization of Assets	Synchronization of assets so everyone has access to the same assets and information as near to instantly as possible. ²⁷
3	Physical Collaborative Tools	Planning may use physical, paper-based inputs, processes and outputs for the performance of tactical mission planning of mission orders, intelligence reports and operational area graphics.
4	Information Technology	Participants utilize Information Technology (IT) tools which increase the availability and capability of collaboration efforts.
5	Global real-time collaborative tactical mission planning	A fully integrated IT system to enable global real-time collaborative tactical mission planning among units, of all types, in all the services. ²⁸
6	Face-to-Face Meetings	Face-to-face meetings with fellow planners.
7	Multiple Information Sharing Techniques	Techniques such as the ability to share applications, have a virtual workspace, use voice/audio, whiteboard, video, and chat functions. ²⁹
By-Products of Utilizing Collaborative Planning		
8	Shared Situational Awareness	Through the use of collaborative tools, individuals develop shared situational awareness among heterogeneous, distributed team members. ³⁰
9	Information Flows, Issues are Raised, Brainstorming occurs	Collaboration enables information to flow quickly, outstanding issues can be raised, and a certain amount of brainstorming can occur to arrive at a decision. ³¹
10	Reach a fuller understanding of the issues	All relevant users or providers of information are able to reach a fuller understanding of the issues because they have seen other viewpoints and received a freer flow of information. ³²
11	Share information across geographic and temporal boundaries	Collaborative tools offer the capability to share information and resources and coordinate among individuals across geographic and temporal boundaries.
12	Near Real Time: maintain clearer picture/access to all relevant information	With sufficient bandwidth warfighters maintain a clearer picture of the situation because everyone involved in planning has access to all relevant information, all the time, and can communicate ideas to all participants in near-real time ³³ (with a goal of the same process becoming instant).

²⁶ Hutchins, Kemple, Adamo, and Boger, 1-2.

²⁷ Hutchins, Kemple, Adamo, and Boger, 1-2.

²⁸ Brzostowski and Smith II, 7.

²⁹ Hutchins, Kemple, Adamo, and Boger, 2.

³⁰ Hutchins, Kemple, Adamo, and Boger, 1.

³¹ Hutchins, Kemple, Adamo, and Boger, 2.

³² Truver, 46-48.

³³ Hutchins, Kemple, Adamo, and Boger, 1-2.

Characteristics of Collaborative Planning

a. Sharing Ideas

The goal of collaborative planning is to achieve a sharing of ideas and actions among people, machines, and joint coalition forces.

b. Synchronization of Assets

Collaborative planning and, more specifically, sharing ideas, requires synchronization of all assets so everyone has access to the same assets and information as near to instantly as possible.

c. Physical Collaboration Tools

The collaborative planning techniques, or style, used today have evolved from where they were during the time of the Battle of Trafalgar in 1805, and from where they were during the Battle of Midway in 1942. Even then, collaborative planning was still people working as a group to strive towards a common goal. However, the exact means and methods by which they achieved their planning and coordination of goals was slightly different, mostly due to the technology available to planners at that time.

Until the late 1970's, tactical mission planning was performed using almost exclusively physical, paper-based inputs, processes and outputs. Mission orders, intelligence reports, and operational area graphics were all received on paper. Mission planning cells processed these inputs and produced maps, overlays, diagrams, checklists and mission briefs by hand. The mission briefings were then conducted referring to paper maps with acetate overlays...³⁴

d. Information Technology

Fast forward to the year 2005, and notice the increase in the availability and capability of collaboration efforts that utilize Information Technology (IT) tools. Participants utilize Information Technology (IT) tools which increase the availability and capability of collaboration efforts.³⁵

³⁴ Stephen C. Brzostowski and Larry E. Smith II, *Transition of naval Expeditionary Force's Tactical Mission Planning Systems to a global collaborative capability (thesis title)*, (Naval Postgraduate School September 2003), 7.

³⁵ Brzostowski and Smith II, 7.

e. Global Real-Time Collaborative Tactical Mission Planning

By the year 2000, the Department of Defense (DoD) began a joint program to develop a fully integrated IT system to enable global real-time collaborative tactical mission planning among units, of all types, in all the services.³⁶

f. Face-to-Face Meetings

Face-to-face meetings allow collaborators to come together with a mutual goal and accomplish their objective through discussion with one another. Some studies have shown people are more likely to buy into a concept if they can see the person who is presenting it. Furthermore, because visual information can be shared in real-time, face-to-face meetings generally condense the time it takes to complete most tasks. “Despite their many conveniences, phones, fax machines and e-mail don't come close to delivering the collaborative energy of a face-to-face meeting because so many of the sociological communication cues are missing.”³⁷

g. Multiple Information Sharing Techniques

Decision makers who plan collaboratively may benefit from the ability to share applications, have a virtual workspace, use voice/audio, whiteboard, video conferencing, and chat functions.³⁸ Regarding chat functions, “during Operation Iraqi Freedom collaborative technology enabled war planners to target elusive targets more quickly. Previously, war planners were placing phone calls and sending emails and faxes to relay data on potential threats.”³⁹

³⁶ Brzostowski and Smith II, 8.

³⁷ <http://www.3m.com/meetingnetwork/readingroom/meetingguide_video.html> Last accessed September 9, 2005.

³⁸ Hutchins, Kemple, Adamo, and Boger, 1-2.

³⁹ Alex Bordetsky, Susan G. Hutchins, William G. Kemple, and Eugene Bourakov, *Providing Network Awareness For Peer-to-Peer Tactical Collaborative Environment*, (Naval Postgraduate School, Information Sciences Department), 3. Butler, 2003.

Products of Utilizing Collaborative Planning

h. Shared Situational Awareness

Through the use of collaborative tools, individuals develop shared situational awareness among heterogeneous, distributed team members.⁴⁰ The following definition offers one way to conceptualize the fundamental meaning of shared situational awareness.

Shared situational awareness... translates to a clear and accurate, common, relevant picture of the battlespace for leaders at all levels and a reduction in the potential for fratricide. Situational awareness answers three fundamental battlefield questions: Where am I? Where are my friends? Where is the enemy? The sharing of timely information enabled by digitalization improves significantly the ability of commanders and leaders to quickly make decisions, synchronize forces and fires, and increase the operational tempo.⁴¹

Of note, there are several other elements of information that contribute to better shared situational awareness such as policy, strategy, operations, technology, logistics, tactics, plans, command structure, personalities, posture, environment, and the list goes on.⁴²

i. Information Flows, Issues are Raised, Brainstorming Occurs

Benefits like information flowing more quickly, outstanding issues being raised, and a certain amount of brainstorming amongst planners occurring to arrive at a decision are just some of the benefits that can be gained via the use of collaborative planning tools.

⁴⁰ Hutchins, Kemple, Adamo, and Boger, 1-2.

⁴¹ Lt. Gen. Paul J. Kern and Lt. Gen. John N. Abrams. <http://armed-services.senate.gov/> Lt. Gen. Paul J. Kern, Military Deputy, and Acquisition, and Lt. Gen. John N. Abrams, Deputy Commanding General, TRADOC, provided this definition of shared situational awareness as part of their testimony before the Senate Armed Services Committee in 1998.

⁴² Albert A. Nofi, *Defining and Measuring Shared Situational Awareness*, (Center for Naval Analyses, Alexandria, Virginia, November 2000), 6.
<<http://www.thoughtlink.com/publications/DefiningSSA00Abstract.htm>> Last accessed on September 9, 2005.

j. Reach a Fuller Understanding of the Issues

Additionally, “all relevant users or providers of information reach a fuller understanding of the issues because they have seen other viewpoints and received a freer flow of information”⁴³

k. Share Information Across Geographic and Temporal Boundaries

Collaborative tools offer the added capabilities of providing the ability to share information and resources and coordinate among individuals across geographic and temporal boundaries.⁴⁴

l. Near Real-Time: Maintain Clearer Picture/Access to All Relevant Information

With sufficient bandwidth, collaborative planning enables warfighters to maintain a clearer picture of the situation because everyone involved in the planning has access to all relevant information, all the time, and can communicate ideas to all participants in near-real time (with a goal of the same process eventually becoming instant).

It is clear to see just how dispersed units, commanders, and coalition forces can and do benefit from the practice of collaborative planning. It is not a far stretch to see how a technique such as collaboration benefits the decision maker/leader in almost every situation, especially in times of crisis.

C. HYPOTHESIS

This thesis, through exploration and research, shall examine the following model: Through the combined use of common training and collaborative planning, a decision maker may sufficiently alleviate the harmful effects of an environment of extreme information ambiguity so that he/she can continue to make effective decisions. In order for a decision maker/commander to make the right decisions and emerge successful from environments of extreme information ambiguity, that decision maker must make use of common training and collaborative planning to lesson the harmful effects of ambiguous information environments. Furthermore, one must be able to utilize both concepts effectively so as to emerge successful and victorious in battle.

⁴³ Scott C. Truver, *Spearheading Joint Transformation – And Supporting Homeland Defense*, Sea Power, December 2001, 46-48.

⁴⁴ Hutchins, Kemple, Adamo, and Boger, 1-2.

D. METHOD OF EXPLORATION

To explore the hypothesis the researcher analyzed two historical military battles: the Battle of Trafalgar and the Battle of Midway. These battles were chosen from an initial pool of more than twenty five different historical military battles or military events that were initially nominated for consideration. The initial pool was created using an exploratory research method which provided an objective method for choosing which battles would receive further study. The goal was to create a large collection of potential military battles where environments of extreme information ambiguity were prominent. Interviews were conducted with several professors who were nominated by others who knew their areas of concentration.

Two battles were chosen for in-depth research. Based on the ten interviews conducted, there were only two cases where a particular battle received at least two votes. At that point, detailed research began into each case in order to determine whether the case studies substantiated or did not substantiate (and how much) the thesis statement. The findings of the analysis for each battle are written up in Chapter IV. While researching each battle, particular attention was paid to three different things: (1) Instances that demonstrated a decision maker operating in an environment of extreme information ambiguity, (2) Instances of a decision maker using common training or collaborative planning or both to diminish the effects of the ambiguous information environment, and (3) Instances of a decision maker using anything else to lessen the effects of the uncertain information environment.

E. THESIS ORGANIZATION

This thesis is organized into the following chapters: 1. Introduction, 2. Research Methods, 3. Discussion of Case Studies, 4. Analysis, 5. Conclusions.

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II. RESEARCH METHODS

A. INTRODUCTION

The focus of the thesis model is to show how military decision makers maintain the ability to make successful decisions by mitigating the debilitating effects of environments of extreme information ambiguity through the combined use of common training and collaborative planning. In order to determine the validity of the model, the researcher analyzed two historical military battles: the Battle of Trafalgar and the Battle of Midway. These battles were chosen from an initial pool of more than twenty five different historical military battles or military events that were initially nominated for consideration including battles such as the Battle of Jutland and Operation Iraqi Freedom.

An initial pool of battles was created using an exploratory research method which provided an objective method for choosing which battles would receive further study. Specific details of the exploratory research method used for this thesis are described at length in section II of this chapter. In short, it is a method that uses a style of interview and questions that help to generate a particular type of data. In this case, the goal was to create a large collection of military battles where environments of extreme information ambiguity were prominent. Interviews were conducted with ten professors from the Naval Postgraduate School and the Naval War College in Monterey, California. These professors were nominated by others who knew their areas of concentration. The battles chosen for further case study analysis were chosen based on a specially scripted question and presented in the same way under the same conditions to every subject interviewed.

Once interviews were conducted with all of the these professors who were considered highly knowledgeable about military history by their peers, their responses were catalogued in Table 4 in order to determine if there was any convergence of opinion in the interview results (i.e., Was any battle cited by more than one of the respondents?). Based on the data obtained from the ten interview, there were only two cases where a particular battle received at least two votes. Based on analysis of the data in Table 4, the respondents most often nominated the Battle of Trafalgar and the Battle

Table 4. Results of Academic Source Survey⁴⁵

Respondent	Battle/Event	War	Year	Commander
A	Battle of Trafalgar			Nelson
	Battle of the Bulge	World War II		
	Tet Offensive	Vietnam War	1968	
	Leyte Gulf	World War II		Halsey
	Saipan	World War II		Spruance
B	Battle of Midway	World War II		
	Battle of Guadal Canal	World War II		
C	No response given			
		Iraqi Freedom		
D	Battle at Tarawa	World War II		
		Iraqi Freedom		
E	Chinese vs. Americans	Korean War	1950	Macarthur
	Battle of Missionary Ridge	Civil War		
F	Battle of Trafalgar			Nelson
				Napoleon
G	Battle of the Atlantic	World War II		
	Invasion of Iraq	Iraqi Freedom		
		Korean War		
	Afghanistan	Operation Enduring Freedom		
	North Korea	Korean War		
H	German High Command	World War II		
	Soviet Union Commanders	World War II		
	Japanese C2	World War II		
		Civil War		George B. McClellan
I				Napoleon
		Iraqi Freedom		General Abizaid
	German Generals	World War II		Rommel and Gudarian
J	Battle of Jutland	World War I		
	Battle of Midway	World War II		
	German Defense of Atlantic Coast	World War II		
	Battle of Komandorsky Islands	World War II		Admiral Hosagaya

⁴⁵ This table represents only that which was actually said or commented on by the respondents during the interview.

of Midway (both of these battles received two votes). It was concluded that these two battles provided the strongest examples of decision making in environments of extreme information ambiguity thus, these battles were chosen for further study.

Next, detailed research was conducted on each case in order to determine whether the case studies substantiated (and how much) or did not substantiate the thesis model. Research consisted primarily of comparing several different accounts of each battle through the use of multiple sources. For instance, for the Battle of Midway, works by seven authors were used (Evans and Peattie, Lundstrom, Morison, Buell, Fuchida, Spector, Potter). Next, through the use of three different colored sticky notes, all instances of environments of extreme information ambiguity, common training, and collaborative planning were marked for later analysis. Upon completion of all reading for each battle, a synopsis of each battle was written up in chapter III using a case study analysis method. Each battle was broken down into the same five parts for the write up. For example, the question format for the Battle of Trafalgar was:

1. What effect did the environment of extreme information ambiguity have on the Royal Navy and the Franco-Spanish Navy?
2. What was the effect of common training for each side?
3. What was the effect of collaborative planning for each side?

Each case study discussion concludes with the following two questions:

4. With respect to questions 1-3, what was expected to happen in the battle?
5. With respect to questions 1-3, what actually did happen in the battle?

At the completion of the analysis it became clear, for each battle, whether or not the military decision makers were able to alleviate their environments of extreme information ambiguity through the use of common training and collaborative planning. Results of the analysis for each battle are written up in Chapter IV. The analysis presented in Chapter IV describes the degree to which each battle case study substantiates or does not substantiate the thesis statement. In each battle, there were decision makers who faced environments of extreme information ambiguity, and clearly, there was a clear winner and loser in each battle. In almost all cases the readings provided more than

enough examples of common training and collaborative planning so that, by the end, it was clear how necessary and apparently sufficient common training and collaborative planning were.

While researching each battle, particular attention was paid to three different things: (1) Instances that demonstrated a decision maker operating in an environment of extreme information ambiguity, (2) Instances of a decision maker using common training or collaborative planning or both to diminish the effects of the ambiguous information environment, and (3) Instances of a decision maker using anything else to lessen the effects of the uncertain information environment.

B. QUALITATIVE RESEARCH – CASE STUDIES AND EXPLORATORY METHODS

1. What is the Case Study Method?

Case study research serves to bring about a better understanding of a potentially complex subject and can provide the researcher or reader (of the case study) more knowledge, or strengthen what is already known, about the subject. Case studies focus on detailed context based on analysis of a finite number of events or situations and their relationships. Case studies have been in use by researchers for a long time, especially by social scientists who use qualitative methods to explore real-life occurrences. They also provide a basis for the use of ideas and the extension of methods.⁴⁶ Yin defines the case study research method as “an empirical inquiry that investigates a phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used.”⁴⁷

Some researchers are critical of the case study method. They say that if the number of case studies is too small, then it offers no footing for establishing reliability or basis of findings. Others believe that the case study method is overused and thus provides biased results. Still others believe case study research should only be used as an

⁴⁶ Susan K. Soy, *The Case Study as a Research Method*, Paper prepared for Uses and Users of Information, (University of Texas at Austin, School of Information, 1997). Available: <<http://fiat.gslis.utexas.edu/~ssoy/usesusers/139>> Last Accessed on August 8, 2005.

⁴⁷ Robert K. Yin, *Case Study Research: Design and Methods*, (Newbury Park, CA: Sage, 1984), 23.

exploratory tool. Nevertheless, researchers continue to use case studies with success for analysis of real-world situations.⁴⁸

One of the primary goals of this chapter is to inform the reader about the practice and procedures for utilizing the case study research method. The other goal of this chapter is to explain the exploratory method used for conducting this research; the later method was used to determine which battles would be chosen for case study analysis.

Several well-known and well-respected case study researchers such as Robert E. Stake, Robert K. Yin and others⁴⁹ have written extensively on case study research and have developed steps for organizing and conducting this style of research with success. Six steps to follow when conducting case study research are:

1. Determine and define all research questions.
2. Select the case studies and decide on data gathering and analysis methods.
3. Prepare for the collection of data.
4. Collect data.
5. Evaluate, analyze, and synthesize all data.
6. Prepare the report.

Step 1: Determine and define all research questions.

A well-defined research focus is the first step in case study research and gives the researcher something to look back on over the course of investigating a particular complicated subject. In the case of this thesis, the focus is on how military decision makers sustain the ability to make successful decisions and succeed in environments of extreme information ambiguity through the combined employment of common training and collaborative planning. By developing questions and assigning variables, the researcher was able to establish and maintain a focus throughout the investigation and writing process. For instance, as discussed in Chapter I, the only dependent variable in this thesis is the environment of extreme information ambiguity, and it is intrinsically

⁴⁸ Soy, <<http://fiat.gslis.utexas.edu/~ssoy/usesusers/139>> Last accessed on August 10, 2005.

⁴⁹ Robert E. Stake, *The Art of Case Study Research*, (Thousand Oaks, CA:Sage, 1995), Chapter 1.

connected to the two independent variables: common training and collaborative planning. Furthermore, as a researcher seeks to answer any thesis questions, a variety of data gathering techniques may be used to produce data to substantiate the claims of the thesis statement.

Step 2: Select the case studies and decide on data gathering and analysis methods.

In order to select which case studies to explore, the researcher must determine the methods to be used in determining which examples and how many to pursue. For this thesis, an exploratory method and “snowball sampling”⁵⁰ were used to determine which battles would be used to examine the validity of the thesis question.⁵¹ Ten professors, including six from the Naval Postgraduate School and four from the Naval War College in Monterey, California, were selected to participate in the interview process. The professors were representative of various disciplines and three different departments: Information Sciences, Operations Research, and Strategy and Policy. **Interview**

Participants:

1. Dr. Alan Ross, Information Sciences, Associate Professor
2. Dr. Bill Kemple, Information Sciences Department, Associate Professor
3. Dr. Dan Boger, Chairman Information Sciences Department
4. Dr. Donald Stoker, Naval War College, Strategy and Policy Professor
5. Dr. Dorothy Denning, Information Sciences Department, Professor
6. Dr. Harold Blanton, Naval War College, Strategy and Policy Professor
7. Dr. John Arquilla, Information Sciences Department, Professor
8. Dr. Kenneth Hagan, Naval War College, Strategy and Policy Professor
9. Dr. Mike Jones, Naval War College, Strategy and Policy Professor

⁵⁰ David C. Leege and Wayne L. Francis, *Political Research – Design, Measurement and Analysis*, (New York: Basic Books, 1974), 120. A particular phenomenon called snowball sampling was used while conducting the interviews with the ten university professors. Part of the Academic Source Survey asked for the respondent to supply three other names of people they thought would be good candidates for the survey. In cases where additional information is provided by the respondent, the researcher may use the information to further the research. For this research, the extra names selected by the original ten respondents were recorded. In this case, when the pool of potential experts grows in such a way it is sometimes called *snowball sampling*. Many of the names provided by the experts interviewed were names of the original ten selected to participate in the Academic Source Survey (duplicates). In the cases where new names were discovered, those names were held aside in the case that sufficient convergence was not achieved after the first ten interviews.

⁵¹ A discussion of the exploratory method follows this discussion on case studies.

10. Dr. Wayne Hughes, Dean of Operations Research

All professors were asked one specific, scripted question called the Academic Source Survey.⁵² The objective of the script was to ensure that all professors surveyed would be asked the same question in the same way. At the time of the survey, each professor was given a copy of the Academic Source Survey to refer to as the interview was conducted.

After each professor was interviewed, their responses were catalogued in Table 4 in order to determine if any convergence of opinion existed, and, ultimately, to determine which battles would be utilized for case study analysis. Two battles were chosen for further research: the Battle of Trafalgar (1805) and the Battle of Midway (1942).

Step 3: Prepare for the collection of data.

Detailed research was conducted for each case study. The case study research for this thesis produced a vast amount of data from many different books, journals, videos, periodicals, as well as the initial interviews. Accordingly, proper organization of all collected data was important. Without organization, the researcher will tend to proceed in an inefficient way, become overwhelmed, and possibly lose focus of the overall goal (see Step 1 above). All data and sources were catalogued via the use of folders, computer spreadsheets and tables, notes, and tape recordings. This organization served to keep all data properly categorized and stored for easy retrieval throughout the process.

Step 4: Collect Data.

The collect data step is mostly concerned with procedures used during the process of data collection. While conducting research, it was necessary to utilize an efficient means for coding the information contained in the readings for future reference and writing. For instance, it was essential to formulate a way to mark and notate the occurrence of the dependent and independent variables in the readings. Colored sticky notes were used, one color for each variable, to mark the readings. Additionally, abbreviations of the variables (e.g., ct, cp, eeia.) and specific criteria were used on the sticky notes in an effort to facilitate quick identification of key citations during the writing phase.

⁵² See Appendix A

Mini cassette recordings were used to annotate feelings and intuitive hunches, formulate questions, and brainstorm ideas for future chapters and work. Recordings were also used as a way of posting reminders for upcoming tasks and to warn against potential potholes that might present themselves. The ultimate purpose for these systematic data recording procedures was to make sure all data was categorized and filed so it could be efficiently and accurately recalled for use over the duration of the study.

Step 5: Evaluate, analyze, and synthesize all data.

Once all the data has been collected, the researcher examines all the material and draws conclusions about the findings with respect to the original thesis statement. It is important at this point to be open to new ideas; the researcher should not fall into the trap of interpreting the data the way he or she thinks it should be. It is essential to remain open to new ideas and revelations and be willing to change course if necessary. For instance, in this work on decision making in environments of extreme information ambiguity, the conclusions and answers to the thesis question turned out differently than originally expected.⁵³ Flexibility and open mindedness are crucial when this occurs.

Many times the methods used to analyze the data force researchers to move in different directions than their initial impressions were taking them. All of this is done to ensure the best possible chance of accurate, reliable, and usable results.⁵⁴ This was especially critical during the research of this thesis because its results carry real life implications for decision making on tomorrow's battlefields.

Step 6: Prepare the Report.

The goal of this research was to investigate the hypothesis of the thesis statement. Once the research and analysis steps were complete, the next step was to prepare a report that took the complex problem and translated it into one that could be easily understood by the reader. A final report should allow the reader to ask questions and find answers without assistance from the researcher. A report should be written in a way that captivates the reader through the use of coherent prose and by displaying enough evidence to gain the reader's confidence in the conclusions drawn and in the prospect that

⁵³ See Chapter IV Analysis.

⁵⁴ Soy, <http://fiat.gslis.utexas.edu/~ssoy/usesusers/139> Last accessed on August 8, 2005.

every possible avenue has been explored. Furthermore, the report should address any conflicting issues that may have arisen over the course of the research and analysis. Lastly, in the case of this thesis, a section on the future or “The Road Ahead” is provided to give the reader some ideas on where this topic may be headed in the future.

In conclusion, case studies can be extremely complex because they comprise many sources of data and subsequently produce a lot of material which must be thoroughly analyzed. However, one thing that makes the process of analysis easier, as in the case of this thesis, is when the case studies offer the advantage of “applicability to real life human situation.”⁵⁵

2. What is an Exploratory Method?

Generation of Data: Methods and Techniques

The goal of section 3 is to explain how the battles were chosen and to show that a systematic process was employed. For this thesis, the objective selection of two battles was made possible through the use of an exploratory research method. The book Political Research – Design, Measurement, and Analysis was consulted for a detailed explanation of how this data generation method works.⁵⁶ The quality of data developed for a thesis, or for any other research project, is intrinsically tied to the quality and reliability of the methods used to generate it. No amount of technology or verbiage can overcome the defects inherent in data cultivated from an underdeveloped or non-rigorous research method. There are many sources available for data, and scientists have often relied on published documents and large-scale surveys. For this thesis, a scripted survey was used to determine which two battles would receive further study.

Extent of Information

The second aspect to consider regarding survey administration is the extent of information required about or from each person surveyed. For instance, in this study, the Academic Source Survey has just one question with the exception of some probing questions that only came into play in the event the respondent gave too vague of a response or if the respondent did not fully understand the primary question. “The decision

⁵⁵Soy, <http://fiat.gslis.utexas.edu/~ssoy/usesusers/l39> Last accessed on August 8, 2005.

⁵⁶ Leege and Francis, Chapter 7.

regarding the extent of information required is based on several criteria: (1) state of theory development about the phenomenon, (2) need for serendipity, (3) degree of efficiency required, and (4) importance of reliability and validity of information.”⁵⁷ Therefore, in the event not much information is known about the topic in question, as was the case with this research (i.e., the combined use of common training and collaborative planning as they pertain to alleviating the destructive effects of environments of extreme information ambiguity on military decision makers.), it is helpful to conduct exploratory research.

Forms of Data Collection – Error Management

When a researcher selects a data-generating instrument (e.g., exploratory research), the researcher needs to be aware of several types of potential errors. Table 5 highlights the most common types of errors using this method. During the interviews conducted for this thesis, the researcher was not aware of the occurrence of any of the errors in Section 1 of Table 5. From Section 2 of Table 5, it is reasonable to presume errors 2A and 2B could have been committed, but it seems unlikely. Errors 2C from Section 2 and 3A-3D from Section 3 were not committed.

There was a time in history when social scientists sometimes opted to discard a data collection instrument if it was determined to contain any error at all. It was soon discovered that every research technique is plagued with some type of error at one time or the other. Since errors cannot not be explicitly avoided some guidelines for researchers to observe are:⁵⁸

11. Pinpoint the most common errors resulting from each method or technique.
12. Control the errors where possible.
13. Generate data by at least two methods or techniques and ensure they are different in the extent to which they may suffer from the same potential (errors).

⁵⁷ Leege and Francis, 191.

⁵⁸ Leege and Francis, 193.

Table 5. Possible Errors Committed During Data Collection⁵⁹

Section 1. Error stemming from persons	
A. Evaluation apprehension	Anxiety a person feels when aware of being tested.
B. Subject role	Subject's desire to behave as he or she thinks the investigator wants, so that the test hypothesis will be substantiated.
C. Response sets	Acquiescence or opposition ("yea-saying" or "nay-saying").
	Choosing of socially desirable answers.
	Systematic selection of alternatives occupying a certain location on the instrument.
2. Error stemming from observers, interviewers, or related sources	
A. Expectancy effects	In some unknown manner - tone of voice, manifestation of nervousness, etc.
	The investigator tipping off the subject to behave, verbally or physically, consistent with the hypothesis.
B. Changes in instrument calibration	Through time the investigator unknowingly altering the administration of the instrument through familiarity with it, fatigue, boredom, etc.
C. Changes in the data matrix	While the format in which data are embedded appears similar through time, undocumented changes in classification principles or recording practices, or unknown erosion effects on the artifacts confounding apparent substantive change with a method effect.
3. Error stemming from physical settings and situations	
A. Process of measurement itself...	...serving as a change agent with lasting affects.
B. Inaccessibility	...of some populations
C. Instability	...of other samples through time.
C. Idiosyncratic situational factors	...generating positive or negative effects on either subject or investigator.
	Such as persons other than the subject present in the situation
	Such as visual and aural attractiveness of the setting
	Such as interaction of subject's and investigator's physical and emotional attributes.

⁵⁹ After: David C. Legee and Wayne L. Francis, *Political Research – Design, Measurement and Analysis*, (New York: Basic Books, 1974), 192.

Self Report

In 1974, Leege felt the dominant type of methods and techniques used for data gathering in social science at that time involved respondents' self-reports of knowledge.⁶⁰ This researcher used scripted self-report interviews (i.e., Academic Source Survey) to select the battles which would receive further case study analysis.

What follows is a brief discussion of the self-report interview. Whereas a questionnaire is administered to and responded to by the respondent (e.g., surveys administered as part of an experiment), a scripted interview is administered and recorded by the researcher. A scripted interview is simply a survey or question, in template form, typed up, and presented in the same manner to every respondent. For the purpose of developing a pool of potential military battles to be used for further case study analysis, the subjects of this thesis research were presented a question about which military battles (historical or present day) provided the best examples of decision making in environments of extreme information ambiguity. The question was designed to illicit a verbal response about the dependent variable. The responses were recorded on the Academic Source Survey and via audio cassette recorder.

Surveys have a number of advantages because of the information they provide. Interview data tends to be more reliable than questionnaire data because any confusion can be clarified during the interview. Also, a skilled interviewer will record sufficient notes during the interview including areas the respondent may struggle with. During the interviews conducted for this thesis the professors questioned often had useful elaboration of their choices of battles above and beyond what the main and probing questions would have provided. This yielded serendipitous discovery of a variety of information among those interviewed and provided potential avenues for further exploration of the thesis statement. For example, Respondent A answered the survey question with the Battle of Trafalgar. Instead of stopping there, he proceeded to explain in great detail what he knew about the battle with respect to the survey question. From that point, the researcher discovered the respondent was the Naval War College, Monterey, California, authority on the Battle of Trafalgar.

⁶⁰ Leege and Francis, 193.

Moving on to the question styles used in the self-report method, there are several different ways to design surveys/questionnaires, namely through the use of open-ended, forced-choice, or fixed-alternative questions.⁶¹ For the scripted interview used in this research, open-ended questions were used followed by the use of probing questions which served to help the interviewee narrow down their responses if the response they gave were too broad. For instance, one respondent gave the response, “North Korea” as an example of an environment of extreme information ambiguity. In this case, a probing question might be, “Can you think of a particular campaign or battle during the war with North Korea where an environment of extreme information ambiguity existed?” The use of probing questions always proved sufficient to get the respondent back on track. Lastly, the use of open-ended questions is most appropriate when not much is known about a particular problem or subject.⁶²

C. CONCLUSION

Chapter II described the researcher’s procedure followed for exploring the thesis question. First, an exploratory research method was used to interview ten professors representing multiple disciplines. Once the results of the interviews were analyzed it was determined that a convergence of opinion existed on two battles in particular. Case study analysis was conducted on the Battle of Trafalgar and the Battle of Midway. At that point, detailed research was conducted on both battles in order to determine whether or not they substantiated the overall thesis question: Can military decision makers maintain the ability to make successful decisions by mitigating the debilitating effects of environments of extreme information ambiguity through the combined use of common training and collaborative planning. Chapter III presents a synopsis of the data collected on these two battles starting with the Battle of Trafalgar.

⁶¹ Leege and Francis, 199.

⁶² With respect to decision making in ambiguous environments, it is clear that much has been written in the past on this topic. Clearly, for centuries people have been describing wars (or any other confusing environment) as ambiguous. However, this study brings to light for the first time the idea of mitigating the effects of an environment of extreme information ambiguity on decision making through the combined application of common training and collaborative planning. The key unique phrase here is “extreme information ambiguity” and the key (novel) concept is that such an environment can be mitigated with common training and collaborative planning.

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III. DISCUSSION OF THE CASE STUDIES

A. INTRODUCTION

As discussed in Chapters I and II, case study analysis on two historical military battles (Chapter IV) was used to show how military decision makers maintain the ability to make successful decisions by alleviating the debilitating effects of environments of extreme information ambiguity through the combined use of common training and collaborative planning. Chapter III serves to enlighten the reader of the fine points of each case study conducted in preparation for the analysis to be conducted in the chapter that follows.⁶³ The case studies will be discussed here in the following order: The Battle of Trafalgar (1805) and the Battle of Midway (1942). For the sake of clarity, thoroughness, scientific rigor, and for efficiency of analysis, both cases will be broken down and discussed based on the same outline.

Each case study will be discussed from the perspective of the one dependent variable and the two independent variables defined in Chapter I.⁶⁴ For each case study, a brief account of the battle will be given based on the following five questions:

1. What effect did the environment of extreme information ambiguity have on the Royal Navy and the Franco-Spanish Navy?
2. What was the effect of common training for each side?
3. What was the effect of collaborative planning for each side?

Each case study discussion concludes with the following two questions:

4. With respect to questions 1-3, what was expected to happen in the battle?
5. With respect to questions 1-3, what actually did happen in the battle?

Following the discussion of both case studies, Chapter IV will serve to assess, analyze, and determine whether or not the thesis statement is substantiated. The first case study is The Battle of Trafalgar which occurred over the span of about one day on October 21, 1805.

⁶³ Refer to Chapter II for an explanation on how and why these particular battles were chosen.

⁶⁴ Reference Tables 1, 2, and 3. Recall the dependent variable is the environment of extreme information ambiguity. The two independent variables are common training and collaborative planning.

B. THE BATTLE OF TRAFALGAR

1. What Effect Did the Environment of Extreme Information Ambiguity Have on the Royal Navy and the Franco-Spanish Navy?

a. *Environment of Extreme Information Ambiguity and the Royal Navy*

Based on the criteria described in Chapter I and listed in Table 1, the admirals for both fleets, Nelson for the British, and Villeneuve for the French, both experienced an essentially continuous environment of extreme information ambiguity. Most, if not all, of the ambiguity stemmed from the uncertainty pertaining to each other's force strength, disposition, and intentions. Nelson wondered when the Combined Fleet would come out of port so that he could bring them to battle and annihilate them.⁶⁵ He also wondered if, at the time of Villeneuve's departure from Cadiz harbor, the British Fleet would be in the right position to bring about a decisive victory over the Franco-Spanish Fleet. In addition to ambiguity, Nelson was forced to deal with other factors such as friction (Table 1, factor 1); i.e., weather in the form of heavy seas and insufficient winds (to move his fleet about).

When Villeneuve finally decided to come out of port, Nelson remained puzzled because here was the enemy fleet sailing towards him in a disorganized gaggle, lacking any semblance of formation he could recognize or would expect. Furthermore, the Combined Fleet was not flying any signal flags. During the age of sail, signal flags were used to communicate many types of information. In particular, there were special flags reserved for the commanders-in-chief for each fleet. Because the French and Spanish Fleets were not flying flags, Nelson had no way to discern which ship was the flagship of Villeneuve. Nelson needed this piece of information so he would know exactly where in the Franco Spanish battle line to concentrate his attack. "Nelson had not counted on any of this."⁶⁶ The British admiral's whole plan revolved around this small piece of information for it was his intention to split the Franco-Spanish battle line at a

⁶⁵ Alan Schom, *Trafalgar Countdown to Battle 1803-1805*, 1990, pg. 315. The Franco-Spanish fleet was also referred to as the Combined fleet.

⁶⁶ Schom, 307.

point just forward of the French flagship (thus cutting off the vanguard) and at a another point, perhaps twelve ships up from the very end of the enemy battle line.⁶⁷

Because the French and Spanish ships were in bunches instead of one long battle line, it would be impossible for Nelson to completely pierce the Franco Spanish line as he had described in his Memorandum.⁶⁸ One might think that Villeneuve had planned this formation when, in fact, the Combined Fleet was in this formation because of the poor skills of its crews and because of the very light wind blowing at the time they were getting underway from Cadiz. Ironically, Villeneuve had “established the one formation that did not fit the British plan.” Nevertheless, Nelson pushed on towards the Combined Fleet despite the ambiguity and uniqueness of the situation. This was not one of the routine situations he had trained for; rather, it was a novel circumstance that he needed to overcome. In Section 3.a., one sees how collaborative planning combined with common training ensures a commander the best possible chance of being able to adapt to novel situations once a battle begins.⁶⁹

Although the ships did not move at high rates of speed, the preparation leading up to the beginning of the Battle of Trafalgar at 1150, October 21st, 1805, partly because of the lack of French and Spanish signal flags, was intense. At 1140 Nelson had changed his mind while still trying to determine the intentions of the Combined Fleet. He decided to push through for the head of the Combined Fleet rather than the center as originally planned. At 1145, the Combined Fleet hoisted their colors, and shortly after that, at the last moment before Nelson made his final maneuver in preparation for battle,

⁶⁷ Van is short for vanguard and is defined as the foremost position in an army or fleet advancing into battle. In the case of the Battle of Trafalgar, the van of the Combined fleet consisted of about twelve ships of the line.

⁶⁸ Schom, 290-291. Nelson referred to his new plan for attacking the Franco-Spanish Fleet the ‘Nelson Touch’. Only one other commander in history (Rodney, 1782) had devised, and attempted to form, two battle lines in an effort to break the battle line of the opposing fleet by approaching them at a perpendicular angle. “Until this time, there were only a couple of traditional methods of attack where two large fleets were concerned. They would approach each other in two long, enormous battle lines, maneuvering to gain the advantage of the wind...both fleets would sail past each other in two close parallel lines, lambasting each other with their broadsides preparatory to boarding.”

⁶⁹ Refer to Chapter I for the discussion on common training and collaborative planning. Recall that decision makers rely on common training for encounters they have faced before. In contrast, in a novel situation, or one for which the decision maker has not sufficiently trained, there is more of a reliance on the collaborative planning utilized before the battle begins. In the end, during the heat of battle, a commander may only rely on the planning and training conducted before the battle begins.

Villeneuve's flag was slowly hoisted on his flagship *Bucentaure*. In a flash, Nelson abandoned his plans to attack the head of the fleet and reverted back to his very first plan of attacking the center.⁷⁰ At 1150 the first shots were fired by the French at the HMS Victory, and the battle had begun.

This example demonstrates how the Royal Navy and Admiral Nelson, through the combined use of common training and collaborative planning, were able to alleviate the negative effects of an environment of extreme information ambiguity. Their prior training and ongoing planning enabled them to carry out last minute changes to deal with ambiguous information. At the point that Villeneuve finally hoisted his command pennant, through the use of collaborative planning Nelson was able to communicate his change of plan to his Captains. He did this by means of flag signals and face-to-face meetings. For instance, at the time the battle began, he had one of his captains aboard; therefore, he was able to use a face-to-face meeting to discuss options and orders with that captain (Table 3, factor 6). At the moment the battle began, Captain Blackwood was departing Nelson's flagship *Victory* and returning to his own ship with new instructions.⁷¹ Although Nelson's overall objective of annihilating the Combined Fleet never changed, his strategy changed by the minute. Moreover, despite all of the changes and the increasingly ambiguous information environment, Nelson's fleet successfully adapted to its environment. This adaptation was enabled by the combined use of common training characteristics such as similar training and vigorous training in areas like ship maneuvering, flag hoisting, and battle procedures (Table 2, factors 1, 2). Moreover, there was also evidence of collaborative planning in the form of synchronization of all assets, face-to-face meetings, and developing shared situational awareness. Skillful use of these factors contributed to Nelson's ability to successfully manage his ambiguous environment despite the onset of battle (Table 3, factors 2, 6, 8).⁷²

⁷⁰ Schom, 321.

⁷¹ Captain Alfred Thayer Mahan, *The Life of Nelson: The Embodiment of the Great Sea Power of Great Britain*, 2d. ed. (Boston: Little, Brown, and Company, 1907), 328. The Honorable Captain Henry Blackwood was the commanding officer of the HMS *Euryalus* (Frigate).

⁷² Schom, 307.

b. Environments of Extreme Information Ambiguity and the Franco-Spanish Fleet

The Franco-Spanish Fleet also suffered from the effects of an environment of extreme information ambiguity. Specifically, they had to contend with friction, ambiguity, time pressure, and high stakes (Table 1, factors 1, 2, 3, 5). First, Villeneuve experienced a high degree of uncertainty trying to determine the status of the Royal Navy outside the harbor, and he felt time pressure because he was under orders from Napoleon to report to the Mediterranean. He needed information about the British Fleet in order to coordinate his escape through the Straits of Gibraltar. Second, Villeneuve experienced the effects of friction with respect to the weather. There was insufficient wind to carry his fleet efficiently out to sea. Additionally, the lack of experienced sailors (common training) compromised his ability to deal with adverse weather conditions. Third, Villeneuve was operating under the pressure that is produced by high stakes. France could not afford to have their navy annihilated, yet Villeneuve knew the Combined Fleet was no match for the Royal Navy. Once out to sea, and engaged in battle, Villeneuve found that his inexperienced fleet, especially the twelve ships of the vanguard, was unable to deal with the apparently disorganized way in which the British Navy was attacking.

When it came to figuring out the strength, disposition, and location of the British Fleet, Villeneuve had considerably more ambiguity (Table 1, factor 2) to deal with than did Nelson. It was not until 1100 on the morning of the battle, October 21st, 1805, that Villeneuve saw Nelson's entire fleet for the first time.⁷³ For weeks the French and Spanish Fleets had been bottled up in Cádiz harbor with little to no idea of the Royal Navy's disposition or intentions.⁷⁴ During the several days leading up to the battle, Villeneuve's intelligence on the strength, disposition, and location of the British Fleet was practically non-existent. In contrast, Nelson had placed Captain Blackwood and a small group of four frigates and two schooners just outside Cádiz Harbor for the sole purpose of monitoring the movements of Villeneuve's forces. Meanwhile, in preparation

⁷³ Schom, 315.

⁷⁴ Cádiz is a coastal city in southwestern Spain in the region of Andalusia. It is the capital of the province of Cádiz.

for battle, Nelson was several miles out to sea and had dispersed his fleet for the purpose of making it difficult for Villeneuve to determine his force strength.

Villeneuve knew his fleet was most likely no match for that of the British. He had always told his superiors the French Navy could never defeat the British Navy in an equal fight, or even if the Royal Navy were one-third weaker.⁷⁵ He struggled to determine the strength, disposition, and location of the British Fleet so that he could come out at a time when they were at their weakest and most dispersed. It was then he would have his best chance to escape south through the Strait of Gibraltar.⁷⁶

Like Nelson, Villeneuve was concerned about the weather, especially with respect to the winds. He needed to get his fleet out to sea, and he knew the current status of light winds would not work to his benefit considering his sailors' obvious deficiencies of seamanship and sea experience. This was a great source of consternation for Villeneuve as it took the Combined Fleet well over a day to exit Cádiz.⁷⁷

Once out to sea, and once the battle had begun, the reports of the Spanish and the French were of "bewildered astonishment" that an attack such as the one Nelson carried out could even work. Accounts such as these from the summary of the Spanish staff confirm that, during this battle, the commanders of the Combined Fleet experienced many confusing times where their senses became overwhelmed.⁷⁸ For instance, immediately as the battle began, Nelson successfully separated the vanguard from the rest of the Combined Fleet's battle line. By the time they came about and maneuvered into position, it was too late. One must infer that the commander of the vanguard, Rear Admiral Dumanoir, in the French ship *Formidable*,⁷⁹ suffered from the effects of an environment of extreme information ambiguity. Returning again to Table 1, factor 1 refers to the United States Marine Corps definition of friction. One can easily identify all of the elements the rear admiral must have been facing: Sea state, weather, lack of coordination, and lack of a clearly defined goal are certainly at the top of the list.

⁷⁵ Schom, 315.

⁷⁶ Corbett, Julian S., *The Campaign of Trafalgar*, 1910, pgs. 360-361.

⁷⁷ Schom, 313.

⁷⁸ Corbett, 394-395.

⁷⁹ Corbett, 391.

Finally, the conclusion of the battle was a time for the leaders and men of the Combined Fleet to see and reflect on the great loss they now faced.⁸⁰ Indeed, the Franco-Spanish Fleet casualty list topped 6,953 men, either dead or wounded. Nineteen of the French and Spanish ships had been taken as prizes by Vice Admiral Collingwood, while the Royal Navy had lost none.⁸¹ Clearly, a sense of demoralization quickly affected the leadership and sailors of the losing fleet. Fears of whether the wrong decisions had been made, fears of not having completely understood the situation, and fear for their lives were no doubt weighing heavily in their hearts and minds.

In contrast, Nelson handled the uncertainty of his information environment as any well-trained and capable admiral would. He dispersed his fleet in such a way as to conceal its full composition, while at the same time maintaining a line of communication and intelligence flow that allowed him to know when the Combined Fleet was leaving Cadiz. In 1805, the British had the most formidable and well-trained fleet in the world. Their seamanship and sea experience were matched by no other nation's fleet. Their skills and experience, combined with the leadership of admirals such as Nelson, represented a force that Villeneuve simply did not want to confront. On the other hand, Nelson, because of how well he had trained his personnel and communicated with his subordinate commanders, could not wait to engage the Combined Fleet.

2. What Did Common Training Mean to the Royal Navy and the Franco-Spanish Navy?

a. Common Training and the Royal Navy

The common training of the Royal Navy and Admiral Nelson was superior to that of the Franco-Spanish Fleet and Admiral Villeneuve for three primary reasons. First, by 1804, the Royal Navy had spent nearly one hundred years refining their strategy.⁸² Second, the officers and sailors under Nelson's command (subject to his style of discipline and training) spent long months at sea. Training conducted at sea enabled

⁸⁰ The explosion of the French Ship Achille marked the factual and symbolic end to the Battle of Trafalgar. Schom, Alan, *Trafalgar Countdown to Battle 1803-1805*, 1990, pg. 354.

⁸¹ Schom, 355. Corbett, 398. Corbett writes that twenty sail of the line were captured. Herman, 393. Herman claimed the tally was eighteen of thirty ships captured, just two short of Nelson's goal.

⁸² Herman, 377.

crews to learn skills that could not be mastered sitting in port, anchored or tied to a pier.⁸³ Third, Nelson, with the advent of his famous memorandum, introduced new battle procedures and doctrine for the Royal Navy's operations at sea.⁸⁴

First, by 1804, the Royal Navy had earned control of the seas around Europe because they had a navy that had been operating together and honing its skills and capabilities for almost a century. In contrast, his adversary's (Napoleon and Villeneuve) ships had remained mostly in harbor during that same time. Meanwhile, for more than ten years, the British Navy had been ready for battle with constant training and weapons practice. The officers and sailors of the Royal Navy were experienced veterans who had proven themselves in combat. For instance, out of seventeen officers on Nelson's flagship, Victory, ten had seen battle at sea at least once, and on one other ship, every officer was a battle veteran.⁸⁵

Nelson adapted much of his common training and discipline style from a man named Sir John Jervis, whom he met on January 19, 1796. "Jervis was a leading apostle of the navy's hard and bold spirit which appealed so much to Nelson..."⁸⁶ Jervis was adamant about cleanliness and was a stern authoritarian and very particular about protocol and the rehearsal of skills. For instance, he required all his ships to practice with at least five of their guns each day. Although Jervis would not hesitate to flog a man or hang him for mutiny, he always cared for the health and welfare of his men.⁸⁷ It was the combination of cleanliness, discipline, protocol, and rehearsal that constituted the training style of Jervis' and that style which Nelson adopted as his own.

⁸³ Schom, 223.

⁸⁴ Schom, Alan, Trafalgar Countdown to Battle 1803-1805, 1990, pgs. 290-291. Nelson referred to his new plan for attacking the Franco-Spanish Fleet the 'Nelson Touch'. Only one other commander in history (Rodney, 1782) had devised and attempted to form two battle lines in an effort to break the battle line of the opposing fleet by approaching them at a perpendicular angle. "Until this time there were only a couple of traditional methods of attack where two large fleets were concerned. They would approach each other in two long, enormous battle lines, maneuvering to gain the advantage of the wind...both fleets would sail past each other in two close parallel lines, lambasting each other with their broadsides preparatory to boarding."

⁸⁵ Herman, 377.

⁸⁶ Arthur Herman, *To Rule the Waves*, (New York: Harper Collins Publishers, 2004), 345. Ernie Bradford, *Nelson The Essential Hero*, (London: Macmillan London Limited, 1977), 123.

⁸⁷ Herman, 345. Bradford, 138-139.

Second, with respect to a sailor honing the everyday skills of seamanship, maneuvering, and stationing, there was no better way to accomplish such a task than actual time spent at sea. The officers and sailors of the British Fleet under Nelson's command received the common training they needed because of the demanding months spent at sea operating the fleet. A sailor's sole purpose at sea is to work, and because a Sailor most aptly learns his job by doing it, in the end, the product of their hard work is unmatched skill and proficiency of their jobs.⁸⁸

Third, as previously demonstrated, the British Fleet was well trained. It was this training that allowed them to carry out Nelson's Memorandum for the Battle of Trafalgar, and subsequently defeat the Combined Fleet. The memorandum was composed on October 9th, 1805, and it highlighted a shortfall in his fleet's battle procedures, training, and doctrine. Nelson's insight was aimed at making his commanders more self-reliant, his communications more efficient, and at reducing the amount of time required for the fleet to form up and engage the enemy. Before this change in doctrine, individual captains were sometimes too reliant on their commander's signals which oftentimes, due to weather or battle smoke, could not be seen. Furthermore, the old method of forming one long battle line consumed too much time in Nelson's view. He believed in getting to the business of fighting as soon as possible. His 'Nelson Touch' technique allowed him to do just that. Lastly, in the last line of his famous memorandum, he shows how much faith he has in the common training of his captains: "Captains," he closed, "...in case signals can neither be seen or perfectly understood, no Captain can do very wrong if he places his ship alongside that of an enemy."⁸⁹

It is not difficult to see just what common training meant to the British Navy. Clearly, it was the superior training of their fleet, in the areas of seamanship, stationing, and maneuvering that enabled them to experience much of the success they enjoyed against the Franco-Spanish Fleet. Furthermore, the manner in which they achieved their similar skills and alignment amongst commanders came from long months at sea doing their job, day after day (vigorous training, doctrine, and rehearsal).

⁸⁸ Herman, 381. Schom, 223.

⁸⁹ Ibid., pgs. 291-292. These two pages also contain Schom's description of what was in Nelson's famous memo and how it was briefed to his Captains.

b. Common Training and the Franco-Spanish Navy

The previous section gave the reader a slight preview of some of the primary reasons the Franco-Spanish Fleet was so poorly trained with respect to their British adversary. First, Villeneuve was a “trained and dedicated officer,”⁹⁰ but he was a young admiral which was a sign of how the French had a limited supply of seasoned sea officers.⁹¹ Second, the Combined Fleet lacked the ability to execute efficiently the most fundamental tasks involving basic seamanship, stationing, and maneuvering. The French and Spanish, for some reason, never spent the time, or had the time, to train properly their navies.⁹² Third, the Franco-Spanish Fleet lacked alignment among the captains of their ships. This was caused, in large part, by a resentment most officers and sailors of the Combined Fleet shared for Villeneuve. This hostility undermined what little skills the crews did have.

Although Villeneuve was a well-trained officer and experienced veteran, he lacked certain indispensable qualities of leadership such as a sense of independent judgment and the motivation to follow his intuition (i.e., he was afraid of Napoleon and would not ever challenge Napoleon’s orders). Villeneuve was an expert naval officer who knew what kind of common training his fleet needed.⁹³ However, Villeneuve’s failings affected his ability to ensure his fleet was properly trained. Moreover, the Spanish Fleet was even less well trained than the French Fleet. To make matters worse, Villeneuve knew the Royal Navy was of a much higher caliber than the French and Spanish Navies combined.⁹⁴ Villeneuve allowed the limitations of his fleet to become an excuse for his continued poor performance, and it was this poor performance that ultimately resulted in Villeneuve’s inability to properly train his own fleet.⁹⁵

⁹⁰ Herman, 375.

⁹¹ Herman, 375.

⁹² Herman, 377.

⁹³ Herman, 375.

⁹⁴ Herman, 388. Even Nelson knew the skills of Villeneuve’s fleet to be seriously deficient to his own: “But Nelson was not facing an enterprising opponent, and he knew his opponent’s standards of gunnery: slow (half as fast as his own), inaccurate, and uncertain.”

⁹⁵ Herman, 376.

The Combined Fleet lacked the ability to efficiently execute the most fundamental tasks involving basic seamanship, stationing, and maneuvering. For example, on January 22nd, 1805, after a failed attempt to get underway from Toulon, Villeneuve informed his superior, Admiral Denis Decrès, that his sailors had no sea experience in stormy weather. When they did finally sail for the first time they panicked and much unnecessary damage was done to several ships.⁹⁶ In another similar incident on March 30th, 1805, Villeneuve was making his second attempt to get underway from Toulon. Schom writes, “The crews of many of these ships, so sparse and so poorly trained, were beefed up at the last minute with several hundred troops, all of whom were given a crash-course in basic seamanship.”⁹⁷ In contrast, Nelson and his fleet spent more than two years at sea without docking for supplies, and had twice traversed the Atlantic Ocean.⁹⁸ As stated earlier, the training a navy receives while operating at sea cannot be substituted with time spent inactive in port. By not spending a sufficient amount of time at sea, the crews of Villeneuve’s ships never received the similar training and vigorous training they needed (Table 2, factor 1, 2). Lastly, without adequate common training, a unit of any kind cannot hope to profit from the by-products of common training such as developing similar skills, similar perception and reaction, alignment amongst commanders, or implicit connections and bonds (Table 2, factors 5, 6, 7, 9).

Third, in addition to the lack of similar training and education, the Franco-Spanish Fleet suffered from a lack of alignment amongst the captains of the ships. First, poor stationing and maneuvering of the fleet (i.e., efficiently standing out to sea and getting into formations) can be at least partially attributed to resentful French and Spanish captains failing to obey orders.⁹⁹ Villeneuve was despised by half of the French Fleet and most of the Spanish Fleet. His subordinates were known to regularly disregard his orders. In fact, on the day of departure from Cádiz harbor, the French and Spanish ships were mixed together in an effort to discourage disloyal units (ships) from not following

⁹⁶ Schom, 199.

⁹⁷ Schom, 207.

⁹⁸ Schom, 223.

⁹⁹ Schom, 312, 313, 314.

orders.¹⁰⁰ Second, as earlier that year in January and March of 1805, at the time of the Battle of the Trafalgar, the Franco-Spanish Fleet suffered from inexperienced captains and crews.¹⁰¹ For example, the Combined Fleet's sortie from Cádiz on October 19, 1805, was the first time that for thousands of its sailors had gone to sea.¹⁰²

In the end, the French and Spanish failed to give their fleets the kind of common training required to engage an adversary like Nelson. The most obvious reason the Franco-Spanish Fleet was so poorly trained was their lack of sea experience, especially with respect to their opponent. If one looks at the number of guns, ships, and personnel taken into battle against the British, a clear advantage was enjoyed by the Franco-Spanish Fleet in all three categories (see Table 6).

Table 6. Gun power, Ships, and Manpower at the Battle of Trafalgar for the Royal Navy and Franco-Spanish Fleet

	Franco-Spanish Fleet	Royal Navy	Advantage	% Advantage
Guns	2,568	2,148	French	16%
Ships	33	27	French	18%
Personnel	33,000	17,000	French	48%

However, Schom noted that although the French and Spanish Fleets enjoyed a 48% advantage in manpower, that manpower was less trained than were the sailors of the British Fleet.¹⁰³ One can infer from this evidence that the Combined Fleet suffered from a serious lack of common training. Referring to Table 2, two of the primary characteristics of common training are similar and vigorous training and rehearsal (factors 1, 2). The products of these factors are similar skills, alignment amongst commanders, and harmony, or focus and direction in operations (factors 5, 7, 8).

In conclusion, referring again to Table 6, the French and Spanish Fleets should have had the clear advantage; however, it is the third element of Table 6 that drives home why they did not. The Franco-Spanish Fleet had more manpower, but they

¹⁰⁰ Schom, 312.

¹⁰¹ Schom, 314.

¹⁰² Schom, 314.

¹⁰³ Schom, 315.

were less trained and they lacked sufficient (if any) sea experience. Villeneuve sensed this lack of common training and had been telling his superiors for some time that the French Navy could never defeat the British in a one-on-one battle (or even a British Navy one third weaker).¹⁰⁴ Nevertheless, based on pressure by Napoleon to defeat the Royal Navy and based on Villeneuve's desire to avoid being relieved by Admiral Rosily (sent by Villeneuve's superiors in Paris), Villeneuve took his fleet to sea. What is more, although his first intention was to flee to the Strait of Gibraltar in an effort to escape Nelson, Villeneuve would eventually, for selfish and prideful reasons, turn his fleet around and face the British despite the obvious common training deficiencies of the Combined Fleet.

3. What Did Collaborative Planning Mean to the Royal Navy and the Franco-Spanish Navy?

a. Collaborative Planning and the Royal Navy

Collaborative planning was essential for the efficient operation and success of the Royal Navy leading up to, and during, the Battle of Trafalgar. Nelson, as the Commander-in-Chief of the Royal Navy, provides the reader with rich examples of a leader who understood the importance of sharing ideas, synchronizing all assets, face-to-face meetings, and in general, using the techniques of collaborative planning (Table 3, factors 1, 2, 3, 6). Furthermore, Nelson understood that from successful collaboration with his superiors and his subordinates he could expect to gain a shared situational awareness, better information flow, a fuller understanding of important issues, and a sharing of information across geographic boundaries (Table 3, factors 7, 9, 10, 11).

Beginning in the month of June, 1805, Nelson, sailing with a contingent of British ships on a trip from England to several islands of the Caribbean, stopped at nearly every island along the way to meet and collaborate with local friendly leaders in order to get situational updates, communications from England, and the most recent intelligence available on the location, disposition, and strength of the enemy fleets.¹⁰⁵ Referring to Table 3, Nelson's interactions with the island officials, while not for the sole purpose of planning a battle per se, facilitated the sharing of ideas, synchronizing of all assets at their

¹⁰⁴ Schom, 315.

¹⁰⁵ Schom, Alan, *Trafalgar Countdown to Battle 1803-1805*, 1990, pgs. 219-222.

disposal, and face-to-face meetings (factors 1, 2, 6). The by-products of these activities were improved situational awareness shared by Nelson and all parties involved (e.g., island officials), and a fuller understanding of the issues (e.g., orders and news from England, intelligence) (factors 7, 10).

After that island campaign in 1805, Nelson returned home to England for twenty-five days of vacation after over two years at sea.¹⁰⁶ However, he spent very little time actually resting; rather, he passed nearly every day in London talking with his superiors about future engagements, strategies, policy, and innovations in the British Fleet.¹⁰⁷

As discussed in Chapter I, there are many ways to conduct collaborative planning, and although the Age of Sail did not present us with information technology (IT) based methods for collaborative planning, it did offer several physical collaborative tools such as signal flags, flares, lights, and sounds. Face-to-face meetings were also a valid means of conducting meaningful planning in the 1800s. In truth, these methods were used by both the Royal Navy and the French and Spanish Navies.¹⁰⁸

The revolutionary system of signal flags employed by the British Navy is just one example of the new and improved forms of collaborative planning used by the British Fleet during this time.¹⁰⁹ Still, the British acknowledged this new way of signaling was not necessarily the only way to communicate; in fact, signal flags could be constrained by elements of the weather such as fog, rain, and heavy seas. Furthermore, factors such as black smoke from cannons or burning wood, or the absence of a ship's mast during or after battle could limit the usefulness of flags. In 19th century naval warfare, a ship's masts were oftentimes a primary target for the enemy.¹¹⁰ By the end of an engagement, a ship's masts may have been blown away. In this case, hoisting flags

¹⁰⁶ Schom, 223-224.

¹⁰⁷ Ibid., pgs. 255-259.

¹⁰⁸ Schom, 235.

¹⁰⁹ Herman, 373-374, 382. Schom, 285. Corbett, 336-337.

¹¹⁰ "...the French generally aiming their big guns at masts and yards to disable their foe, while the British preferred to concentrate many of their heavy guns on the hulls of their opponents, though not excluding higher targets." Ibid., pg. 327

and sails became impossible. It was at times like these that the alternative methods such as rockets, gun volleys, and color lamps could be used to keep the lines of collaboration open.¹¹¹

Face-to-face collaboration was probably the most frequently utilized form of collaborative planning used by Nelson. Nelson would often, especially when out to sea, and most notably while waiting for the Franco-Spanish Fleet outside of Cádiz in October 1805, bring the fleet's captains aboard to discuss how they would attack the Combined Fleet when the time came. In fact, it was at one of these dinners where Nelson's famous memorandum, which outlined a new plan for attacking the Franco-Spanish Fleet, was first introduced. Referring to Table 3, factor 6, face-to-face meetings, one can see how the commanders were able to maintain an easier flow of information, provide an opportunity to raise issues, and also conduct a certain amount of brainstorming to help arrive at a decision (Table 3, factor 9). Elements of Table 3, such as factor 10, reaching a fuller understanding of the issues, and elements of factor 12, maintaining a clearer picture and access to all relevant information, are also observed.

Nelson also relied on written lists and correspondence to convey his thoughts and orders to the captains of the British Fleet.¹¹² With these orders he was able to relay instructions about anything from the procurement of supplies for the fleet to orders on actions to carry out in the case of bad weather. What's more, the captains receiving this correspondence used the same method to write back to Nelson as a means of resolving issues during those times when geographical or other factors prohibited face-to-face meetings.¹¹³ Despite its usefulness, written correspondence was limited by the distances between ships and by weather.

In conclusion, decision makers of the Royal navy valued collaborative planning and used it as a means to alleviate the deleterious effects of environments of extreme information ambiguity. Through the use of face-to-face meetings and the

¹¹¹ Schom, 285.

¹¹² Schom, 294. "To the respective Captains...It is my positive directions..."

¹¹³ Schom, 293.

concomitant sharing of ideas the leaders of the Royal navy were able to maximize their ability to mitigate ambiguity so that continued operation and mission execution was possible.

b. Collaborative Planning and the Franco-Spanish Navy

Where the British navy serves as an example of a military organization (of decision makers) that was able to use collaborative planning to their advantage, Villeneuve, and the decision makers of the Franco-Spanish Fleet provide a contrasting view.¹¹⁴ The Combined Fleet did attempt to share ideas, synchronize assets, and conduct face-to-face meetings (Table 3, factors 1, 2, 6). However, examination of the way in which the Combined Fleet conducted collaborative planning, raises the question of how much success they had in improving their situational awareness, increasing information flow, understanding the issues, and sharing information across geographic boundaries (Table 3, factors 7, 9, 10, 11). First, the effectiveness of the Combined Fleet's collaborative planning was seriously degraded by the dissention and distrust among Villeneuve's superiors and subordinates.¹¹⁵ Second, the Combined Fleet's collaboration was often based on lies and false information (See below). Third, both subordinates and superiors of Villeneuve hid information from him and communicated about him behind his back. Lastly, much of Villeneuve's collaborative planning suffered from the effects of distance and the delays that distance posed on the orders he would receive from Napoleon and Decrès.

As discussed above earlier, Villeneuve, although capable, was not well respected by the captains and crews of the French Navy and was even less well respected by the men of the Spanish Fleet.¹¹⁶ As an example, on October 19, 1805, when Villeneuve had just ordered the Franco-Spanish Fleet to get underway from Cadiz, Schom describes it in the following way, "...with so much dissention among his fleet commanders, Admiral Villeneuve was of course taking the considerable risk of finding

¹¹⁴ Samuel Leech, *A Voice from the Main Deck*, (1844), quoted in John Keegan, *Price of Admiralty*, (New York: Penguin, 1988), 39. The Royal navy was a well oiled machine, "a set of human machinery in which every man is a wheel, a band, or a crank, all moving with wonderful regularity and precision to the will of the machinist – the all powerful Captain."

¹¹⁵ As with the common training of the Franco-Spanish fleet, it is demonstrated again here how dissention in the ranks, up and down the chain of command, is a seriously debilitating factor in the effectiveness of collaborative planning.

¹¹⁶ Herman, 384.

part of his fleet separating from and abandoning him...”¹¹⁷ Additionally, neither Napoleon nor Admiral Decrès, Villeneuve’s superiors, respected or had confidence in him.¹¹⁸ However, Villeneuve received the job because there was no more qualified than he at the time. The bad relations Villeneuve had with his superiors and with his subordinates served to derail most of the effective collaborative planning that would have otherwise benefited by the Combined Fleet.

Clearly one of the things that hurt the collaborative planning efforts of the French and Spanish navies the most was the lying or false information they gave each other. Effective collaborative planning is founded on accurate information. Sharing of ideas, synchronizing, and various forms of correspondence are severely hampered, if not rendered useless, if the information flowing between to entities is not based on truthful data. For instance, after a battle between Admiral Calder of the Royal Navy and Villeneuve on July 22nd, 1805, “Villeneuve’s report on the battle was very sketchy, indeed, more typical of a diplomatic assessment than of a naval summary of events...”¹¹⁹ In his report, Villeneuve lied so continuously it would have been impossible for his superiors or anyone else to benefit from any number of the positive products of collaborative planning such as accurate situational awareness, information flow/issues being raised, and certainly not a fuller understanding of what had happened during the battle (Table 3, factors 7, 9, 10).

On August 8th, 1805, upon receiving the report on the battle between the Franco-Spanish Fleet and the Royal Navy, Napoleon, in his report to the French Arch-Chancellor, further perpetuated the lies begun previously by Villeneuve. For instance, he reported that any failings in the battle could surely be attributed to the Spanish when in fact it was the Spanish who had fought the most bravely. Research reveals that Villeneuve never indicated the full truth in his reports to Decrès and Napoleon and that Napoleon was the only one who reportedly lied more than Villeneuve.¹²⁰

¹¹⁷ Schom, 309.

¹¹⁸ Herman, 375. Schom, 199.

¹¹⁹ Schom, 234. The battle took place west of France and 117 miles from El Ferrol.

¹²⁰ Schom, 238.

In the absence of truthful information, Villeneuve's efforts suffered from hidden information as well. Both Napoleon and Decrès secretly corresponded with General Lauriston, commander of troops onboard Villeneuve's fleet. For instance, in one case (though these private communications occurred often), Napoleon is reported to have written privately to General Lauriston; "I really believe your Admiral does not know how to command."¹²¹

In addition to the ill effects of hidden/false information, Villeneuve suffered delays in receiving information from both Decrès and Napoleon. In one particular instance, Napoleon sent a long list of orders and missions (dated 13th and 14th April, 1805) including some amendments (dated 23rd April), all of which would take weeks to carry out. Unfortunately, Villeneuve did not receive the orders until the end of May of the same year. What is more, Napoleon insisted these new orders be carried out and completed in enough time that Villeneuve leave for a new destination no later than the 22nd of June (same year).¹²² The distance from Napoleon and Decrès location in Paris to Villeneuve's operating area in the vicinity in the Caribbean severely slowed down the speed of sharing ideas and the synchronizing of assets (Table 3, factors 1, 2), and obviously precluded the use of collaborative planning via face-to-face meeting (Table 2, factor 6).

In the end, Villeneuve and the Combined Fleet collaboratively planned, though it appears not very well. Dissention amongst his commanders and crew, false information, hidden information, and delayed receipt of orders made it difficult for Villeneuve and the Combined Fleet to achieve some of the essential products of collaborative planning. Factors such as shared situational awareness, increased information flow, developing a fuller understanding of the issues, and gaining access to all relevant information, no doubt, could have contributed to Villeneuve's successful alleviation of his environment of extreme information ambiguity.

4. What Was Expected to Happen in the Battle?

Initially the Combined Fleet expected to get to sea and avoid a fight. Villeneuve's motives were not like those of Nelson's. He was putting to sea because he knew he was

¹²¹ Schom, 199. Bonaparte, Napoleon, Correspondence de Napoleon I^{er}, op. cit., 1804, 1805.

¹²² Schom, 225.

about to be relieved by the Council of War in France. Days earlier on the 12th of October, just four days after the Council of War, Admiral Rosily of the French Navy arrived in Madrid, but was detained there because the route to Cádiz was unsafe for travel. Nevertheless, word reached Villeneuve that he would be superseded. On the 18th of October, Villeneuve ordered Rear Admiral Charles Rene Magon (in the French Ship Algeiras with Commanding Officer Captain Gabriel-Auguste Brouard) with seven of the line and one frigate to proceed to sea to capture Captain Blackwood's squadron of frigates (they were just outside the harbor) in order to find out more about the make-up and intentions of the British Fleet.¹²³ However, before this command could be executed, Villeneuve received word from Louis's detachment at Gibraltar that a convoy waiting there for escort (by some of Nelson's ships) had sailed eastward with a total of four ships of the line and that two other ships were in port. Villeneuve inferred that Nelson must now be six of the line short and decided that this was the best time, if ever, to put out to sea in order to escape or attack. Most importantly however, the idea of being relieved by Admiral Rosily was no doubt in the forefront of his mind. So, despite the fact there was little wind, he gave the order for his fleet to get underway.

What did Nelson expect to happen in the battle considering his environment of extreme information ambiguity? He expected the enemy eventually to proceed to sea. Next, he expected both fleets to form up and engage each other. Lastly, he expected to bring about a decisive victory and take at least twenty prizes (ships, etc.).

5. What Did Actually Happen in the Battle?

By taking the Combined Fleet to sea on the 20th of October, 1805, Villeneuve avoided being relieved by Admiral Rosily. Although Villeneuve would eventually stand and face the enemy, his first intention was to escape to the Strait of Gibraltar. As it turns out, he probably could have managed this considering the heavy rain and fog present in the area that day. On the 21st of October, 1805, between 0700 and 0800, Villeneuve was heading south and dealing with his own ambiguous thoughts. Should he run from Nelson, avoid battle, and report to the Mediterranean as ordered by Napoleon? If Villeneuve did

¹²³ Blackwood's squadron was nearest to Cadiz of all under Nelson's command. All of Blackwood's ships were fast and were on station for the purpose of getting word to Nelson and the fleet immediately upon learning of any new change in the status of the Combined Fleet, especially if the news was that they were getting underway to sea.

that, he knew he would eventually have to face Napoleon and Decrès to explain all of his previous actions. Villeneuve had made a career out of coming up with good excuses for all of his failures. At 0800, Villeneuve made his decision and gave the order to reverse the course of the Combined Fleet and head north directly into the waiting guns of Nelson and the Royal Navy.¹²⁴ Villeneuve knew it was probably a suicide mission, but decided it best to go down at the hands of a worthy opponent like Nelson, than to be stripped of rank and power upon his return to France. The battle was on, and there was no turning back.¹²⁵

Historians are divided as to whether or not Nelson followed the original plan of attack laid out in his memorandum. Suffice it to say, whether the plan was followed or not, his actions in battle were wholly justified. Nelson had predicted the vanguard of the Combined Fleet, once cut off, would not be able to figure out what to do or execute properly in order to reinsert itself back into the battle. As mentioned earlier, Nelson's tactic to cut the vanguard off and put it out of commission worked exactly as planned. The commander of the vanguard was no doubt overcome by his own environment of information uncertainty, and never got the vanguard turned around until the very end of the battle, and by that time it was too late.

With respect to the ineffectiveness of the vanguard, one must also question what effect Villeneuve's transposition of the battle line had on the tactics his officers were able to deploy, considering (while they were sailing south towards the Straits of Gibraltar) he ordered the fleet to 'wear together,' or turn back, which literally reversed the sailing order of the whole fleet. An alternative order would have been to 'turn in succession' which would have changed the direction of the fleet to the north, but would have also maintained the original battle order as well. Now, the Spanish Admiral Gravina's Observation Squadron was to function as the rear-guard instead of as the commander of the vanguard as originally planned. One last thing Villeneuve's order served to do was demonstrate again how much his inexperienced captains struggled to get their ships quickly into any semblance of a new battle line.

¹²⁴ Schom, 314.

¹²⁵ Schom, 315.

Proceeding on with further details of the battle and as told by the Spanish in a summary written once all the details were known, “The attack,” they say, “was upon the centre and rear of our line, and by concentrating their force upon it, they involved the rearguard in a regular action, line to line, doubling our extreme rear and leaving the van out of action.”¹²⁶ Corbett believed these words to be true and said they also gave a correct summary of the main idea of the Memorandum. Furthermore, the reports of both the Spanish and the French are full of surprised reactions that Nelson would have tried such a reckless attack and one absent of common established principle. Furthermore, both the French and the Spanish could not believe they themselves were not able to thwart it right away because of its reckless nature. This serves as yet another reminder of the poor training and lack of sea experience of the Franco-Spanish Fleet. Their “sprawling display of naval ineptitude”¹²⁷ was not surprising considering upon departure from Cádiz, on the 20th of October, it was the first time several thousand of the Combined Fleet’s sailors had ever ventured out of the harbor!¹²⁸ How could the men be expected to sail a ship into battle without having received the training to do so? They could not.

So it was no surprise they were unable to repel Nelson’s attack once the battle begun. Contemporary evidence agrees that these were the facts of the battle, so then, was the battle fought according to Nelson’s Memorandum? “In major tactics it was; in its minor tactics it was not.”¹²⁹ It is possible that Nelson may have discussed some of the “minor tactics” verbally with his subordinate commanders, though nothing about the exact way he and Collingwood initiated the attack on the Allied Fleet is found in the Memorandum itself.

When the last shots had been fired the British had emerged victorious over the Combined Fleet. Villeneuve and two of his admirals had been taken prisoner by the British Fleet. Only nine of the thirty-three ships which had left Cádiz the day before

¹²⁶ Diario del navio Principe de Asturias (Gravina’s flagship): Desbriere, Trafalgar, App. 387

¹²⁷ Schom, 313.

¹²⁸ Ibid., pgs. 312-313.

¹²⁹ Corbett, Julian S., The Campaign of Trafalgar, 1910, pg. 395.

would return that night; four were headed for the safety of the straits which left no fewer than twenty French or Spanish ships still on the battlefield (17 totally dismantled, thirteen in possession of prize crews, and one in flames).¹³⁰

The significance of all this, especially with respect to the three variables, is that Nelson, in the very hour of battle, relied on his unmatched experience and the experience of his officers and sailors, and simply charged at the enemy, neglecting the security of a more scientific employment of force. What is more, he used his presumed moral and material advantage of speed and momentum against an adversary who at that point of battle was still having trouble forming up.¹³¹ Still some would argue that he accepted too much risk; however, the success of his attack and the known defects of his enemy are justification in and among themselves. Still, regardless of all that can and has been said, Nelson possessed an unquenchable thirst to bring the enemy to battle and destroy it. There is nothing that could have kept him from doing so.

In the end he was right; there was a great lack of training and sea experience on the part of the Combined Fleet and that helped to make his tactics successful. Some reliable officers of the time argued that had Nelson waited another hour for everything to take shape, the mission could still have been completed with more decisive results. Nevertheless, his attack was a stroke of genius and what's more, "It was a glorious victory."¹³²

C. THE BATTLE OF MIDWAY

The Battle of Midway, like the Battle of Trafalgar, is a case study rich with examples of decision makers immersed in the heat of battle, caught up in environments of potentially paralyzing extreme information ambiguity. The Battle of Midway, which took place over the course of three days, from June 4th to 6th, 1942, offers many more opportunities to observe the actions of the decision makers. Furthermore, unlike the Trafalgar case study that focused on two decision makers, Nelson and Villeneuve, this study of Midway explores the decisions of four admirals: Fleet Admiral Chester W.

¹³⁰ Corbett, 393-394.

¹³¹ Schom, 315. "By 1000 the Combined Fleet had finally changed direction, but formed an ill regular, angular crescent, with some ships bunched together, others separated by enormous spaces, as they hauled slowly upwind in northerly direction..."

¹³² Corbett, 396.

Nimitz, Admiral Raymond Spruance, both of the United States Navy and of Commander-in-Chief Yamamoto and Vice Admiral Nagumo, both of the Japanese Imperial Navy.

The Battle of Midway matched two navies whose strategies were rooted in the writings of Alfred Thayer Mahan.¹³³ His works were required reading in American schools and Japanese schools alike. Both navies studied Mahan's teachings on staff planning and table-top maneuvers at their respective war colleges.¹³⁴

The Japanese naval strategy was actually a blend of Mahan's doctrines and traditional Chinese and Japanese military doctrine -- their thinking emphasized the subjugation of the enemy through maneuver, strategy, and attrition rather than by strict quantitative superiority.¹³⁵ While both navies were battleship-centric forces, the Americans realized much sooner than the Japanese that a shift to a focus on aircraft carriers using the battleship in a supporting role was necessary.¹³⁶

The American admirals were willing to evolve their policy towards a more carrier-centric strategy. In the process, they changed the use of the battleship: Not by scrapping it altogether, rather by using some of its greatest strengths to perform vital mission functions. The battleship's capability as an air warfare asset were well leveraged once these mighty ships began seeing use as screens for the carrier task forces; this combined use of carriers and battleships represents the origins of the first carrier battlegroups. Additionally, later in the war, the battleship's larger guns were used for shore bombardment in order to prepare the Japanese islands for invasion by American ground forces.

In contrast, the Japanese never could, despite the urging from many inside their own navy, evolve their thinking from the battleship-centric to the aircraft carrier-centric

¹³³ Ronald H. Spector, *Eagle Against the Sun: The American War with Japan*, (New York: Vintage Books, 1985), 42-43. Mahan's emphasis was on climatic battle for "command of the seas."

¹³⁴ Mark R. Peattie, *Akiyama Saneyuki and the Emergence of Modern Japanese Naval Doctrine*, U.S. Naval Institute Proceedings, Vol. 103, January 1977, 62-65. David C. Evans and Mark R. Peattie, *Kaigun: Strategy, Tactics, and Technology in the Imperial Japanese Navy 1887-1941*, (Annapolis: Naval Institute Press, 1997), 516.

¹³⁵ Sadao Seno, *Chess Game With No Checkmate: Admiral Inoue and the Pacific War*, (Naval War College Review, January-February 1974), 27-28.

¹³⁶ Evans and Peattie, 483.

force until it was too late.¹³⁷ The Japanese reluctance to adapt is important because it became a primary contributor to many of the ambiguous information environments they faced in the war, and especially in the Battle of Midway.

1. What Did the Environment of Extreme Information Ambiguity Mean to the United States Navy and the Imperial Japanese Navy?

a. *Environments of Extreme Information Ambiguity and the United States Navy*

For the Japanese, Admirals Yamamoto and Nagumo stand out as the two decision makers on the Japanese side that suffered the most from factors such as friction, ambiguity, time pressure, delayed action-feedback loops, and high stakes (Table 1, factors 1, 2, 3, 4, 5). On the American side, Admirals Nimitz, Spruance, and Fletcher suffered from many of the same debilitating factors, though not to as great an extent. The discussion resumes here with what these environments meant to the United States Navy during the battle.

In analyzing the ambiguous information environments that Spruance faced during the Battle of Midway, it is important to look not only at Spruance, but also at his battle staff which also experienced significant ambiguity. Nevertheless, Nimitz and Spruance actually handled ambiguity better than did their staffs. As soon as Spruance took command of Admiral Halsey's Task Force Sixteen, he became immediately aware of the seriousness of his situation. High stakes (Table 1, factor 5) is one of the first things Spruance was forced to deal with.¹³⁸ Fletcher's and Spruance's orders were clear: Hold Midway Island and inflict maximum damage on the Japanese Fleet.¹³⁹ However, Spruance and Fletcher were ordered by Admiral Nimitz to preserve the valuable American carriers, even at the cost of giving up Midway. Admiral Spruance understood the high stakes involved -- if he saved the carriers and lost the island, he would be

¹³⁷ Mitsuo Fuchida and Masatake Okumiya, *Midway: the battle that doomed Japan*, (Annapolis: Naval Institute Press, 1955), 240.

¹³⁸ Thomas B. Buell, *The Quiet Warrior: A Biography of Admiral Raymond A. Spruance*, (Annapolis: Naval Institute Press), 1987, 133-137.

¹³⁹ Morison, 84. Since Fletcher was senior to Spruance, Fletcher became the O.T.C., or Officer in Tactical Command for the Midway operation. In addition to being the O.T.C., Fletcher was also the commander of Task Force 17 (including the carrier Yorktown). Furthermore, since Fletcher possessed "no aviation staff and Spruance had Halsey's, it was probably fortunate that Spruance exercised practically and independent command during the crucial actions of 4-6 June." Lastly, on June 4th, after Yorktown was hit by Hiryu strike planes and abandoned, Fletcher, without a carrier to command, essentially turned over O.T.C. to Spruance for the rest of the battle.

shamed for not saving the island. Furthermore, if he saved the island and lost his carriers, he would be failing to fulfill Admiral Nimitz's primary order which was to cause the highest damage on the enemy while not unnecessarily risking heavy American losses (i.e., the carrier strike force). Finally, he might lose both the carriers and the island.¹⁴⁰

After Spruance received his orders from Nimitz, neither Thomas Buell nor Ronald Spector, both historians of the Pacific War, give any indication that the news of receiving this new command affected Admiral Spruance in any particular way. He appeared calm most of the time.¹⁴¹ Also, after receiving his new orders, Spruance received from Nimitz a detailed operation order (document) describing the composition of the huge Japanese Fleet and how Nimitz expected the Japanese to employ their forces. Additionally, Spruance was provided with intelligence reports which gave him even more detailed information than that covered in the general order. Buell comments that this provided Spruance with a huge advantage. Spruance understood that he had fewer ships and aircraft to fight this battle than the Japanese. However, he felt the accuracy of his intelligence evened the playing field considerably.¹⁴² Spruance would soon learn that at least some of this advantage due to intelligence would soon be overshadowed by the inefficiency of his staff.

On the morning of the first day of battle, June 4, 1942, the first signs that Admiral Spruance's newly inherited staff would not hold up under the strains of an environment of extreme ambiguity developed. "The inconclusive reports had an unintended and malignant effect upon the staff officers, wrenching their nerves and intensifying their anxiety," Buell writes.¹⁴³ At about 0545 (June 4th), they had been waiting for reports from the American search planes out of Midway, and they had been receiving incomplete reports about the exact status of the Japanese carriers and attack planes. The staff seemed to be dealing with the following characteristics: friction, ambiguity, time pressure (Table 1, factors 1, 2, 3).

¹⁴⁰ Buell, 137.

¹⁴¹ Morison, 82.

¹⁴² Buell, 137.

¹⁴³ Buell, 144-145.

The staff would continue to suffer from friction (Table 1, factor 1), so much so that by later in the afternoon on June 4th, Buell wrote and Spector concurred, that Spruance's staff had collapsed and become dysfunctional.¹⁴⁴ The staff became gradually more confused and unsettled as the battle wore on. They were unable to deal with the requirement for regimented planning and well orchestrated task force operations.¹⁴⁵ They became increasingly more paralyzed because they could not deal with sensors (scout planes) that delivered less than 100% accurate data, or with the time pressure of their current situation. Regarding, time pressure, the entire staff, including the Chief of Staff, Captain Miles Browning, could not execute some of their most fundamental duties. For instance, after the first air attack was launched by Spruance, it was the staff's job to calculate the "Point Option." Since carriers are not stationary airfields, the Point Option gives the pilots a set of coordinates to return to upon completing their missions.¹⁴⁶ The calculation and the updating of this point is the job of the staff. However, because of their ambiguous environment, they failed to do this. As a consequence, many pilots, failed to find their carriers, ran out of fuel, and crashed into the sea.¹⁴⁷

In contrast, Spruance, who was also waiting for the Midway scout plane reports, did not seem the least bit affected by having to wait. In fact, upon hearing the same report as his staff on June 4th announcing the discovery of two Japanese carriers and battleships steaming towards Midway, without apparent emotion, he rose from his chair, asked for some information, did some plotting, and quietly directed, "Launch the attack." The important question is: Why did Spruance not appear to be affected by factors such as ambiguity, time pressure, and fear of making bad decisions (Table 1, factors 2, 3, 13)? Even though Spruance knew that there were still two or three additional Japanese carriers whose location he did not know, he still launched all of his planes at the only two he had located. Although he knew it was a gamble, his immediate decision to launch illustrates that he did not intend to wait to find the other Japanese carriers. Returning to the initial

¹⁴⁴ Buell, 153. Spector, 177.

¹⁴⁵ Buell, 139.

¹⁴⁶ "Point Option" is discussed more in the section, "What would common training have meant to the United States Navy?"

¹⁴⁷ Buell, 148. Spector, 177.

question about the ambiguity, Spruance made assumptions based on wind direction and from that deduced what the probable Japanese actions would be. Spruance concluded that the Japanese would continue towards Midway, recover and rearm the planes from the first strike, and re-launch either at Midway or the carriers of Task Forces 16 and 17. Lastly, he had to assume that his forces might be discovered at anytime. Ultimately, he knew that his time to decide the best course of action was limited. Launching immediately was the surest way for him to maximize his chance of Nagumo's planes not being able to attack the Task Force before he could get his planes launched and away. Still, Spruance refused to get overexcited -- he took it all in stride.¹⁴⁸

Throughout the day on June 4th, 1942, Spruance remained calm while his staff became increasingly exhausted. After the Yorktown was attacked by planes launched from the Japanese carrier Hiryu, Spruance ordered his Chief of Staff to launch the second attack of the day.¹⁴⁹ Despite the completely inefficient and uncoordinated way in which the attack was finally launched, the attack did hit and sank the fourth Japanese carrier.¹⁵⁰

At this point, evening was approaching, and Spruance needed to decide whether to pursue the Japanese at night or retire to the east and then change course and head back west towards the enemy fleet in the morning. In this case he did not know whether the Japanese Fleet would retire after losing four carriers, or if they would press on with their battleships and cruisers in order to achieve decisive battle against the American Fleet and capture Midway. He also knew that his force would be no match for the Japanese's superior surface ship fire power and night fighting skills. He opted to retire to the east and fight, if necessary, on the 5th of June. Once again, Spruance seemed to keep a clear head and was not affected by high stakes or fear of making bad decisions (Table 1, factors 5, 13). However, in spite of his normal calm demeanor, on June 5th, one could observe Spruance experiencing some of the factors that characterize environments

¹⁴⁸ Buell, 145-146.

¹⁴⁹ Buell, 153.

¹⁵⁰ Samuel Eliot Morison, *History of the United States Naval Operations in World War II Volume IV: Coral Sea, Midway, and Submarine Actions*, (Boston: Little, Brown, and Company, 1971), 124. The first three Japanese carriers at Midway were sunk by American dive-bombers on June 4, 1942, from about 1022-1030.

of extreme information ambiguity, such as ambiguity, time pressure, and delayed action-feedback loops (Table 1, factors 2, 3, 4). For instance, research indicates he became agitated because the planes scouting the location of the Japanese forces continued to send back inconsistent reports.¹⁵¹

On the morning of June 5th, at about 0400, the American submarine Tambor spotted several unidentified ships ninety miles west of Midway. Spruance began to wonder if the Japanese were going to press on with their invasion of Midway. Several hours later Tambor sighted two Japanese cruisers retiring from Midway. At about the same time, an American patrol plane sighted the same two cruisers streaming oil. Spruance decided that these reports indicated the Japanese had given up their plans for Midway.¹⁵²

After breakfast, Spruance's Chief-of-Staff, Captain Miles Browning, certain that the Japanese were retiring, recommended that he speed up and attack immediately. Spruance waited -- though he knew that he had crippled or sunk four Japanese carriers, he still believed that perhaps a fifth Japanese carrier remained that might delay its attack until Spruance committed his last few planes against other Japanese surface combatants. Furthermore, the weather was bad for flying. Based on this information, he chose to wait until he knew more. Buell refers to Spruance's inability to know this information as the fog of war. Specifically, Spruance experienced ambiguity, delayed action-feedback loops, and high stakes (Table 1, factors 2, 4, 5), even if ever so slightly.¹⁵³

Because Spruance was concerned about the possibility of a fifth Japanese carrier, he conserved his remaining planes just in case. The high stakes associated with potentially losing his carrier force or Midway still existed, and the ambiguity of not having all the information he needed to make a decision, for the first time, seemed to have affected Spruance. Poor scouting reports from Midway continued to compound Spruance's uncertainty about the composition, location, and movement of the Japanese Fleet. Although he had not launched search planes from his own Task Force (on June 5th),

¹⁵¹ Buell, 154.

¹⁵² Buell, 155.

¹⁵³ Buell, 156.

he became increasingly more annoyed that the Midway planes failed to maintain constant contact with the enemy. The Midway planes would locate the Japanese Fleet and then break off, lose the enemy (again), and return to base.¹⁵⁴

By the afternoon of June 5th, the weather and situation were clearing. Spruance finally decided to attack the Japanese even though by the afternoon, he had received no further reports and had no idea where the Japanese were. He could only guess at the location of the enemy. Nevertheless, at 1500, he launched the attack which proved unsuccessful because he had lost the Japanese Fleet again.¹⁵⁵ So, by the end of the day, on June 5th, Spruance was still dealing with the same ambiguity that had plagued him the day before. That evening, he decided to launch his own cruiser float planes the following morning. What he did not know was that the ambiguity of the situation would not change.

Early on the morning of June 6th, the Enterprise's patrol aircraft finally reported two distinct groups of Japanese ships and their composition.¹⁵⁶ Spruance ordered the planes to stay in contact with the enemy until relieved by his cruiser float planes.¹⁵⁷ Then, after receiving an order from Nimitz, Spruance ordered an attack on the Japanese forces using Hornet's bombers.¹⁵⁸ The Hornet bombers reported attacking just one Japanese force.¹⁵⁹ They reported hitting a cruiser, but not sinking it. Enterprise bombers reported many hits on both cruisers, but reported the cruisers would not sink. Hornet launched a third attack.¹⁶⁰

At this point, Spruance experienced the effects of an environment of extreme information ambiguity. Spruance was puzzled and irritated. After three intense attacks, the cruisers still would not sink. What's more, Spruance was still unable to identify what he was attacking. Some aviators reported attacking one battleship and one cruiser, and others reported attacking two cruisers. In reality, his planes had been

¹⁵⁴ Buell, 156.

¹⁵⁵ Buell, 157.

¹⁵⁶ Composed of Japanese battleships, cruisers, and destroyers. No numbers given.

¹⁵⁷ Buell, 159.

¹⁵⁸ Buell, 160.

¹⁵⁹ Composed of one battleship, one cruiser, and two destroyers.

¹⁶⁰ Buell, 160

attacking two cruisers and two destroyers. All of this confusion was produced by the faulty and inaccurate contact reports made by the pilots. At this time, Spruance still thought the enemy ships were in two distinct groups. Clearly, Spruance was experiencing ambiguity, delayed action-feedback loops, and fear of not understanding the situation (Table 1, factors 2, 4, 13). Buell again refers to this as the fog of war.¹⁶¹

In one final attempt to alleviate this environment of extreme information ambiguity, Spruance launched two planes with cameras. Unfortunately, when they returned, the pilots said they were unable to identify the ships because they had forgotten their ship identification cards. Nevertheless, the photos they had taken finally revealed that Spruance's Task Force 16 had been attacking Mogami class cruisers and not battleships. With this final report, early in the evening on June 6th, the ambiguity of the situation gone, his destroyers low on fuel, his aviators exhausted from three days of combat flights, and with his ships getting ever closer to the Japanese land-based bombers on Wake Island, Spruance decided to end the battle. He turned his ships around and headed for home.¹⁶²

Despite whatever fog of war, or extreme information ambiguity he may have felt, Spruance detached himself from the bedlam that surrounded him so that he could continue his planning and coordination of the battle. During the Battle of Midway, Admiral Spruance found himself in many ambiguous information environments. In fact, he clearly experienced friction, ambiguity, time pressure, delayed action-feedback loops, high stakes, and fear of not understanding the situation (Table 1, factors 1, 2, 3, 4, 5, 13). In spite of being exposed to the potentially debilitating effects of all these factors, he consistently demonstrated the ability to acknowledge that such environments existed, and with that, moved on and focused on his orders and mission objectives which were to defend Midway and preserve his fighting force, namely, the American carriers.¹⁶³

¹⁶¹ Buell, 162.

¹⁶² Buell, 163.

¹⁶³ Buell, 151-154.

b. Environments of Extreme Information Ambiguity and the Imperial Japanese Navy

After the Battle of Coral Sea, Admiral Yamamoto and his planners were not terribly upset by the turning back of the Port Moresby invasion. However, the decisions made from that point forward would be affected by the effects of extreme information ambiguity. First, the Japanese believed two American carriers had been sunk during the battle, when in fact only the Lexington had been sunk. The Yorktown returned to Pearl Harbor for quick repairs and returned to sea in time for action at Midway.¹⁶⁴

Second, the Japanese failed to capitalize on two vital intelligence opportunities. One of the failed intelligence gathering attempts would have given the Japanese knowledge of whether or not the American carriers were at Pearl Harbor before beginning their Midway invasion plans. The second failure occurred because Yamamoto was unable to get important information to Nagumo about the American's ongoing preparations on Midway. Because Yamamoto was out to sea on his flagship, Yamato, he refused to break radio silence and collaborate with Nagumo and his other commanders. These intelligence failures were two more strikes against the Japanese, and eliminated any chance they had to alleviate the environment of extreme information ambiguity they faced.

Third, Yamamoto effectively took his main force and much of the rest of the Japanese Fleet out of the fight through the excessive disposition of his fleet.¹⁶⁵ The Japanese failed to concentrate their force even though concentration is one of the longest lasting principles of war.¹⁶⁶ In contrast, the Americans concentrated their fleet northeast of Midway. In the end, Yamamoto was not present where the Japanese Imperial Navy needed him the most, concentrated up north with Nagumo, screening for the carrier strike force. Furthermore, had Yamamoto been with Nagumo, he could have taken command of the battle as well. Yamamoto and his main force, together with Vice Admiral Kondo and his Midway Invasion Force, and Vice Admiral Hosogaya and his Northern (Aleutians)

¹⁶⁴ Spector, 166.

¹⁶⁵ Nagumo to the northeast of Midway, Yamamoto three hundred miles to the West of Midway, Vice Admiral Kondo to the southeast of Midway, and Vice Admiral Hosogaya way to the north in the Aleutians.

¹⁶⁶ Evans and Peattie, 490. Spector, 167.

Force, were all too far away from Nagumo to make a difference in the battle.¹⁶⁷ These second and third issues of radio silence and force disposition were important because they kept the Japanese Fleet from being able to collaborate before and during the battle. For some reason, the Japanese never saw the need to fix these communication issues until it was too late. Improving collaboration would have helped to clear up their intelligence failures as well.

The Japanese never recovered from the ambiguity caused by these three elements: incorrect information about the survival of Yorktown, intelligence failures, and failure to concentrate their forces. Overcoming either of these would have helped to alleviate the ambiguity the Japanese experienced. For instance, if the Imperial Japanese Navy had not imposed a radio silence, they could have overcome their collaborative planning challenges. If Yamamoto had been in Tokyo, as Nimitz was in Hawaii, he would have been able to benefit from collaborative planning. These benefits include sharing ideas and synchronization of assets and their products of shared situational awareness, better information flow, issues raised, and overall, Yamamoto would have reached a fuller understanding of the issues (Table 3, factors 1, 2, 8, 9, 10).¹⁶⁸ Yamamoto could have freely collaborated with all of his commanders at sea. The use of any number of these factors would have more than likely increased his situational awareness to a higher level than he was able to achieve onboard his flagship at sea under the restriction of radio silence. At sea, under the restriction of radio silence, Yamamoto effectively cut himself and his battleship force out of the battle. He was never in a position to help Nagumo at all.

The wide disposition of Japanese forces at the Battle of Midway was one of the leading contributors to the environment of extreme information ambiguity with which Nagumo was forced to cope. Yamamoto had placed Nagumo and his strike force of four carriers to the northwest of Midway. From there, Nagumo launched the Japanese air attacks on Midway Island while he laid in wait for the American Fleet. So, where was the rest of the Japanese Fleet? Yamamoto was three hundred miles to west, Kondo was

¹⁶⁷ Spector, 166-167.

¹⁶⁸ Fuchida, Mitsuo and Okumiya, Masatake, *Midway: the battle that doomed Japan*, (Annapolis: Naval Institute Press, 1955), 239.

hundreds of miles to the southeast, and finally, Hosogaya was entirely out the action up north in the Aleutians. Nagumo was all alone.

As the preceding paragraphs have shown, the Japanese had a lot working against them before the Battle of Midway even began. What follows is a detailed discussion of Admiral Nagumo's experience at the Battle of Midway. The scenario he faced, and the conditions under which he fought, tell the story of how an environment of extreme information ambiguity affected the Imperial Japanese Navy.

It is important to note that the primary mission of the Japanese navy at Midway was to destroy the U.S. Fleet and extend their defensive perimeter to Midway and the Aleutians. After the first wave of Japanese attacks on Midway Island, more and more of Nagumo's assets became tied up attacking Midway and fending off American air attacks from Midway. Nagumo knew he needed to keep a certain number of planes prepared to conduct an immediate strike on the American carriers once they were found. Events however, derailed Nagumo's plan.

Adding to his problems was the way in which he decided to employ his carriers. Instead of launching planes from just two carriers and keeping two carriers in reserve so they could launch a full attack on the American carriers once they were located by Japanese scout planes, he chose to launch several planes from each of his four carriers; thus effectively tying up all of his carriers. Through the use of this tactic, Nagumo gained more speed with respect to launching attacks on Midway, but it left him incapable of immediate launch on the enemy carriers.¹⁶⁹ Nagumo's choice to use all four carriers to attack Midway would be a cause of great stress for him later.

By about 0740-0800 on the 4th of June, as Nagumo was fully involved in the Battle of Midway, he had a great deal of information ambiguity to deal with.¹⁷⁰ At this time, in the unfolding scenario, Nagumo needed to decide on his next move, and five major challenges weighed heavily on his thoughts.¹⁷¹ First, the Japanese incurred a loss

¹⁶⁹ Fuchida and Okumiya, 236-237.

¹⁷⁰ 0728-0740 is the time most standard accounts report 0728-0740 as the time when Nagumo received the first report back from the scout plane, Tone4. In a recent argument by Dallas Woodbury Isom, he forwards the argument that Nagumo did not receive his first report from Tone4 until 0800. Regardless, in between 0728-0830, Nagumo was under almost constant attack by Midway based planes.

of over sixty percent of their planes during the first attack on Midway.¹⁷² Second, the Japanese strike commander, returning from the first Midway strike, radioed that a second strike against Midway would be necessary. Third, at the time of that communication, Nagumo's carriers were fending off continued attacks by American planes from Midway, which told him that Midway was still dangerous. Fourth, Nagumo faced the question: "What should he do?" He expected the first attack on Midway Island to be sufficient, so he had armed all his planes for an attack on the American carrier strike force. Fifth, should he now rearm his planes again, a process that would cause over an hour delay, for another attack on Midway? After all, he was still waiting for information from his scouting planes, out for over two hours, which were to inform him of the location of the American carriers.¹⁷³ Preparing his strike force for another land attack would be a grave mistake if there were enemy carriers near by.

He decided that an hour's delay to rearm the planes would be safe enough considering that he had not heard any reports of American carriers being in the area. At 0715 on June 4th, Nagumo gave the order to rearm the planes for a second attack on Midway.¹⁷⁴ At 0728 one of Nagumo's scout planes from the cruiser Tone, which earlier that morning had been ten minutes late in launching, reported back news of ten enemy ships, but not what kind of ships. At that time, Nagumo ordered a halt to the rearming of the planes.

A little while later, Tone's scout plane reported five cruisers and five destroyers, but said nothing of the American carriers. Ten minutes later, a third and final dispatch reported sighting one American carrier. Upon the arrival of this report, Rear Admiral Yamaguchi Tamon, commander of the Japanese carriers Soryu and the Hiryu of Carrier Division Two, signaled to Nagumo's flagship: "Consider it advisable to launch

¹⁷¹ It will be shown later in this section that at this time Nagumo was experiencing the following characteristics of an environment of extreme information ambiguity: friction, ambiguity, time pressure, and high stakes (Table 1, factors 1, 2, 3, 5). These characteristics may have affected his ability to think and he may have experienced a fear of making bad decisions (Table 1, factors 10, 13).

¹⁷² Paul S. Dull, *A Battle History of the Imperial Japanese Navy, 1941-1945*, (Annapolis: United States Naval Institute, 1978), 144.

¹⁷³ Spector, 171.

¹⁷⁴ Spector, 171.

attack force immediately.”¹⁷⁵ Yamaguchi had three dozen dive-bombers ready and Nagumo’s carriers, Kaga and Akagi, had several torpedo planes ready. Amongst all of this information, Nagumo’s senses must have been overloaded. Nagumo made the decision to wait, reorganize a coordinated attack, and prepare his planes for a strike against the American carriers.¹⁷⁶

By this point in the battle, shortly after 0800, June 4th, Nagumo has reversed a decision, halted a decision, and finally, reversed the same decision again. Nagumo suffered from friction, ambiguity, time pressure, and high stakes (Table 1, factors 1, 2, 3, 5). These characteristics very often affect a decision maker’s ability to think, and the decision maker may experience a fear of not understanding a situation and a fear of making bad decisions (Table 1, factors 10, 13). Table 7 outlines these factors and the situations which caused them.

¹⁷⁵ Spector, 172. Fuchida and Okumiya, 150.

¹⁷⁶ Spector, 172. Fuchida and Okumiya, 150.

Table 7. Factors that Contributed to Nagumo’s Environment of Extreme Information Ambiguity

#	Factor	Situation causing environment of extreme information ambiguity factors for Nagumo
1	Friction	Enemy attacks.
		Lack of coordination with Yamamoto’s Main Body and Kondo’s Invasion Convoy to the south and Hosogaya’s Northern Area Force (Aleutian) and Takasu’s Screening Force (Aleutian) to the north because of disposition and fleet radio silence.
		Unclear or complicated plan based on the number of variables he was trying to consider at that time.
2	Ambiguity	Ambiguous Data: His scout planes were not feeding him data on the location and disposition of the American forces.
		The scout plane Tone had taken off late.
		Yamamoto was not able to feed him at least one critical intelligence report and guidance because of radio silence.
		Correlation of data: The plane strike commander was recommending a second strike on Midway Island.
		Correlation of data: Rear Admiral Yamaguchi was recommending immediate attack on the American Fleet.
		Correlation of data: Only the scout plane Tone4 was sending back data, and it was in small sporadic pieces.
13	Fear	Fear of making bad decisions: If he decides poorly, many men and ships will be lost, and he may lose the battle.
		Fear of not understanding the situation: It is difficult to completely understand everything that is happening. He may be misinterpreting the situation.
3	Time Pressure	Nagumo must make a decision and act quickly. He does not know how many carriers the Americans have nor when the American planes will be able to attack.
5	High Stakes	If he decides correctly, he saves the carrier strike force, if he decides incorrectly, he dooms them.

After all that had happened, and was still occurring shortly before 0800, *friction* was clearly one of the factors most affecting Nagumo. Although the attacks had not yet started from the American carriers, he was being hit by nearly constant attacks from the Midway-based American planes.¹⁷⁷ A large part of the friction he felt stemmed from his inability to coordinate and correlate data with other Japanese forces.¹⁷⁸ Lastly, based on everything discussed so far, it seems obvious that the number of variables and the complexity involved in the situation facing him became difficult to manage: (1) Midway plane attacks, (2) lack of scouting reports, and (3) multiple suggestions from his subordinates.

Nagumo was also affected by *ambiguity*. Nagumo had a lot of information, but it was not helping him. First, his information was not helping him because he was under constant attack by the enemy. Second, Nagumo struggled because it was difficult to differentiate between the inaccurate or incomplete data he was receiving from his reconnaissance planes. Nagumo either had no data at all (the two plus hours Nagumo's planes were away and did not see anything) or the data that Nagumo was receiving was incomplete (when Tone's scout plane finally did find the American forces, it took the pilot a long time (almost one hour) to fully discern what he had spotted.).

During a battle, *ambiguity* (correlation of data) may lead a decision maker to several different possible threat assessments. During the Battle of Midway, Nagumo was correlating battle damage data and suggested courses of action from his subordinates. For instance, the Midway plane strike commander recommended a second strike on Midway. Rear Admiral Yamaguchi was recommending that Nagumo launch an immediate attack. Finally, not only was it difficult to correlate the inputs and suggestions from his subordinates, but at times, there just was not enough useful data coming in (from scout planes and the complete lack of orders from Yamamoto).¹⁷⁹

¹⁷⁷ Spector, 171.

¹⁷⁸ The reason for this was the disposition of the Japanese fleet and because the Japanese fleet was in radio silence.¹⁷⁸

¹⁷⁹ Spector, 171-172.

Time pressure forced Nagumo to make decisions and take action when he did not feel he had all the information he needed. This was especially evident while he was waiting for the rearming of the planes that would fly the second attack against Midway and while waiting for reports back from his scout planes.¹⁸⁰

Nagumo, more than any other Japanese commander involved in the battle, had to make *high stakes* life and death decisions that would impact his men, equipment, and even the future of Japan. In the case of arming his planes to attack Midway vice the American carriers, if he decided correctly, he would save his carrier strike force and possibly go on to win an important battle. If he did not, he may lose his carriers, kill a lot of his men, and lose the battle.

It seems obvious Nagumo also experienced at least two reactions to his environment of extreme information ambiguity: a *fear of making bad decisions and the fear of not understanding the situation*. He had many variables to consider and may have felt incapable of completely understanding the whole situation.¹⁸¹

In conclusion, Nagumo found himself in an environment of extreme information ambiguity from the onset of the battle all the way through to the end. Tragically for the Japanese, he never found a way to reduce it enough to be able to function and make the decisions necessary to save his force from destruction. Nevertheless, it is important to note, Nagumo is not completely to blame for how poorly the Japanese performed during the Battle of Midway. The information ambiguity he faced was due in large part to the Japanese navy's inability to develop effective collaborative planning and common training. From these deficiencies came intelligence failures and a lack of a training program to replace aviators lost in battle. Lastly, the disposition and dispersion of their forces, and Yamamoto's location at sea also made it difficult for them to plan collaboratively.

¹⁸⁰ Spector, 171.

¹⁸¹ Fuchida, 237.

2. What Did Common Training Mean to the United States Navy and the Imperial Japanese Navy?

a. *Common Training and the United States Navy*

Decision makers like Spruance trained their whole navy careers for fleet engagements like the Battle of Midway. This research will show that men like Nimitz, and Spruance do not just emerge by good luck. Rather, they are trained and promoted through the ranks in common ways throughout their careers. Referring to Table 2, which presents the characteristics and products of receiving common training, decision makers like these share similar skills, similar training and education, and the result of all that common training is a certain harmony, or focus and direction, during operations (Table 2, factors 1, 8).

Common training meant a great deal to the United States Navy around the turn of the twentieth century. Although the Japanese, entering into the war, probably had a better track record for common training, the Americans by no means neglected it altogether. (The Japanese had their problems as well.) On many occasions, the Americans relied on common training as a means of reducing the friction that inevitably arises in environments of extreme information ambiguity. Nevertheless, the training and proficiency of the United States Navy was not without problems. What follows are several examples of what they did right and, equally important, what they did wrong.

With respect to officer education, officers that aspired to “important” commands attended the Naval Academy, at Annapolis. In fact, almost all of the top Naval commanders of World War II attended the Naval Academy between 1901 and 1905. Spector writes that the leaders of the Academy attempted to stimulate the intellect as much as mold character.¹⁸² At first glance, one might conclude that this meant the American naval leaders of that era were not receiving the kind of similar skills, training, and education that promoted quality common training. They learned their general education topics, but they also left Annapolis with a lot of character, guts, presence, personality, and qualities of mind. Midshipmen were expected to learn the “qualities of reliability, leadership, integrity, good judgment, loyalty to service and to others.”¹⁸³ The

¹⁸² Spector, 18.

¹⁸³ *Reminiscences of Admiral Thomas C. Hart*, U.S. Naval Historical Foundation, Oral History Collection, 65, 25-46. Rosenberg, Arleigh Burke, pg. 507.

Naval officers left with ideas about warfare and “sea power” developed by Alfred Thayer Mahan and his collaborators at the Naval War College before the turn of the century.¹⁸⁴

Looking to the leadership of some of the decision makers who served during the time of the Battle of Midway, one sees the Navy’s equivalent of mission-oriented command (Table 2, factor 3). Buell writes that Spruance received his written orders for the Midway operation on the evening of May 27, 1942, and adds that all operation orders during that time were short and to the point, which reflected the leadership styles of Fleet Admiral King and Admiral Nimitz. Like mission-oriented command, the idea was to tell the subordinate commanders what was to be done, give them the necessary resources, and make sure they knew that it was their responsibility to get the job done. Fleet Admiral King was especially adamant that his commanders use this leadership style. Spruance believed that, if he was responsible for accomplishing a mission, then it should be he who developed the necessary plans. Furthermore, the role of his superior should be to establish the objective and perhaps suggest, not direct, how it should be carried out.¹⁸⁵ Spruance, after all, had prepared his whole Navy career for a genuine fleet action. He needed only to be given the objective and he knew what to do.¹⁸⁶

For instance, upon receiving his orders from Nimitz to take over Task Force 16, Spruance no doubt appreciated the danger in the forthcoming battle, but “by his nature he would not allow his imagination to magnify the threat and paralyze his thinking.”¹⁸⁷ Before receiving this independent command of the task force, Spruance had had command six times previously. He had prepared for fleet action and decisive battle at sea for many years. Being a professional officer, commanding ships in battle was his life’s profession. The common training he received throughout his career, starting with the Naval Academy, had prepared him for decision making in environments of extreme information ambiguity.¹⁸⁸

¹⁸⁴ Spector, 18-19.

¹⁸⁵ Buell, 136.

¹⁸⁶ Buell, 138.

¹⁸⁷ Buell, 138.

¹⁸⁸ Buell, 138.

One area where Spruance's training was still in development was in his understanding of carrier aviation. Normally, command of a carrier task force required a flag officer who was a naval aviation expert. The man he was replacing, Admiral Bill Halsey, had served eight consecutive years in carrier aviation. Spruance, on the other hand, had cut his teeth in the cruiser navy. Command of a carrier task force would be all new to him in many respects. Still, even though Spruance did not have all of the same aviation training and education that Halsey had, he had been educated at the Naval Academy like Halsey, and he had access to the same doctrine. By this point in his career he had already commanded six different ships and in September 1941 (just nine months before the Battle of Midway), he commanded Cruiser Division Five. In addition to his command experience, Spruance used his skills as a planner to offset any lack of carrier aviation experience he may have had.¹⁸⁹ In the end, Nimitz supported Halsey's strong endorsement of Spruance although, despite Halsey's endorsement, career aviators were less confident about the decision -- they knew only that Spruance was not an aviator. "The aviators were uneasy going into the battle of their lives being led by a stranger, a shawdowy figure who had been riding about in the cruisers." Later on, during the Battle of Midway, the aviators would find themselves in a situation of collaboration with Spruance on June 5th, 1942, and he did not disappoint them. Spruance overruled an order given to the aviator by Spruance's Chief of Staff.¹⁹⁰

Buell's biography of Admiral Spruance provides invaluable examples of how common training prior to encountering an environment of extreme information ambiguity proves its worth many times over. One such example shows how Spruance utilized inactive time at sea to build the staff's operational skills by administering theoretical operational problems for them solve, problems similar to those used at the

¹⁸⁹ Spruance often demonstrated collaborative planning characteristics such as sharing ideas, synchronization of assets, and face-to-face meetings. See next section for What Collaborative Planning Meant to the United States Navy.

¹⁹⁰ Buell, chronology xxxiv-xxxv, 135, 157. There was an occasion on June 5th when Spruance's Chief of Staff had prepared an attack plan against the Japanese that all the pilots thought was a suicide mission. Wade McClusky, the plane commander got into a heated argument with the Chief of Staff, Miles Browning. Eventually, Spruance intervened and ruled in favor of the aviators. Spruance said, "I will do what you pilots want."

United States Naval War College.¹⁹¹ Here the commander was reinforcing the factor of similar skills by letting his staff mentally rehearse possible scenarios on what their responses might be.

Common training was always important to the United States Navy. During the war in the Pacific, both the Japanese and the Americans lost many aviators. The loss of so many pilots proved to be devastating for the Japanese because they lacked a training program that adequately replaced the lost pilots – the Japanese desired pilots that were perfectly trained. The Americans maintained an ample supply of pilots by emphasizing competence rather than excellence.¹⁹² Like the Japanese, the Americans also sustained heavy pilot casualties, but “because of a far more flexible training system, the U.S. Navy could absorb these losses and still continue to function effectively.”¹⁹³ As a result, the Japanese found themselves running out of pilots whereas the Americans always found themselves in fresh supply – all because of their training program.¹⁹⁴

However, on several occasions Spruance’s staff, aviators, and operators demonstrated behavior and performance characteristic of poor common training. For instance, the first American attack on June 4th, 1942, against Nagumo’s carrier strike force was considered to be “piecemeal and uncoordinated.”¹⁹⁵ In the first wave of attacks launched by the Hornet-Enterprise¹⁹⁶ carrier group, the faster and more maneuverable fighters had failed to protect the slow moving torpedo planes from the devastating fire of the Japanese combat air patrol¹⁹⁷; consequently, all of the torpedo planes were shot

¹⁹¹ Buell, 128. When Spruance took over for Halsey, he inherited Halsey’s staff. This was thought to be the best decision since Halsey’s staff had spent the whole first part of the war training and getting experience in flight operations and combat; along with Halsey’s staff came his Chief of Staff, Captain Miles Browning. The only person Spruance would bring over from his old staff was his flag lieutenant. Spruance would learn that his newly inherited staff was not as savvy as he would have hoped.

¹⁹² Evans and Peattie, 503.

¹⁹³ Evans and Peattie, 501.

¹⁹⁴ Fuchida, 106, 243.

¹⁹⁵ Buell, 150.

¹⁹⁶ The USS Hornet and USS Enterprise (Task Force 16) were the two carriers Spruance was in charge of. His flagship was the Enterprise. Admiral Fletcher was on the USS Yorktown (Task Force 17) and was in tactical command of Task Force 16 and Task Force 17.

¹⁹⁷ The combat air patrol, or CAP, has the mission of defending the ship/carrier against air attack.

down. Another group of planes, the dive-bombers, never managed to find the target and had to return to the ship because they were low on fuel.¹⁹⁸

Although there exists convincing evidence that American aviators were not as well trained as their Japanese counterparts (especially in first two years of the war), there was one aspect of American carrier aviation that was clearly superior to that of the Japanese. Dive-bombing was the one aspect of aviation where the United States, during World War II, held a decisive advantage over Japanese aviation. The Americans developed the concept for dive-bombing, and not surprisingly, had arguably better dive-bombing planes, pilots, and tactics. In the years after 1930, military aircraft began to be drastically improved which helped to further evolve the concept of dive-bombing. For some reason, the Army Air Corp did not put emphasis on dive-bombing, but the United States “Navy had taken it up as a distinct policy.”¹⁹⁹

During World War II, from 1941-1943, the Americans used the Douglas SDB Dauntless. “The Dauntless was older and slower” than its Japanese counterpart, but the SBD was far more impervious to battle damage, and its flying qualities suited it to its role perfectly. “In particular - as Dauntless pilots testified - it was very steady in a dive.”²⁰⁰ Lastly, in what is probably one of the most famous examples of dive-bombing during the war in the Pacific, Lieutenant Commander Wade McClusky led the perfectly executed attack that destroyed three Japanese carriers during the battle.²⁰¹ Luck that day was on the side of the Yorktown planes – together with some of the remaining Enterprise bombers, they were able to make one last attack before returning to the American carriers which left three of the four Japanese carriers burning. Only one Japanese carrier remained.²⁰²

There were other instances of staff failures in addition to the “Point Option” debacle. Yet again, on the first day of the Battle of Midway, Spruance was

¹⁹⁸ This was not entirely the fault of the Spruance’s pilots because Nagumo had turned his strike force to the northeast in order to increase the distance between his force and that of Spruance. Therefore, Nagumo’s carriers were not exactly where the pilots expected them to be.

¹⁹⁹ <http://www.microworks.net/pacific/battles/midway.htm>

²⁰⁰ <http://www.sunwest-emb.com/wiseman/dauntless.htm>

²⁰¹ <http://www.microworks.net/pacific/battles/midway.htm>

²⁰² Buell, 150.

waiting for a scout plane report before he launched a second and final air attack for the day. When the reports came in, and when Spruance was satisfied with his information, he ordered an air attack at 1445 on June 4th. It was at this point, late in day, that Spruance's staff began to fall apart: they sent the wrong signal to the other ships in the task force, they sent the signals late, and ultimately, at the time they finally started launching aircraft for the attack (1530), the carrier Hornet still had not received an order to attack. At 1539, Hornet received an order to attack, and was finally able to launch by 1605. Her planes were thirty-five minutes behind those of Enterprise. This was to be the second time in one day that the two carriers had failed to launch a coordinated attack against the enemy.²⁰³

The staff had all but ceased to function. Buell indicated that this was the staff's first real test during sustained combat against powerful enemy forces. Furthermore, the staff's earlier engagements (island raids) had been against weak island defenses. Those operations had not prepared them for the difficulty of sustained fleet action. They had succeeded in the past in spite of their deficiencies. However, as the Midway battle wore on, they discovered that they were unable to deal with the "need for disciplined planning and the coordination of complex task force operations."²⁰⁴ The cause of Spruance's staff's poor ability to cope under the strain of actual combat was insufficient vigorous training and rehearsal before battle. Moreover, a staff or a force must train on the "right" areas. The staff of Task Force 16 had real world training doing island raids. However, when the time came for intense battle against a relentless enemy, their previous training was not sufficient.

The outcome of the Battle of Midway was a victory for the United States. Despite the obvious adverse effects of an environment of extreme information ambiguity had on the United States Navy, there is no denying that common training played a huge role in helping the Navy succeed. Spruance, even though he spent his career on cruisers and non-carrier type platforms, showed that similar training, education, and doctrine appear to sufficient. Furthermore, the superior training, tactics, and equipment of the American dive bombers carried the day on the 4th of June, 1942, by destroying three Japanese carriers in a very short amount of time. Of note, the element of time played a

²⁰³ Buell, 153.

²⁰⁴ Buell, 153.

role on both sides during the Battle of Midway. McClusky spotted the wake of the Japanese destroyer (which led him to the Japanese carriers) at almost the exact time he was going to turn around because of low fuel -- he was literally out of time. That little piece of time benefited McClusky and the American effort, but it was detrimental to Nagumo and the Japanese. There was an element of luck on the side of the Americans that deserves mentioning. One may also argue that leadership, and intelligence played a significant role as well. In contrast to the Battle of Trafalgar, the Battle of Midway has shown that there is more to overcoming environments of information ambiguity than just common training and collaborative planning .

b. Common Training and the Imperial Japanese Navy

The training and preparation strategy for the Japan Combined Fleet for World War II was “quality rather than quantity.” They had prepared for a long time to defeat a numerically superior fleet. However, at Midway the opposite happened -- a stronger Japanese fleet was defeated by a significantly weaker American fleet.²⁰⁵

The Japanese naval strategists focused on three factors to ensure the success of its naval forces against the United States in World War II: (1) the superior toughness, morale, and fighting spirit of their servicemen, (2) constant drill and training, and (3) advances in new and superior weapons.²⁰⁶ One can clearly see from factors (1) and (2) that common training played a big role in ensuring the Japanese Navy was prepared to deal with whatever situation they might face in battle.

The high-ranking Japanese naval officers of the World War II era, like their American counterparts, had similar training, education, and doctrine. For instance, Fuchida, who entered the Naval Academy in 1921, reported that the officers at that time were already being taught that the United States was the next potential enemy (The Orange Plan also dates from the early 1920s). Second, most of the up and coming officers in the navy shared in the experience of serving as Naval Attachés in Washington. Because of this, almost all high ranking officers during the time before the attack on Pearl Harbor were well versed in the capabilities of the United States Navy.²⁰⁷

²⁰⁵ Fuchida and Okumiya, xiii.

²⁰⁶ Spector, 45.

²⁰⁷ Fuchida and Okumiya, 11.

Buell states that Spruance's staff became increasingly more "confused and disoriented" as the battle progressed because the staff lacked the capacity for the disciplined planning and coordination of complex task force operations.²⁰⁸ This does not seem to have been the case with Nagumo's staff. Whereas Spruance inherited his staff from Admiral Halsey, and that staff lacked sustained combat experience, Nagumo's staff had been with him for a long time, had spent months at sea (sea experience), and they had even conducted the attack on Pearl Harbor with Nagumo. Research shows that his staff was not afraid to make suggestions to Nagumo or to the Combined staff of Yamamoto, even if their suggestions were sometimes ignored.²⁰⁹

Nagumo's Chief-of-Staff was Rear Admiral Kusaka Ryunosuke who was also a graduate of the Naval Academy. Kusaka was a seasoned Naval officer and was not only Nagumo's Chief-of-Staff for the attack on Hawaii, December 7, 1941, but also played a major role in planning that operation and the air operation on Midway.²¹⁰ A diligent and forward thinking officer, during the planning for Midway, Kusaka urged Yamato to relay all information to Akagi for the duration of the Midway operation. As mentioned earlier, the Japanese carriers did not have antennas sufficient to reliably receive all message traffic that would be coming from Tokyo. However, the relay from Yamato to Akagi (or to any other ship) never happened because Yamamoto refused to break radio silence. In fact, it was Yamamoto's senior staff officer, Kameto Kuroshima that convinced Yamamoto that radio silence should not be broken and that Nagumo was probably receiving the same messages they were.²¹¹

The previous example demonstrates how well thought ideas from a well-trained staff can sometimes be ignored or overridden, and often with dire consequences. It will be shown later in the section on collaborative planning and the Imperial Japanese Navy, how Nagumo, his staff, and his ability to alleviate his environment of extreme

²⁰⁸ Buell, 153.

²⁰⁹ Evans and Peattie, 479.

²¹⁰ Evans and Peattie, 528.

²¹¹ Dallas Woodbury Isom, *The Battle of Midway: Why the Japanese Lost*, (Naval War College Review, Summer 2000, 21.

information ambiguity was drastically reduced due to the information void created by Yamamoto's unwillingness to get Nagumo the information he desperately needed.

With respect to air operations, Commander Genda Minoru was Nagumo's air officer of the First Air Fleet. Commander Genda Minoru was also a graduate of the Naval Academy. Once, when requested by Yamamoto to submit ideas for the attack on Pearl Harbor, Genda returned two weeks later with a paper which asserted recommendations and identified potential problems – essentially it was a call for maximum air power. Not by coincidence, Genda was soon after handpicked by Yamamoto to serve as the chief air officer of Nagumo's staff -- he played a major role in the development of the tactical plans for the attack on Pearl Harbor.²¹²

This description of Genda serves to highlight yet another capably trained element of Nagumo's staff. One example of Genda's capability and of his ability to lead and train his officers and operators is seen in how well the Japanese conducted air operations during the Midway operation. In contrast to the Spruance's staff's inability to launch coordinated air strikes involving just two carriers on June 4th, 1942, Nagumo's staff and the operators demonstrated flawlessly launched aircraft from four carriers at the same time.²¹³ Furthermore, when the Japanese recovered planes: "With the veteran fliers we had at this time, speedy recovery operations on board the carriers even under stringent battle conditions were little more than child's play."²¹⁴

Any military unit, navy or otherwise, requires vigorous training before actual battle. The result is a force that is more prepared to execute its mission. The Japanese were no exception. The Japanese utilized many techniques to offset their quantitative disadvantages. For example, tactical concepts were ingrained throughout the fleet through a means of "hard and unremitting training." Relentless training led to a confident and well-trained Japanese force.²¹⁵

²¹²<<http://www.microworks.net/pacific/special/history1.htm>>

²¹³ Fuchida, 151.

²¹⁴ Fuchida, 164.

²¹⁵ Fuchida and Okumiya, 12.

The Japanese Navy, like the U.S. Navy, also saw value in war gaming. For the operation against Midway, the staff officers and commanders involved in the planning and execution of the mission, on several occasions, got together for the purpose of conducting war games as a means of battle preparation. This training was generally held onboard the flagship Yamato and was directed by Yamamoto's Chief of Staff, Rear Admiral Ugaki.²¹⁶ In spite of the apparent benefits of this type of training, there were problems with how the Japanese carried it out.

While conducting the war games, the Japanese (referees and Yamamoto's Chief of Staff) cheated themselves when it came to reporting the results of the mock battles. For example, in one scenario nine enemy hits on Japanese ships were scored and two Japanese carriers sunk. At first, the results were changed to three hits scored and one carrier sunk. The final results reported no Japanese carriers sunk. This "cheating" was done to ensure the whole Japanese Navy would be under the *impression* they were well trained and prepared for battle. It is not clear from the research conducted just how much the Japanese tampered with the results of the war games.²¹⁷ Fuchida described this as "thoughtless and stupid arrogance."²¹⁸

Another area worth serious scrutiny is the common training of the Japanese aviators and lack of a program or process to replace them once lost in combat.²¹⁹ The Japanese pilots, like the planes they flew, were some of the best trained and most experienced in the world. Many of the pilots had several years of experience flying missions over China. By 1941, some of these pilots had as many as 300 hours of experience flying their planes, while those who flew the Pearl Harbor mission averaged nearly 800 hours each.²²⁰ In this case, one can clearly see that common training prevailed

²¹⁶ Fuchida and Okumiya, 95.

²¹⁷ Spector, 166.

²¹⁸ Fuchida and Okumiya, 247.

²¹⁹ Fuchida and Okumiya, 242-243.

²²⁰ *Marder, Old Friends, New Enemies*, 305.

with this one batch of pilots. However, there was a problem. The main deficiency in the Japanese aviation program was the lack of a system for producing replacements for the experienced pilots once they were lost in battle. This would prove to be a serious weakness later in the war.²²¹

For instance, in the case of Carrier Division Five flagship Zuikaku, this carrier escaped physical damage during the Battle of Coral Sea in May 1942. However, because of the severe loss of pilots in the battle and because of the subsequent lack of replacement pilots, she would not be available for the Midway operation in June.²²²

Upon their entrance into the Battle of Midway, Japanese commanders such as Yamamoto and Nagumo believed their force was more than sufficiently trained and prepared for battle against the navy. In this case, they believed they had the quality and quantity advantage. In short, they believed superior tactics and their superbly trained (commonly trained) pilots and sailors would carry the day no matter what. Unfortunately, although their training techniques served to produce an extremely capable force, it was the few critical deficiencies that undermine many of their efforts.

3. What Did Collaborative Planning Mean to the United States Navy and the Imperial Japanese Navy?

a. Collaborative Planning and the United States Navy

Collaborative planning was essential for the efficient operation and success of the United States Navy during the Battle of Midway. Some methods used to facilitate collaborative planning leading up to and during the Battle of Midway include: face-to-face exchanges, flashing lights, Morse code, radio, paper correspondence, and horn blasts.

Evidence of collaborative planning by the US Navy begins with Admiral Nimitz's preparation for the attack on Midway. Despite a very busy schedule, the Admiral flew out to the Midway Atoll in early May 1942 in order to ensure his two commanders there were fully informed and prepared for the ensuing engagement with the Japanese. The purpose of his visit was twofold: Nimitz inspected all physical aspects of

²²¹ Spector, 47.

²²² Fuchida and Okumiya, 106. A better common training program for replacement pilots would have meant Zuikaku being ready for Midway. More carriers for the Battle of Midway would have reduced Yamamoto and Nagumo's environment of extreme ambiguity.

the defenses of this American outpost, and most importantly, he collaborated with Midway's two commanders, Commander Cyril Simard and Lieutenant Colonel Harold Shannon, USMC, commander of the ground forces. Nimitz asked his subordinate commanders if they had what they needed and if they needed anything else. Nimitz ensured he had a good two-way dialogue between himself and his commanders. Nimitz's visits to Midway demonstrated the following characteristics of collaborative planning: Sharing ideas, synchronization of assets, and face-to-face meetings. Those characteristics yielded the following products: shared situational awareness, improved information flow/issues being raised, and participants reaching a fuller understanding of the issues.

On May 26th, Halsey returned to Pearl Harbor with his twenty-one ship task force after six long months at sea. While at sea, possibly due to stress, he developed dermatitis and would not be able to return to sea for the upcoming Battle of Midway.²²³ Halsey was relieved by Spruance, and one might think this would be cause for Spruance to be concerned. He was not. Spruance and Halsey had so often collaborated about what they both would do, should Spruance need to take command, that when Halsey fell ill with this torturing skin rash, the two did not have to say anything. They were already prepared for what was to come next.²²⁴

On May 27th, 1942, after a full morning attending meetings and visiting Enterprise in order to decorate some of her pilots, Nimitz received word that Admiral Fletcher's Task Force 17 had arrived with a badly damaged Yorktown. Nimitz was again down in the trenches (in the dry dock) with his subordinate commanders, ship engineers, and workers alike, inspecting the damaged carrier, making assessments, and letting all involved know that the damaged ship was to be back in service in three days, not ninety as was previously estimated. The importance of face-to-face meetings as a form of collaborative planning cannot be overemphasized. In this case, time was of the essence,

²²³ Potter, E.B., Nimitz, Naval Institute Press, 1976, pg. 84.

²²⁴ Buell, 135.

and Nimitz used the following characteristics of collaboration: Sharing of ideas and face-to-face meetings which again yield the following by-products: flow of information, issues raised, brainstorming, and, in the end, a fuller understanding of the challenges that were ahead of them.²²⁵

Later in the day, on May 27th, Admiral Nimitz met two more times with his admirals to discuss upcoming plans.²²⁶ During the evening meeting on the same day, he met with the staffs of Task Forces 16 and 17 to hammer out the details for the defense of Midway. This group was called the Council of War and it was one way the admirals and staffs involved in the preparations for the Midway operations collaborated.²²⁷ This meeting involved the commanders of Task Force 16 and 17 and their staffs' operations' officers. All key parties were involved.

Face-to-face meetings were not the only way to convey orders during World War II. Other methods such as written correspondence and written orders were a common way in which these leaders could dispatch direction and receive feedback. Often times, these messages were then transmitted via flashing light (Morse code) or encrypted radio communications. For example, before the battle, Nimitz used letters to convey orders to Spruance and Fletcher.²²⁸ Later on, Spruance drafted orders on paper and dispatched them to his ships via Morse code and flashing lights.²²⁹

In spite of the successful ways in which the leaders of the Navy collaboratively planned leading up to and during the battle, a closer look at the carrier staff that Spruance inherited from Halsey also provides an example of a group with some collaborative planning deficiencies.

By the end of the first day of the Battle of Midway, as mentioned earlier, Spruance learned just how poorly his staff functioned under the full pressure of sustained fleet action.²³⁰ To him it was just a normal day of combat on the high seas, but to his staff

²²⁵ Potter, 85.

²²⁶ Potter, 86.

²²⁷ Buell, 143.

²²⁸ Buell, 137

²²⁹ Buell, 141

²³⁰ Reference the section on what common training meant to the United States Navy.

it was much different. Spruance's staff, especially his Chief of Staff, had collapsed. They became confused and disoriented and simply could not deal with "the need for disciplined planning and the coordination of complex task force operations."²³¹

Months of work, and many new faces, were required to resolve the deficiencies that had paralyzed the staff on June 4th, 1942.²³² Spruance's staff was overcome by their environment of extreme information ambiguity. They failed to share ideas with each other and with the other ships in Task Forces 16 and 17. Furthermore, the amount of time it took to launch a coordinated air strike (it did not end up being coordinated at all) demonstrates how they failed to synchronize fleet assets. Consequently, Spruance's staff was not able to benefit from the usual products of collaborative planning.

With the exception of the deficiencies in the collaborative planning skills demonstrated by Spruance's battle staff, it is clear the Americans demonstrated the ability to effectively conduct collaborative planning, in preparation for, and during the Battle of Midway.

b. Collaborative Planning and the Imperial Japanese Navy

Similar to the preparations conducted for Pearl Harbor, there were extensive preparations and planning by the Japanese for their Midway operation. All planning operations were conducted on the flagship Yamato and the Commander-in-Chief Yamamoto which was anchored with a battleship group at the wartime stand-by anchorage at the Island of Hashirajima. Through the use of underwater cables, running from the flagship to the shore, Yamamoto maintained constant communication with Tokyo. However, this connection was lost once Yamamoto and the rest of the fleet eventually departed for sea enroute to Midway in May of 1942.²³³ The Japanese navy attempted collaborative planning, but ultimately chose courses of action that almost completely prohibited any type of efficient and productive collaborative planning between Yamamoto and the rest of his subordinate commanders, namely, Vice Admiral Nagumo. Tragically for the Japanese, during the planning phases of the Midway

²³¹ Buell, 153.

²³² Spector, 177.

²³³ Fuchida and Okumiya, 1.

operation, on many occasions various admirals and their staff officers made recommendations for ways to fix nearly all (future) failures that eventually doomed the Japanese to defeat at the Battle of Midway. For example, specific recommendations were made on how to reorganize the fleet to allow for better communications between Yamamoto and the carrier strike force. It was decided that current disposition plan for the ships acceptable.²³⁴

As previously noted, all preparations for the Midway operation were made onboard the Combined Fleet flagship, Yamato, by Admiral Yamamoto and his staff. Telephone cable linking the flagship with the shore was incessantly busy with a constant stream of messages as Yamamoto's Fleet Headquarters maintained close contact and coordination with the Naval General Staff in Tokyo. In addition, through the same method, they also collaborated with the Kure Naval Base for ship repairs, maintenance, and supply.²³⁵

Another similarity drawn from the planning of the Japanese attack on Pearl Harbor, and the attack on Midway, concerned the secrecy that surrounded the planning of the battle. What is significant is that many key admirals who would be involved in the fight, like Vice Admiral Nagumo and Vice Admiral Kondo, were left out of the planning altogether. Furthermore, once let in, their suggestions for improvement were disregarded. The plan was already set. Nagumo and Kondo were never consulted regarding the Midway operation until the end of April 1942.²³⁶ This would be the first of many examples of where the collaborative planning of the Japanese fell short.

Another example of ineffective collaborative planning occurred at the conclusion of the wargames onboard Yamato on May 4th. A few days were set aside for study and briefing discussions about the upcoming operation. A variety of changes or alterations were proposed, but these suggestions basically went no where. For instance, there were several recommendations from Vice Admiral Kondo on down the chain of

²³⁴ Fuchida and Okumiya, 91.

²³⁵ Fuchida and Okumiya, 91.

²³⁶ Fuchida and Okumiya, 91.

command that the operation should be postponed in order to allow more time for preparation. These suggestions were briefly considered and then discarded. In this case, collaborative planning occurred; however, the recommendations, although sound, fell on deaf ears.²³⁷

In another separate attempt to share ideas with the Yamamoto staff (during the conferences held onboard Yamato before the war games May 1-4), Commander Genda and other officers from Nagumo's staff made recommendations to reorganize the fleets to place more emphasis on being carrier centric rather than surface fire power centric (i.e., battleship centric). Specifically, Rear Admiral Yamaguchi suggested organizing all of the Japanese naval forces into three separate "task fleets" which would have three to four carriers as their center with a proportionate number of battleships, cruisers, and destroyers acting as screening forces. In yet another example of ineffective collaborative planning, the Combined Fleet agreed to the proposal, but never took any action to put the new plan in place.²³⁸

As discussed earlier, the Japanese carriers did not typically have good radio communications with the rest of the fleet because of the small antennas on these ships. The antennas were designed to be small so they would not interfere with flight operations. Consequently, the carriers could not send or receive vital information as effectively as other ships. Thus, their ability to plan was seriously degraded. For example, in the time leading up to the morning of June 4th, Vice Admiral Nagumo, onboard flagship Akagi, was not aware of the enemy fleet movements because of his limited radio-receiving capacity and due to the radio silence being employed by the Japanese forces. He was not privy to much of the same information Yamamoto had at that time. Access to this information would have told Nagumo that the American forces were, in fact, aware of his presence and that the element of surprise had been lost.²³⁹

In conclusion, the command arrangements that were in place for the Midway operation did not allow the Japanese Commander-in-Chief Yamamoto to effectively collaborate with his subordinate commanders. The Japanese, at this time,

²³⁷ Fuchida and Okumiya, 97.

²³⁸ Fuchida and Okumiya, 98-99.

²³⁹ Fuchida and Okumiya, 123-124.

believed the place for the Commander-in-Chief was at the front. In accordance with this belief, Admiral Yamamoto put to sea with the fleet to serve as inspiration to the fleet. However, this was no place for the commander of such an operation to be. Yamamoto left himself with no way to stay informed or to inform and maintain control over his forces. In contrast, the Americans had realized the implications this particular Japanese practice could have on their ability to collaborate with all necessary parties. Consequently, American Fleet Admiral Nimitz was stationed in Hawaii where he had the ability to communicate with all of his subordinates before and during the battle. Lastly, in addition to Yamamoto's position onboard Yamato at sea, radio silence killed any last chance he would have had to keep Nagumo and others informed of the latest information from Tokyo.²⁴⁰

4. What Was Expected to Happen in the Battle?

The Americans expected that several factors, such as their disposition of forces at sea (i.e., concentration), their reinforcement of Midway Island, and the element of surprise would give them an advantage. This expectation was based on the fact they could read the Japanese communications which yielded to the Americans an overwhelming amount of intelligence. Nimitz felt the advantage of surprise and superior intelligence would be sufficient to repel the Japanese attack and defend Midway Island.

The Japanese had no idea the Americans had broken their encryption code, and that subsequently, the element of surprise had been lost. They had fully expected to be able to launch at least one or two attacks on Midway before the American Fleet would be able to respond. They wanted to lure the Americans into a trap at Midway, and in a Mahanian way, use one decisive battle to destroy the United States Pacific Fleet early in the war in 1942. They acknowledged that keeping Midway as a part of their perimeter would be nice, but that it was probably too far away from home to realistically do so. Attacking Midway was just a way to get the American Fleet to come out and fight.²⁴¹

After the Battle of the Coral Sea, Yamamoto believed the Americans had lost at least two carriers, Lexington and Yorktown; however, in reality, the Americans had only lost one, the Lexington. The Japanese believed the Americans had lost a lot in recent

²⁴⁰ Fuchida and Okumiya, 239.

²⁴¹ Fuchida and Okumiya, 105. This was the impression of the Japanese fleet.

defeats and believed the Americans lacked the will to fight. Yamamoto had sixteen groups of ships deployed for the attack on Midway, including four aircraft carriers (Akagi, Kaga, Soryu, Hiryu,). He felt these forces would be more than enough to finish the job.²⁴²

One thing the Japanese knew might hurt them, though they seemed to do very little to fix it, was their failure to change their message crypto key on April 1st, 1942, as planned. Instead the change was delayed because so much of the fleet was out to sea and too far extended to make the change. It was delayed until May 1st, and it was delayed again until June 1st for the same reason. In the meantime the Americans were copying and breaking essentially all of the Japanese's communications. It is unclear whether changing the keys on schedule would have actually stopped the Americans from breaking the code, but it is certain it would have slowed them down. In the end, the American's knew exactly what the Japanese intended to do.²⁴³

5. What Did Actually Happen in the Battle?

The Japanese, despite having a stronger force, were defeated by a weaker enemy.²⁴⁴ The preceding paragraphs on the Battle of Midway have highlighted many instances where aspects of Japanese common training and especially collaborative planning, proved inferior compared to that of the United States. From the beginning, and certainly in the end, the Japanese were unable to overcome these shortcomings in training and planning. These weaknesses prohibited them from sufficiently alleviating the environment of extreme information ambiguity which stayed with them almost from the very moment they left Japan on their way to fight at Midway.

Additionally, the Japanese did a number of other things wrong. First, the disposition of the Japanese Fleet for the Battle of Midway effectively spread their forces too thin. In the end, during Nagumo's hour of need, there was not a sufficient number of ships in concentration to thwart the American attacks from Midway and the American carriers. Second, the Japanese were over confident and made inaccurate assumptions

²⁴² Spector, 166.

²⁴³ John Prados, *Combined Fleet Decoded: The Secret History of American Intelligence and the Japanese Navy in World War II*, (New York: Random House, 1995), 101-2, 165-66

²⁴⁴ Evans and Peattie, 513. Fuchida and Okumiya, pg. xiii.

about the Americans' will to fight and the composition of the United States Navy; namely, the number of carriers the Americans had available for the battle. Third, intelligence failures inhibited them from getting current reports back on the status of ships in Pearl Harbor. Lastly, Yamamoto, on the morning of the battle, had received an intelligence report detailing all of the activity occurring on Midway. However, Nagumo never received this vital information because Yamamoto refused to break radio silence.

Despite the failures of the Japanese, the Americans were not without their own deficiencies. During the Battle of Midway on June 4th, the Americans twice failed to launch coordinated air attacks against the Japanese carriers. In spite of how they struggled, they were nevertheless able to get to and destroy all four Japanese carriers.

Not being able to launch coordinated air strikes amongst the carriers in the American Fleet is attributable to the inefficiency and lack of common training practices of Spruance's staff. This inherited staff lacked sound leadership from their Chief-of-Staff, Miles Browning. Their poor ability to hold up under the stress of continued fleet engagements should be attributed to these leadership and training failures. Recall the productive training Spruance gave to his aid LT Oliver and the battle staff. On the other hand, throughout this research, never once was there an account of the training techniques used by Browning.

If both sides had their own share of failures before and during the Battle of Midway, why then did the Americans prevail so decisively? In a conversation after breakfast one morning during the battle, Spruance summed it all up: He said that the Battle of Midway had been a typical major battle. You enter the battle with a sound plan, and you trust it will work. Next he said, the fog of war sets in and, at that point, you are never quite sure what is happening. Lastly, you must have faith, Spruance comments, and a lot depends on luck.²⁴⁵

D. CONCLUSION

In the end, all the training, planning, tactics, and confidence in the world did not help the Japanese overcome the five things the Americans either executed better or had more of: (1) common training in the form of dive bombing planes, pilots, and techniques;

²⁴⁵ Buell, 56.

(2) the American's intra-fleet collaboration, which was made possible due to Nimitz's location in Hawaii vice being at sea; (3) Spruance's leadership and the way he would not allow himself to be overcome by his environment of extreme information ambiguity. This strong leadership allowed Spruance to stay focused so that, upon finding the Japanese carriers, he immediately ordered the launch of all of his planes; (4) the gold mine of intelligence they had on the disposition, location, and make-up of the Japanese Fleet; and (5) a little bit of luck.

IV. ANALYSIS

A. INTRODUCTION

1. Model and Hypothesis

Case study analysis on two historical military battles was used to gain insight into how military decision makers maintain the ability to make successful decisions by mitigating the debilitating effects of environments of extreme information ambiguity through the combined use of common training and collaborative planning. Chapter III described the fine points of each case study conducted. This chapter presents the evaluation of the findings of those case studies. Specifically, based on the model, did common training and collaborative planning alleviate the effects of environments of information ambiguity so that decision makers could continue to make good decisions?

The first and second parts of this chapter discuss the results of an evaluation of whether or not the thesis model holds for the Battle of Trafalgar and the Battle of Midway. Each battle was broken up into two different time periods (see Table 8.) For each battle, each country's respective navy's (i.e., British, Franco-Spanish, American, or Japanese) ability to mitigate the effects of an environment of extreme information ambiguity through the combined use of common training and collaborative planning will be evaluated by means of four simple questions (see below). The third part acknowledges other possible independent variables such as time, leadership, strategy, good intelligence and the principles of war, in addition to common training and collaborative planning, which may also contribute to ameliorating the effects of an environment of extreme information ambiguity. Two of the possible independent variables, in particular, occurred through serendipitous discovery while performing the case study analysis on the two battles studied in this thesis. They are leadership and time, and will be discussed in detail.

Table 8. Case Study Results of Common Training and Collaborative Planning Advantages and Disadvantages

	Battle of Trafalgar: BEFORE Villeneuve Leaves for the West Indies		Battle of Trafalgar: AFTER Villeneuve Returns from West Indies	
	British	French	British	French
Common Training	+	--	+	--
Collaborative Planning	+	--	+	--
Successfully alleviate own EEIA	Yes	No	Yes	No

	Midway: BEFORE Japanese Sortie for Midway May 27, 1942		Midway: AFTER Japanese Sortie for Midway May 27, 1942	
	American	Japanese	American	Japanese
Common Training	--	+	+	--
Collaborative Planning	+	+	+	--
Successfully alleviate own EEIA	Yes	Yes	Yes	No

+ : Advantage -- : Disadvantage

For the analysis of the Battles of Trafalgar and Midway, the following logic is used in accordance with the thesis model:

1. Did the decision makers experience an environment of extreme information ambiguity (Yes/No)?
2. Did they have effective common training (Yes/No)? Were there any deficiencies or highlights in their common training (Yes/No)?
3. Did they utilize effective collaborative planning (Yes/No)? Were there any deficiencies or highlights in their collaborative planning (Yes/No)?
4. Did they successfully alleviate their environment of extreme information ambiguity (Yes/No)?

If the answers to questions 1-3 are “Yes” and the decision maker successfully alleviated their environment of extreme information ambiguity, then the decision maker did so predominantly via the use of common training and collaborative planning (See Section D, Other Considerations, for postulation that other factors besides common training and collaborative planning may be taken into account.)

This method of analysis serves to emphasize that alleviating an environment of extreme information ambiguity and subsequently winning a battle is not always about

who has the best common training and who most effectively engages in collaborative planning, but who has it at all, and if so, whether or not it is effective. For instance, the case study analysis on the Battle of Trafalgar showed that the British had effective common training for both periods discussed. However, we see quite the opposite situation with the Franco-Spanish Fleet, who often got underway with sailors that had little to no training at all. In another example, in the Battle of Midway, the Japanese had effective common training and collaborative planning leading up to May 27th, 1942. However, it seems clear there were various common training and collaborative planning issues that led to the Japanese demise after their sortie from Japan. For instance, regarding their collaborative planning, once they left Japan for Midway, the actions they took, based on the way they had planned the operation, were absolutely contrary to establishing and maintaining effective collaborative planning.

Lastly, in a situation where both sides alleviate their respective environments of information ambiguity, the outcome of a battle may be determined by who has the most effective common training and collaborative planning. By the logic discussed earlier, if a decision maker or organization successfully alleviates their environment of extreme information ambiguity, then it appears that decision maker did so primarily through the combined use of common training and collaborative planning. Continuing with that same logic, in a battle between two adversaries, assuming both have alleviated their respective environments of extreme information ambiguity, it seems likely, based on the this limited model, that the side which demonstrates the most effective common training and collaborative planning will win the battle.

B. BATTLE OF TRAFALGAR

The results of the case study analysis for the Battle of Trafalgar did not demonstrate any differences in the common training and collaborative planning used by the Royal Navy and the Franco-Spanish Navy from the time Villeneuve left for the West Indies to the time when he returned and was finally blockaded in the Cadiz Harbor by the Royal Navy.

1. Royal Navy

Did the Royal Navy decision makers experience an environment of extreme information ambiguity? Yes. The Royal Navy and more specifically, Admiral Nelson, experienced characteristics of an environment of extreme information ambiguity such as friction in the form of poor weather and the unpredictability of the formations employed by the Franco-Spanish Fleet. Moreover, the British experienced ambiguity in the form of correlation of data during the time right before the battle when Nelson was trying to determine the center (Villeneuve's flagship) of the Franco-Spanish battle line.

Did the Royal Navy have effective common training? Yes. Were there any deficiencies or highlights in their common training? Yes. The Royal Navy demonstrated the following characteristics of common training: similar training/doctrine and vigorous training. The products of their common training were similar skills; similar perceptions and reactions; alignment amongst commanders; harmony and focus in operations; and lastly, the commanders under Nelson shared implicit connections and bonds.

Clearly, the Royal Navy demonstrated effective common training. Prior to the Battle of Trafalgar, the Royal Navy had spent nearly 100 years refining their navy's seamanship and combat skill. Next, their sailors, especially those under Nelson, had vast amounts of time practicing their skills at sea. Lastly, the Royal Navy, during the battle, fought in accordance to doctrine (which had been written by Nelson) for which they had trained under Nelson.

Did the Royal Navy utilize effective collaborative planning? Yes. Were there any deficiencies or highlights in their collaborative planning? No. Nelson was a leader who understood the importance of sharing ideas, synchronizing all assets, holding face-to-face meetings. Furthermore, Nelson understood that from successful collaboration with his superiors and his subordinates he could expect to gain a shared situational awareness, better information flow, a fuller understanding of important issues, and a sharing of information across geographic boundaries. For instance, there were many occasions during Nelson's operations in the Caribbean where he would stop and collaborate with local island leaders. Additionally, while at sea in the days preceding the

Battle of Trafalgar, Nelson, on numerous occasions, enabled effective collaboration by means of face-to-face meetings with his captains, held aboard the British flagship, Victory.

Did the Royal Navy successfully alleviate their environment of extreme information ambiguity? Yes

2. Franco-Spanish Navy

Did the Franco-Spanish Navy decision makers experience an environment of extreme information ambiguity? Yes. The Franco-Spanish Fleet also suffered from the effects of an environment of extreme information ambiguity. Specifically, they suffered from friction in the form of poor weather caused by light winds; ambiguity caused by not being able to accurately determine the disposition, location, and exact force size of the British Navy; time pressure; and high stakes. Regarding time pressure, Villeneuve knew his French superiors (Decrès and Napoleon) had sent an admiral to relieve him. For that reason, despite his apprehension to face Nelson, Villeneuve headed for sea in order to avoid his impending termination of command.

Did the Franco-Spanish Navy have effective common training? No. Were there any deficiencies or highlights in their common training? Yes. The common training of the Franco-Spanish fleet was highly ineffective and in some cases the crewman received only crash courses in seamanship before going to sea or into battle. Villeneuve was a “trained and dedicated officer,”²⁴⁶ but he was a young admiral which was a sign of how the French had a limited supply of seasoned sea officers.²⁴⁷ By not spending a sufficient amount of time at sea, the crews of Villeneuve’s ships never received the similar and vigorous training they needed. Looking at the numbers of guns, ships, and manpower taken into battle against the British, a clear advantage was enjoyed by the Franco-Spanish Fleet in all three categories (see Table 6, Chapter III). However, Schom points out a critical factor. Although, the French and Spanish Fleets enjoyed a 48% advantage in manpower, that manpower was less well trained than that of the British

²⁴⁶ Arthur Herman, *To Rule the Waves: How the British Navy Shaped the Modern World*, (New York: HarperCollins Publishers Inc., 2004), 375.

²⁴⁷ Herman, 375.

Fleet.²⁴⁸ Clearly, captains and sailors cannot learn to maneuver their ships independently, let alone as a fleet, if they have never left the harbor (and gone to sea) to rehearse.

Did the Franco-Spanish Navy utilize effective collaborative planning? No. Were there any deficiencies or highlights in their collaborative planning? Yes. Similar to their lack of common training, the collaborative planning of the Franco-Spanish Fleet was also ineffective for several reasons. The Combined Fleet attempted to share ideas, synchronize assets, and conduct face-to-face meetings. However, when they tried to collaboratively plan, the French and Spanish Fleets did not have a lot of success in improving their situational awareness, information flow, understanding of the issues, and shared information across geographic boundaries. The effectiveness of the Combined Fleet's collaborative planning was seriously degraded by the dissention and distrust Villeneuve's superiors and subordinates had against him.²⁴⁹ Second, the Combined Fleet's collaboration was often based on lies and false information. Third, the subordinates and superiors of Villeneuve hid information from him and communicated about him behind his back. Lastly, much of Villeneuve's collaborative planning suffered from the effects of distance.

Did the Franco-Spanish Navy successfully alleviate their environment of extreme information ambiguity? No. Clearly, the Franco-Spanish Fleet did not reduce their environment of extreme information ambiguity sufficiently to emerge victorious over the Royal Navy. Although they had some measure of common training and attempted to plan collaboratively, what little the French and Spanish did was not enough to contribute to their overall ability to overcome the ambiguous environment that consumed Villeneuve and the other French and Spanish decision makers involved in the Battle of Trafalgar.

²⁴⁸ Schom, 315.

²⁴⁹ As with the common training of the Franco-Spanish fleet, it is demonstrated again here how dissention in the ranks, up and down the chain of command, was a seriously debilitating factor in the effectiveness of collaborative planning.

C. BATTLE OF MIDWAY

1. Americans before May 27, 1942

Did the American Navy decision makers experience an environment of extreme information ambiguity? Partially. For the Americans, the time leading up to the Battle of Midway was more about a race against time in order to get prepared for the battle than it was about dealing with an environment of extreme information ambiguity. That the Americans had broken the Japanese code (communication) was the primary reason the American commanders had an almost perfect picture of what would be the force composition, disposition, and location of the Imperial Japanese Navy for the battle. In one example, as soon as Spruance took command of Admiral Halsey's Task Force 16, on May 26th, 1942, he became immediately aware of the seriousness of his situation. High stakes is one of the first things Spruance was forced to deal with.²⁵⁰

Did the American Navy have effective common training? Yes. Were there any deficiencies or highlights in their common training? Yes. The common training of the high level US naval commanders was more than satisfactory. Decision makers like Spruance had been training during their entire navy careers for fleet engagements like the Battle of Midway. The case study on the Midway battle demonstrated that men like Nimitz and Spruance did not just emerge by good luck. Rather, they trained and rose through the ranks in similar ways throughout their careers. Decision makers like these two shared the following characteristics of common training: similar training/education/doctrine and mission-oriented command. As a result they also benefited from the following by-products: similar skills; similar perceptions and reactions; alignment amongst commanders; and harmony, or focus in direction, in operations.

In contrast, regarding the common training of the American battle staffs and operators, their training was lacking in comparison to the training received by the American officers. Furthermore, research indicates that, unlike their Japanese adversary, the American operators had not been training and preparing for war anywhere near as much. The Japanese Navy's operators and staffs had been training for years in

²⁵⁰ Thomas B. Buell, *The Quiet Warrior: A Biography of Admiral Raymond A. Spruance*, (Annapolis: Naval Institute Press), 1987, 133-137.

anticipation of facing off with the American Fleet. As a consequence, the common training of the operators of the United States Navy was not spectacular.

Spruance's staff's inability to cope under the strain of actual combat was the result of not being sufficiently trained. Vigorous training and rehearsing is necessary before actual battle. Furthermore, a staff or a force must train on the "right" areas. The staff of Task Force Sixteen had real world training doing island raids against Japanese outposts. However, when the time came for intense battle against a relentless enemy, their previous training was not sufficient.

One aspect of the United States Navy's training that does stand out is their pilot training program, especially in comparison to that of the Japanese. In addition to the United States Navy's ability to replace pilots, they also maintained an advantage in dive-bombing planes, tactics, and the pilots who flew them.

An additional highlight of staff and operator common training worthy of note shows how Spruance utilized inactive time at sea to build the staff's operational skills by posing theoretical operational problems for them solve, problems similar to those used at the United States Naval War College.²⁵¹ This was an example of similar training, education, and doctrine. Here the commander was reinforcing similar skills; similar perceptions and reactions; and harmony, or focus and direction, in operations by letting his staff mentally rehearse possible scenarios on what their responses might be.

Did the American Navy utilize effective collaborative planning? Yes. Were there any deficiencies or highlights in their collaborative planning? No. Collaborative planning was essential for the efficient operation and success of the United States Navy during the Battle of Midway. Some means used by the United States to facilitate collaborative planning leading up to the Battle of Midway include: sharing ideas; synchronization of assets; use of physical collaboration tools such as intelligence reports and operational orders; and face-to-face meetings.

²⁵¹ Buell, 128. When Spruance took over for Halsey, he inherited Halsey's staff. This was thought to be the best decision since Halsey's staff had spent the whole first part of the war training and getting experience in flight operations and combat; along with Halsey's staff came his Chief of Staff, Captain Miles Browning. The only person Spruance would bring over from his old staff was his flag lieutenant. Spruance would learn that his newly inherited staff was not as savvy as he would have hoped.

In particular, the visits by Nimitz to Midway demonstrated the following characteristics of collaborative planning: sharing ideas, synchronization of assets, and face-to-face meetings. Those characteristics yielded collaboration products such as shared situational awareness, improved information flow, issues being raised, and participants reaching a fuller understanding of the issues.

Did the American Navy successfully alleviate their environment of extreme information ambiguity? Yes.

2. Japanese before May 27, 1942

Did the Japanese Navy decision makers experience an environment of extreme information ambiguity? Partially. For the Japanese, Admirals Yamamoto and Nagumo stand out as the two decision makers on the Japanese side that suffered the most from factors such as friction, ambiguity, time pressure, delayed action-feedback loops, and high stakes.

Did the Japanese Navy have effective common training? Yes. Were there any deficiencies or highlights in their common training? Yes. The high-ranking Japanese naval officers of the World War II era, like their American counterparts, had similar training, education, and doctrine. For instance, Fuchida, who entered the Naval Academy in 1921, reported that the officers at that time were already being taught that the United States was the next potential enemy. Second, most of the up-and-coming officers in the navy shared in the experience of serving as Naval Attachés in Washington. Because of this, almost all high ranking officers during the time before the attack on Pearl Harbor were well versed in the capabilities of the United States Navy.²⁵²

The operators/sailors of the Japanese Navy, because of their vigorous training and battle drill, worked like well-oiled machines, far out pacing their American counterparts in common training. Some of the highlights of the Japanese Navy's common training included similar training/education/doctrine and constant drill. However, one serious deficiency in the common training of the Japanese Fleet was the lack of a flexible pilot training program capable of re-supplying the fleet with replacement pilots. This deficiency in the Japanese common training illustrates how they had already begun to

²⁵² Fuchida, Mitsuo and Okumiya, Masatake, *Midway: the battle that doomed Japan*, (Annapolis: Naval Institute Press, 1955), 11.

derail their ability to successfully alleviate the environment of extreme information ambiguity they would face the moment of their departure on May 27th. Lastly, due to the shortage in pilots, the Japanese Navy departed Japan with one less carrier (Zuikaku).

Did the Japanese Navy utilize effective collaborative planning? Yes. Were there any deficiencies or highlights in their collaborative planning? Yes. The biggest highlight regarding Japanese collaborative planning was the fact that their idea sharing, synchronization of assets, and face-to-face meetings all worked well for them before they left Japan May 27th. In contrast, as soon as they left Japan, because of radio silence, the disposition of their forces, the location of Yamamoto, and the weather itself, their ability to conduct effective collaborative planning began to decline at an exponential rate. What is more, they never recovered from these problems, and as a result, the severity of their environment of extreme information ambiguity increased at an exponential rate from May 27th through the end of the battle on June 6th, 1942.

Did the Japanese Navy successfully alleviate their environment of extreme information ambiguity? Yes. Prior to their departure on May 27th, the Japanese did not have an environment of extreme information ambiguity to speak of. They believed they had a good plan, superior forces, and they believed they had a good idea where the American carriers were, although they did not know for sure.

3. Americans after May 27, 1942

Did the American Navy decision makers experience an environment of extreme information ambiguity? Yes. Closer to the beginning of the battle on June 4th, Admirals Nimitz, Spruance, and Fletcher and their staffs experienced factors such as friction, ambiguity, time pressure, delayed action-feedback loops, and high stakes, though not to as great an extent as their Japanese counterparts. They already had the force size, disposition, and approximate size. The Americans needed only to confirm the location of the Japanese Strike Force.

During the Battle of Midway, Admiral Spruance found himself in many ambiguous information environments. In spite of being exposed to the potentially

debilitating effects of all these factors, Spruance consistently demonstrated the ability to acknowledge that such environments existed, and with that, moved on and focused on his orders.²⁵³

Did the American Navy have effective common training? Yes. Were there any deficiencies or highlights in their common training? Yes. Spruance may have lacked the same extensive carrier aviation experience as the man he relieved, Admiral Halsey, but because he had spent his career on cruisers and non-carrier type platforms (command at sea six times plus command of a cruiser destroyer group), he demonstrated factors such as similar training/education/doctrine and mission-oriented command. For example, recall Spruance, prior to receiving his commission in the navy, had received a similar education and the Naval Academy and similar training and doctrine later on upon reporting to the fleet.

There are two other positive aspects of American common training (at the time of the battle) that stand out. First, the Americans had an adaptive training system, namely, their pilot training program which emphasized a theme of producing sufficient quantities of capable pilots versus a finite number of perfect pilots. Second, the superior training, tactics, and equipment of the American dive bombers carried the day on the 4th of June, 1942, by destroying three Japanese carriers in a very short amount of time.

Did the American Navy utilize effective collaborative planning? Yes. Were there any deficiencies or highlights in their collaborative planning? Yes. The most significant highlight of American collaborative planning during the war in the Pacific is the fact that Admiral Nimitz, the operational commander, oversaw the battle from Hawaii (unlike Yamamoto). From there, he was able to maintain contact with his forces at sea, and on Midway Island, throughout the battle.

Did the American Navy successfully alleviate their environment of extreme information ambiguity? Yes. The Americans accomplished this feat because they continued to practice good collaborative planning via a sharing of ideas and synchronization of assets. Furthermore, utilizing superior training and equipment, McClusky and his fellow dive-bombers eventually found and sunk three Japanese carriers

²⁵³ Buell, 154.

in a matter of minutes. Lastly, due in large part to certain aspects of the American Navy's effective common training and their ability to plan collaboratively, Spruance was able to remain focused, was able to make a decision, and subsequently, launched his strike force. The Americans won a decisive battle.

4. Japanese after May 27, 1942

Did the Japanese Navy decision makers experience an environment of extreme information ambiguity? Yes. Nagumo found himself in an environment of extreme information ambiguity well in advance of the onset of the battle, all the way through to the end. He never found a way to reduce it enough to be able to function and make the decisions necessary to save his force from destruction. Nagumo experienced friction, ambiguity, time pressure, delayed action-feedback loops, and high stakes. From the time Nagumo left Japan with the carrier strike force, he experienced friction due to weather in the form of dense fog, rain, and heavy seas. Regarding ambiguity, because of radio silence and inadequate communications antennas on his carriers (and the lack of a back-up communications plan), Nagumo did not receive all reports and intelligence from Yamamoto and the headquarters in Tokyo. These characteristics most likely affected Nagumo's ability to think, causing a subsequent fear of not being able to understand the situation and a fear of making bad decisions.

Did the Japanese Navy have effective common training? No. Were there any deficiencies or highlights in their common training? Yes. The flaws mentioned in the previous section (pre-May 27th) haunted the Japanese once they arrived at Midway as well. Like the Americans, up to this point in the war, the Japanese had also sustained heavy pilot casualties. However, unlike the American Navy, the Japanese Imperial Navy lacked a pilot training program to replenish those pilots lost in battle.

Did the Japanese Navy utilize effective collaborative planning? No. Were there any deficiencies or highlights in their collaborative planning? Yes. As mentioned earlier, the Japanese fleet got underway with Yamamoto onboard the battleship Yamato, serving as the commander and as an inspiration to his men. Additionally, they were forced to contend with severely limited visibility due to foggy, cloudy, and rainy weather during the entire transit to Midway. Furthermore, the whole fleet was under radio silence. Regarding the issue of radio silence, Yamamoto failed to

pass vital information and reports to Nagumo and his strike force in the days, hours, and minutes leading up to the battle. This lack of collaborative planning exacerbated the effects of an environment of extreme information ambiguity that Nagumo and Yamamoto were experiencing.

If Yamamoto had been in Tokyo, as Nimitz was in Hawaii, or if he had been with Nagumo's strike force, he likely would have been able to benefit from collaborative planning such as sharing ideas and synchronization of assets and their products of developing shared situational awareness, better information flow, issues being raised, and having a fuller understanding of the issues.²⁵⁴ At sea, under the restriction of radio silence, Yamamoto effectively cut himself and his battleship force out of the battle. He was never in a position to help Nagumo at all.

Did the Japanese Navy successfully alleviate their environment of extreme information ambiguity? No. From the time the Japanese Fleet departed from their homeland of Japan, their environment of extreme information ambiguity got progressively worse and worse. By the time they figured out the location of the American strike force, the Americans had already found them and launched a strike. Nagumo, due mostly to deficiencies in collaborative planning, was never able to rise above his environment of extreme information ambiguity. The Japanese carriers were sunk and they lost the battle.

D. OTHER CONSIDERATIONS

The case study analysis of the Battle of Trafalgar and the Battle of Midway has shown that, to sufficiently contend with the effects of an environment of extreme information ambiguity, the decision maker does so predominantly through the combined use of common training and collaborative planning. These two concepts appear to have significantly contributed to the success of the victors, the British and American Navies, when applied to these two maritime battles. However, it is prudent to acknowledge that, over the course of this research, two other concepts presented themselves at various times throughout the case study process. They are time and leadership.

²⁵⁴ Fuchida and Okumiya, 239.

1. Time

Time is the essence in war, and while a defeat may be balanced by a battle won, days and hours – even minutes – frittered away, can never be regained.²⁵⁵

With respect to alleviating environments of extreme information ambiguity, consideration of the factor of time is most likely necessary. A characteristic of time worthy of note is that time lost cannot be recovered, and while space is important, if lost, it can conceivably be retaken. Not so is the case with time. Time is required for planning, preparing, conducting, and sustaining military operations. Time is often referred to as the fourth dimension, the other three being: length, width, and height. However, time is by no means the least important dimension, rather, it is arguably the most important, and commanders have had to consider it since the beginning of history. Time is an integral and unavoidable part of all decision making in war and must be considered and managed carefully.²⁵⁶

Leonard and Vego, two authors who have written on the concept of time and warfare, concur that that decision makers may try to buy allotments of time through maintaining a forward presence in threatened theaters; developing and sustaining alliances; intelligence operations; deliberate planning; creating newer and lighter materials; and lastly and most important, more and faster strategic lift.²⁵⁷ Additionally, an operational commander (decision maker) and his/her staff have the greatest ability to effect the time needed for planning, preparing, and conducting a major operation. In general, the more time a decision maker has, the greater the probability of success. Adequate preparation time is important for “alerting, mobilization, pre-deployment, deployment, and combat employment of one’s forces.”²⁵⁸

Increasing ones *warning time* of an impending attack can be achieved through the use of a capable long-range early warning system. Similar and closely related to warning

²⁵⁵ S.B. Griffith II, Brigadier General, USMC

²⁵⁶ Robert R. Leonhard, *Fighting by Minute: Time and the Art of War*, (Westport: Praeger Publishers, 1994), 3.

²⁵⁷ Leonhard, 8-9. Vego, 51. Regarding lighter materials, the lighter the equipment, the more of it that can be moved and the faster it can be moved.

²⁵⁸ Milan N. Vego, *Operational Warfare*, (Naval War College, 2000), 49, 55-56.

time is *reaction time* to an adversary's attack or unplanned action. Once a battle begins, reaction time, like so many other things, "is a function of the decision-making cycle, command and control process, and theater-wide communications."²⁵⁹ By reacting faster, one side may significantly increase the possibility of achieving its military goals.

In conjunction with the movement of one's military forces and the speed of carrying out actions, time is capable of significantly increasing the freedom of action for the operational commander. For example, an unanticipated incident in the course of a battle (think Midway, Nagumo, and the destroyer's wake), can derail the entire sequencing or synchronization schedule. The consequences may even quickly change the entire outcome of the battle or campaign.²⁶⁰

During the time of the Battle of Trafalgar, the speed of warfare changed slowly. Consequently, there was no extreme compression of the factor time. Nearly 140 years later, at the Battle of Midway, new technologies had enlarged the area of combat over what had been the norm in 1805. Consequently, this new technology had also compressed the amount of time afforded to leaders for making decisions.²⁶¹ In the end, when one considers ways in which to ameliorate the debilitating effects of an environment of extreme ambiguity, it seems sensible to consider the factor of time.

2. Leadership

Leadership also requires consideration regarding other factors which may contribute to a decision maker's ability to mitigate the negative effects an environment of extreme information ambiguity. The fundamental purpose of leadership is to obtain and use information to mitigate uncertainty. One specific role of a leader is to ensure that there exists a process in place to reduce uncertainty. Furthermore, the concept of leadership and its role must be taken beyond the traditional narrow idea that leadership is just a study of the interpersonal relationships of leader/leader and leader/subordinate. Rather, leadership should be applied across all organizational levels. If an attribute of

²⁵⁹ Vego, 50-51.

²⁶⁰ Vego, 47.

²⁶¹ Vego, 55-56.

leadership is reduced uncertainty, then “effective leadership (at all levels of command) depends on an adequate cognitive map, which enables understanding and interpretation of complexity at subordinate levels.”²⁶²

So, if leadership can help to reduce the uncertainty of a situation, then perhaps it’s valid to postulate its credibility as an additional factor which, when used effectively, could contribute to the reduction of the effects of an environment of extreme information ambiguity. The next step then, is to attempt to predict which style of leadership may be most suited for the situation considered here. According to the United States Army’s field manual for operations, some of the criteria which are inherent and essential to the kind of leadership required to fight and win battles are listed below and briefly described thereafter.²⁶³

1. “Subordinate leaders are to be given freedom and responsibility...”
2. “Initiative...”
3. “Independence of action...”
4. “Mission-type orders will be required at every echelon of command...”
5. “Risk taking and an atmosphere that supports it...”
6. “Quick-minded and flexible...”
7. “Imagination, audacity, and willingness to take risk...”
8. “Resolute and independent...”
9. “As battles become more complex and unpredictable, decision making must become more and more decentralized...”

Each item in the list above relates directly to the mission-oriented command leadership style or Auftragstaktik. Recall, this style of leadership, currently utilized by the United States Army and developed by the German Army more than 200 years ago, is a decentralized leadership and command philosophy that pushes decisions and actions down to the lowest level.

Mission-oriented command is based on the principle that initiative and creativity in execution and completion of the mission is done without fear of retribution by higher

²⁶² Joseph Zeidner, *Human Productivity Enhancement: Organizations, Personnel, and Decision Making Volume 2*, (New York: Praeger Publishers, 1987), 50, 56.

²⁶³ FM No. 3-0, Operations, Headquarters, Department of the Army, 14 June 2001. It is assumed that the existence of battle implies that an environment of extreme information ambiguity exists.

command. Simply stated, the subordinate is trained and expected to act. The list above details several characteristics of mission-oriented command such as independence of action, mission-type orders, risk taking, flexibility in the absence of higher authority, willingness to take risk, and decentralization of command. Exercise of these attributes should increase the leader's ability to make decisions as ambiguity and friction increase the harmful effects of an environment of extreme information ambiguity. The success of battle with *Auftragstaktik* depends on the initiative of junior decision makers/leaders and their willingness to act in support of their commander's intent.

In conclusion, it appears that, after conducting detailed case study analysis on the Battles of Trafalgar and Midway, and after applying the findings to the thesis model, there may be other variables that should be considered, namely, time and leadership. Others which may merit future consideration are strategy, good intelligence and the principles of war (e.g., cohesiveness, unity of force, unity of effort, and unity of command).

E. CONCLUSION

Results of the analysis conducted on the battles of Trafalgar and Midway indicate that for these two case studies the thesis model appears to be a useful tool for interpretation and description of the events and their outcomes.

Trafalgar was a case that did not change from the first time period observed to the next (see table 8). In the end, the Royal Navy effectively employed common training and collaborative planning, which, through their combined use, enabled the British decision makers, like Nelson, to successfully alleviate their environments of extreme information ambiguity and emerge victorious. In contrast, although the Franco-Spanish Navy attempted to employ common training and engage in collaborative planning, they did so ineffectively. As a consequence, Villeneuve, for example, was unable to reduce the effects of the ambiguity and friction he faced, and in the end, was defeated in battle by a British force that was able to ameliorate those similar effects.

Midway was a case where the Japanese and the Americans were both able to conduct effective common training and collaborative planning prior to and after May 27th. However, as shown in the analysis of the Japanese Imperial Navy during the period

before May 27th, particular deficiencies in common training and collaborative planning, in the end, created an environment of extreme information ambiguity that Yamamoto, and especially Nagumo, could not overcome. First, the Japanese lacked a sufficient and flexible pilot training program for the purpose of replacing aviators lost in combat. Lastly, and arguably most damaging to their effort, was the ineffective way in which they collaborated once they left Japan on May 27th. With the Japanese fleet too far dispersed and with Yamamoto at sea instead of on land in Tokyo (or much further forward with Nagumo and the carrier strike force), the Japanese exacerbated an already ambiguous situation beyond a recoverable point. Consequently, the Japanese Fleet found itself experiencing the harmful effects of extreme information ambiguity. Moreover, the Japanese decision makers were unable to alleviate these effects sufficiently in order to continue making effective decisions.

In contrast, the American Navy accomplished almost the exact opposite. Regarding common training, before and after May 27th, the United States maintained an adaptable and sufficient pilot training program capable of supplying the fleet with an apparently insatiable supply of pilots. Additionally, the American dive bomber pilots, due to their superior equipment and flying skills were the ones that found and sunk the four Japanese carriers at Midway. Lastly, the Americans, unlike their Japanese counterparts, put themselves in a position to be able to successfully collaboratively plan (i.e., by keeping Nimitz in Hawaii and concentrating their forces). Because of this, they maintained the ability for a continued sharing of ideas and actions amongst the American decision makers and fighting forces. Furthermore, the American Navy, when it counted, enjoyed shared situational awareness and a flow of information that inevitably enabled them to mitigate the normally overwhelming effects of the ambiguous information environment present during the battle.

In conclusion, one may postulate the generalizability of the thesis model to land and air battles. The obvious difference in both scenarios is the environment and speed of battle. Regarding land battle, the speed of battle is much slower than that of maritime battle. For example, at the Battle of Trafalgar, the British and Franco-Spanish Fleets may have reached a top speed of about four knots, but that was still faster than the speed of advance in most World War II battles (e.g., the Battle of the Bulge). In contrast, air battle

presents an environment where the speed of battle is many times faster than either the land or maritime environments. Nevertheless, an environment of extreme information ambiguity is what it is -- ambiguous. Regardless of the element of time, a decision maker, in battle, will always have to deal with the disruptive effects of an environment of extreme information ambiguity. However, with increased speed, and subsequent condensed event timelines, the decision maker will be forced to adjust and evolve their common training and collaborative planning methods (i.e., in a way that acknowledges the challenges of increased speed and decreased time) in order to succeed.

So, for the maritime battles at Trafalgar and Midway, common training and collaborative planning were necessary and appear to be sufficient for alleviating the destructive effects of the environment of extreme information ambiguity the decision maker's faced. In consideration of land and air battles, common training and collaborative planning will continue to be necessary. However, whether or not they will be sufficient will depend on the leader/decision maker's or organization's ability to adapt their common training and collaborative planning methods as necessary. In addition there must be a mutual willingness to consider other factors such as leadership, and especially, time.

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V. CONCLUSIONS

A. INTRODUCTION

This thesis model²⁶⁴, with a focus on behavior not technology, has presented a detailed case study analysis of two historic maritime military battles, the Battle of Trafalgar and the Battle of Midway. Both battles, although separated by 140 years have some similarities, namely, both battles provide a good example of an environment of extreme information ambiguity and both ended in decisive victory for one side. The thesis model seems to be valid on the basis of the limited number of case studies conducted. Additionally, in Chapter IV, it was proposed that perhaps time and leadership should be considered as factors that may also serve to alleviate the detrimental effects of an environment of extreme information ambiguity.

Any conclusion based on the two cases is bound to be limited. However, one can see connections and relevance with what the thesis model describes and how the United States Joint Forces doctrine seems to be evolving. This chapter focuses on the evolution of future joint operations for the United States military as described in the United States Department of Defense Capstone Concept for Joint Operations (CCJO) Version 2.0 August 2005. Specifically, does this thesis model have implications for the success of future joint military operations? The answer is yes, and what follows is a brief discussion that postulates how the joint force decision makers of tomorrow will depend on a combined use of common training and collaborative planning in order to alleviate the information ambiguity and complexity they will inevitably face in future operations.

First, a brief description is presented of the CCJO. Next, the CCJO proposes broad “solutions” for how the joint force will operate in order to accomplish its mission. It is here that one really begins to recognize the implications the thesis model has for the CCJO. The third, and arguably the most important part of this chapter, delineates the characteristics of the joint force and offers some suggestions on how to achieve the goals of the CCJO. The inference will be that the joint force’s goals will be attainable through

²⁶⁴ Are common training and collaborative planning necessary and sufficient for lessening the harmful effects of an environment of extreme information ambiguity so that a decision may continue to make effective decisions.

the use of common training and collaborative planning. Additionally, the third part of this chapter asserts that an environment of extreme information ambiguity cannot be eliminated, rather, it can only be reduced. Fourth, some suggestions are offered for future joint operations and its inevitable environments of extreme information ambiguity. Finally, the conclusion offers some recommendations for future use of the model.

B. BRIEF OVERVIEW: CAPSTONE CONCEPT FOR JOINT OPERATIONS

The CCJO is the summary document for all future joint military operations and is the main document in a family of joint operations concepts (JOpsC)²⁶⁵ that detail how joint forces are expected to function across the range of military operations from 2012-2025. One noteworthy implication of the CCJO is that the future joint force must seek full spectrum dominance and continue to improve its ability to operate in a unified way.²⁶⁶

In all situations, the joint force will seek Full Spectrum Dominance through unified action as a supporting or supported element of a larger national or multinational effort designed to achieve strategic and operational objectives, and outcomes.²⁶⁷

C. SOLUTIONS TO FUTURE MILITARY PROBLEMS

The future joint force will operate in order to complete strategic objectives and prevail over the military problems described in the CCJO. The CCJO details the solutions to future military problems in the following way:

1. Central Ideas

2. A **Systems View of the Environment** where all situations (adversary and crisis response) are view as involving complex adaptive systems
3. The **Fundamental Joint Actions** that are key to designing joint force operations

²⁶⁵ The CCJO guides the joint operating concepts, joint functional concepts and the joint integrating concepts.

²⁶⁶ United States Department of Defense Capstone Concept for Joint Operations Version 2.0, August 2005, 2. **Unified action:** Strategic objectives are determined in the context of the global situation and interaction with a variety of allies and other multinational partners. Achieving these objectives requires integrating joint force actions with those of interagency and perhaps multinational partners.

²⁶⁷ An Evolving Joint Perspective: US Joint Warfare and Crisis Resolution in the 21st Century, 28 January 2003, 10. **Full Spectrum Dominance** is the decisive defeat of any adversary or control of any situation across the full range of military operations.

4. The **Supporting Ideas** which describe how the future joint force is expected to operate
5. The **Key Characteristics** the joint force must possess to operate as envisioned

Taking a systems view of the environment, the information that will exist regarding future military problems will be complex. Because of this complexity, the framework used in the CCJO treats adversaries and situations as complex, adaptive systems. Regarding complex adaptive systems, it is important to understand the structure and dynamics of adversaries to the extent possible and to continue to learn about them over time. The thesis model addresses common training and collaborative planning which, in this case, appears to be the way the CCJO envisions the future battle space. For example, regarding common training, one infers from “learn about them over time” that common training should be applied. Moreover, the joint force could use similar training/education/doctrine and vigorous training to ensure learning over time. In another example, this time regarding collaborative planning, the CCJO states “the inability to predict the outcome of actions taken on a system requires an adaptive and flexible approach to joint force operations.” This last idea indicates the joint force will need to be able to deal with novel situations where collaborative planning techniques such as sharing ideas among distributed decision makers, planners, and leaders, synchronizing the use of assets, engaging in global real-time collaboration, and making use of multiple information sharing techniques such as a virtual workspace, video conferencing, and chat tools could be used to help with planning for novel scenarios prior in advance of military operations.²⁶⁸

The solution of developing and sustaining fundamental joint actions suggests the joint force must acquire, refine, and share knowledge. Knowledge must be timely, applicable, and correct to be useful, and it must be obtained, prioritized, refined, and shared vertically and horizontally. In order to accomplish this level of knowledge management, the joint force will need to utilize multiple collaboration tools to develop and maintain shared situational awareness, facilitate information flow, examine other viewpoints, and share information across geographic boundaries. With sufficient

²⁶⁸ CCJO, 11-12.

bandwidth, a clearer picture of the situation can be developed because everyone involved in planning will have access to all relevant information, all the time, and will be able to communicate ideas to all participants in near-real time (with the goal of this process becoming instant).

D. CHARACTERISTICS OF THE JOINT FORCE

In reviewing the anticipated future military problems that the CCJO will likely face, it is clear that tomorrow's joint force decision makers will likely encounter far greater environments of extreme information ambiguity than what past decision makers had to contend with. For the most part, the leaders of the Department of Defense recognize the necessity of reducing environments of extreme information ambiguity. It also seems clear that in order to accomplish the solutions to the future military problems prescribed in the CCJO, a joint force capable of effective common training and collaborative planning will be necessary.

The CCJO details several characteristics the future joint force will most likely need to possess in order to be capable of dealing with the future military threats. The future joint force's key characteristics include being knowledge empowered, networked, and interoperable. A closer look at these characteristics should reinforce the reader's understanding of the correlation between common training, collaborative planning, environments of extreme information ambiguity, and how the thesis model applies to what the CCJO hopes to accomplish.

Regarding knowledge empowerment, the CCJO explicitly states that the focus of a joint military force includes being able to function in, vice removing, the environment of extreme information ambiguity (The CCJO refers to an environment of extreme information ambiguity as the fog of war.). Chapter I of this thesis also stated that it was absolutely essential to emphasize that the effects of an environment of extreme information ambiguity can only be mitigated and not eliminated completely. Furthermore, a joint force that tries to get rid of the effects of this type of environment will expend a disproportionate amount of time, energy, and resources for little to no gain. For clarification, one cannot eliminate an environment itself; rather, one can only lessen or tone down its harmful effects.

The CCJO states, “Although we will never eliminate the fog of war, an increased level of understanding should empower leaders throughout the joint force.”²⁶⁹ One can infer from the CCJO’s call for “an increased level of understanding should empower leader,” that what is occurring is the alleviation of the harmful effects of the decision maker’s uncertain information environment. It is the intention of the CCJO that all joint leaders realize that the effects of environments of extreme information ambiguity cannot be removed or eliminated, only lessened.

Once this concept of “mitigation” is accepted, the decision maker/leader may go on to “anticipate and act as opportunities are presented, apply innovative solutions, mitigate risk, and increase the pace, coherence, and effectiveness of operations even in complex environments.”²⁷⁰ In the end, an ability to continue making effective decisions, is what is accomplished through the amelioration of the unfavorable outcomes of an extremely ambiguous information environment.

Networked refers to the idea that a networked joint force is achieved through the use of collaborative planning. “All joint forces will be connected and synchronized in time and purpose...”²⁷¹ A networked joint force is able to capitalize on the benefits of decentralization, adaptability, and increased tempo -- without sacrificing coordination or unity of effort. The joint force, through the use of networking, will be able to efficiently share ideas, synchronize assets, utilize information technology, conduct global real-time collaborative mission planning, and use multiple information sharing techniques. As a result of having a networked joint force facilitated by collaborative planning, the force will benefit from shared situational awareness, freer flowing information, fuller understanding of all issues, information shared across geographic and temporal boundaries, and near real-time ability to maintain a clearer picture/access to all relevant information. In the end, in order to improve unified action, networks must extend to interagency and multinational partners.

A force that is interoperable refers to a force that is capable of sharing and exchanging knowledge and capabilities between elements and commands at various

²⁶⁹ CCJO, 21.

²⁷⁰ CCJO, 21.

²⁷¹ CCJO, 21.

levels, and helps to eliminate the “guess work” about how countries, militaries, units, and individuals will interact in the battlespace. Common training and common understanding of concepts and terms are a huge part of interoperability. The CCJO is about common understanding of the principles of warfare and how groups are organized to fight together. This is facilitated through collaborative planning.

E. FINAL THOUGHTS ON THE CAPSTONE CONCEPT FOR JOINT OPERATIONS

The joint force decision makers of tomorrow will find themselves immersed in an environment of extreme information ambiguity. The thesis model has shown that common training and collaborative planning, at least on the basis of limited case study exploration, appear to help mitigate the debilitating effects of such an environment. Moreover, it will be imperative that the US military leaders of the future utilize common training and collaborative planning to build a joint force capable of successfully facing the future military scenarios anticipated in the CCJO. Environments of extreme information ambiguity have always existed in warfare, and this level of information ambiguity is anticipated to increase in future scenarios. One of the assumptions of the thesis model is that the debilitating effects of such environments cannot be eliminated; rather, the effects of the harmful environment may only be reduced (hopefully to a level where the joint commander may continue to make effective decisions).

Solutions detailed in the CCJO that propose to deal with future military scenarios will only be possible provided future joint force decision makers do not become overwhelmed by their inevitable environment of extreme information ambiguity. Creation of a joint force capable of this feat will be accomplished through the use of common training and collaborative planning. Validation of this claim is found in Chapter III and IV of this thesis. Specifically, these chapters underscore how the Royal Navy prepared for the battle they faced at Trafalgar in 1805 and the how the United States Navy prepared for the Battle at Midway in 1942. It is worth noting that the findings of this thesis have brought historical relevance to much of what is portrayed in the CCJO within the operational and organizational limits of time.

In conclusion, the CCJO proposed several possible characteristics for the future joint force. It was postulated that any joint force capable of implementing the solutions

previously described would require such characteristics. Close examination of these characteristics showed obvious implications for common training and collaborative planning as they pertain to assuaging the hazardous effects of an environment of extreme information ambiguity. However, when all is said and done, and as the future joint force moves towards the eventual goal of full spectrum dominance through unified action, the United States military must learn to succeed even when the environments remain ambiguous.

F. CONCLUSION: RECOMMENDATIONS

We should endeavor to explore this model through a variety of methods in addition to the two maritime case studies already done. Perhaps more research could be conducted using a more quantitative dynamical model (vice the qualitative model used for this thesis) which takes into account change in all the variables over the time of a battle. Such a statistical model could be applied against a far more quantified database of battles. This would enable detail horizontally (quantitative) and may improve the validity of the model.²⁷²

This thesis has been an initial exploration that essentially asked the question, how does the researcher think this particular aspect of the world works (i.e., decision making in an environment of extreme information ambiguity and its relation to common training and collaborative planning)? So how does one go about answering that question? In this thesis, the question was answered via an exploratory case study method which, being qualitative, took the researcher deep, not wide, into a small cross-section of the topic of decision making in environments of extreme information ambiguity. Now that the initial exploration is complete, it appears reasonable that this model should be looked into further, and since it appears to have implications for the CCJO, the model appears to be important.

²⁷² D.T. Campbell and D.W. Fiske, *Convergent and discriminant validation by multi-trait-multi-method matrix*, (Psychological Bulletin, 1959), 56, 81-105.

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APPENDICES

APPENDIX A: ACADEMIC SOURCE SURVEY

MILITARY ENVIRONMENTS-OF EXTREME-INFORMATION-AMBIGUITY STUDY

2004-2005

LT ANDY REEVES, CHIEF RESEARCHER

1. INTRODUCTION:

I AM LT ANDY REEVES. I AM DOING THESIS RESEARCH ON MILITARY ENVIRONMENTS OF EXTREME INFORMATION AMBIGUITY.

Q1. DO YOU UNDERSTAND WHAT I MEAN BY A “MILITARY ENVIRONMENT OF EXTREME INFORMATION AMBIGUITY?”

Y OR N

IF (Y,) CAN YOU TELL ME WHAT YOU MEAN BY A “MILITARY ENVIRONMENT OF EXTREME INFORMATION AMBIGUITY?”

(IF THE DESCRIPTION FITS YOURS), ASK:

Q2. CAN YOU PROVIDE AT LEAST THREE HISTORICAL OR CURRENT EXAMPLES OF AN ENVIRONMENT OF EXTREME INFORMATION AMBIGUITY?

- 1.
2. CAN YOU PROVIDE ANOTHER?
3. CAN YOU PROVIDE ANOTHER?
- 4.

(IF THE DESCRIPTION DOES NOT FIT YOURS), ASK:

Q3. COULD WE THINK OF A MILITARY ENVIRONMENT OF EXTREME INFORMATION AMBIGUITY IN THE FOLLOWING WAY?:

- **AN ORGANIZATION IS COMPOSED OF PEOPLE, EACH OF WHICH, UNDER THE RIGHT CONDITIONS, CAN BECOME A DECISION MAKER. A MILITARY DECISION MAKER IS OFTEN TIMES FACED WITH ENVIRONMENTS-OF-EXTREME-INFORMATION-AMBIGUITY.**

- AT THE MOST CONFUSING POINT OF SUCH AN ENVIRONMENT, THE DECISION MAKER REACHES A POINT AT WHICH SURVIVING SEEMS INCONCEIVABLE. HIS SENSES AND CAPACITY TO CONTINUE FUNCTIONING ARE SO OVERWHELMED, IT IS AS IF HE IS PARALYZED, AND CEASES TO FUNCTION.
- DESPITE THIS CONFUSION, A DECISION MAKER WHO HAS PREPARED HIMSELF TO DEAL WITH SUCH AN ENVIRONMENT WILL CONTINUE TO FUNCTION AND ORCHESTRATE AN OPERATION OR CAMPAIGN.
- AN ORGANIZATION THAT FUNDAMENTALLY UNDERSTANDS THAT ENVIRONMENTS-OF-EXTREME-INFORMATION-AMBIGUITY CANNOT BE AVOIDED OR ELIMINATED, WILL NOT TRY; RATHER, IT WILL WORK TO UNDERSTAND THEM, FUNCTION WITHIN THEM, AND IF POSSIBLE, REDUCE THE CONFUSING AND DEBILITATING EFFECTS OF THEM.
- THE TASK OF DEFINING AN ENVIRONMENT-OF-EXTREME-INFORMATION-AMBIGUITY IS MET BY UNDERSTANDING HOW A HUMAN'S 5 SENSES, COGNITION, AND AFFECT (EMOTIONS) FACTOR INTO AN ORGANIZATION'S ABILITY OR INABILITY TO MAKE EFFECTIVE DECISIONS IN THIS OVERWHELMING ENVIRONMENT. IN SHORT, WHAT DOES THE DECISION MAKER OF AN ORGANIZATION FEEL, AND HOW DO THESE FEELINGS AFFECT HIM.

(NOTE TO INTERVIEWER: GET INTERVIEWEE TO AGREE)

(N TO Q1) COULD WE THINK OF A MILITARY ENVIRONMENT OF EXTREME INFORMATION AMBIGUITY IN THE FOLLOWING WAY?:

- AN ORGANIZATION IS COMPOSED OF PEOPLE, EACH OF WHICH, UNDER THE RIGHT CONDITIONS, CAN BECOME A DECISION MAKER. A MILITARY DECISION MAKER IS OFTEN TIMES FACED WITH ENVIRONMENTS-OF-EXTREME-INFORMATION-AMBIGUITY.
- AT THE MOST CONFUSING POINT OF SUCH AN ENVIRONMENT, THE DECISION MAKER REACHES A POINT AT WHICH SURVIVING SEEMS INCONCEIVABLE. HIS SENSES AND CAPACITY TO CONTINUE FUNCTIONING ARE SO OVERWHELMED, IT IS AS IF HE IS PARALYZED, AND CEASES TO FUNCTION.
- DESPITE THIS CONFUSION, A DECISION MAKER WHO HAS PREPARED HIMSELF TO DEAL WITH SUCH AN ENVIRONMENT WILL CONTINUE TO FUNCTION AND ORCHESTRATE AN OPERATION OR CAMPAIGN.
- AN ORGANIZATION THAT FUNDAMENTALLY UNDERSTANDS THAT ENVIRONMENTS-OF-EXTREME-INFORMATION-AMBIGUITY CANNOT BE AVOIDED OR ELIMINATED, WILL NOT TRY; RATHER, IT WILL WORK TO UNDERSTAND THEM, FUNCTION WITHIN

- THEM, AND IF POSSIBLE, REDUCE THE CONFUSING AND DEBILITATING EFFECTS OF THEM.**
- **THE TASK OF DEFINING AN ENVIRONMENT-OF-EXTREME-INFORMATION-AMBIGUITY IS MET BY UNDERSTANDING HOW A HUMAN'S 5 SENSES, COGNITION, AND AFFECT (EMOTIONS) FACTOR INTO AN ORGANIZATION'S ABILITY OR INABILITY TO MAKE EFFECTIVE DECISIONS IN THIS OVERWHELMING ENVIRONMENT. IN SHORT, WHAT DOES THE DECISION MAKER OF AN ORGANIZATION FEEL, AND HOW DO THESE FEELINGS AFFECT HIM.**

(THEN CONTINUE WITH Q.2 ABOVE)

PROBING QUESTIONS:

- 1. WHY DID YOU CHOOSE THAT CAMPAIGN/PERSON?**
 - i) IS THERE ANY ASPECT ABOUT THE TRAINING THAT STANDS OUT?**
 - ii) IS THERE ANY ASPECT OF THE PLANNING THAT STANDS OUT?**
 - iii) CAN YOU TELL ME ABOUT HOW THIS SITUATION/CASE THAT TALKS ABOUT THE TRAINING THEY USED?**
- 2. IF HE SAYS A NAME LIKE ROMMEL:**
 - i) WHICH CAMPAIGN WOULD YOU BE TALKING ABOUT ROMMEL IN?**

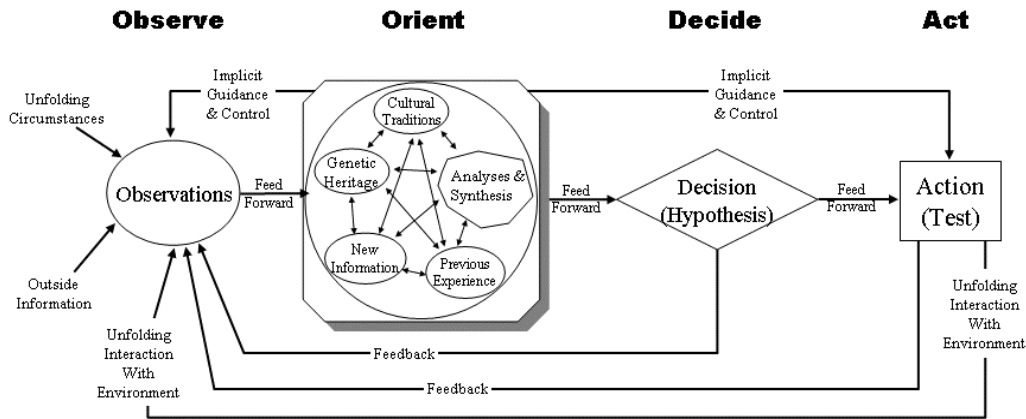
(1) ANS: NORTH AFRICA
 - ii) WHAT PART OF NORTH AFRICA? LIBIYAN CAMPAIGN OF 1941?**

(1) ANS: ANY OF HIS CAMPAIGNS.
 - iii) STOP HERE.**
- 3. IF THE ANSWER IS TOO BROAD:**
 - i) WHAT CAMPAIGN?**
 - ii) ANYTHING ABOUT THE PLANNING OF EACH SIDE THAT STRIKES YOU ABOUT THIS CAMPAIGN?**
 - iii) ANYTHING ABOUT THE TRAINING OF EACH SIDE THAT STRIKES YOU ABOUT THIS CAMPAIGN?**
- 4. CAN YOU THINK OF ANY OTHER CAMPAIGNS?**
 - i) ANS: NO**

STOP HERE. DO NOT PUSH FOR OTHERS.

APPENDIX B: BOYD'S OODA "LOOP"

Boyd's OODA "Loop" Sketch



Note how orientation shapes observation, shapes decision, shapes action, and in turn is shaped by the feedback and other phenomena coming into our sensing or observing window.

Also note how the entire "loop" (not just orientation) is an ongoing many-sided implicit cross-referencing process of projection, empathy, correlation, and rejection.

From "The Essence of Winning and Losing," John R. Boyd, January 1996.

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