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THESIS

**THE EFFECTS OF GWOT AND DEPLOYMENT INTENSITY
ON THE PROPENSITY TO DEVELOP
POST-TRAUMATIC STRESS DISORDER (PTSD)
AMONG NAVY PERSONNEL**

by

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March 2008

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AMONG NAVY PERSONNEL**

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I. INTRODUCTION

A. PURPOSE

Post-traumatic stress disorder (PTSD) is a type of anxiety disorder that is triggered by either a traumatic event or witnessing a traumatic event that happened to someone else. PTSD has tremendous impacts on the mental stability of those involved in the heaviest fighting, especially in light of the current Global War on Terrorism. In an effort to acknowledge this threat to the combat readiness the U.S. military has supported research on PTSD for the first time through the Mental Health Advisory Teams Reports (MHAT I-IV, 2006). The military has also been supporting independent research through the RAND Corporation and other academics.

With the continued deployments of large numbers of service members to combat zones in the Middle East and elsewhere, there is a continued risk for increasing rates of PTSD among our soldiers and sailors regardless of duty descriptions. Data from Iraq and Afghanistan that can be used to determine the risk factors for PTSD is becoming more available for study the longer the Global War on Terror continues. Risk assessments for deploying servicemen is one potential solution while limiting the number of combat tours seems a better, although more unlikely, option available for policy makers.

This study will give information about the potential rates of PTSD in sailors after multiple deployments to Iraq or Afghanistan as well as the impact of increased tour lengths on those rates. The results will serve to identify the current trends of PTSD among sailors based on quantitative analysis of medical data provided by AMSA and DMDC. It will also inform the Department of Defense on the potential policy implications involved in this study.

B. RESEARCH QUESTIONS

The primary research question is to analyze the effect of repeated deployment and other deployment characteristics on the rate of PTSD among Navy personnel. Secondary questions include:

- Determine the frequency of PTSD among those U.S. Navy personnel who serve longer tour lengths than those with shorter tours.
- Identify other potential risk factors for PTSD based on demographic and service characteristics.
- Identify policy implications for the Department of Defense due to these risk factors for PTSD after combat deployments.

C. STUDY OVERVIEW

There will be two main sections to the body of this thesis. The first section will be a review of the history as well as the current literature on post-traumatic stress disorder among combat veterans. The focus will be on historical treatment of mental disorders among veterans, the effect of continued exposure to combat conditions as well as the current data that has been gathered on Operation Iraqi Freedom / Operation Enduring Freedom veterans. This review will also include demographics as well as initial findings and conclusions about rates of PTSD among veterans. The second section of the thesis will provide a quantitative analysis of naval personnel and effects of longer tours of duty in the combat zone. The medical data analyzed will be provided and released from the Army Medical Surveillance Activity (AMSA) and DMDC will be combined by AMSA to obtain demographics, pre and post deployment health assessment, deployment areas, and years of deployment. Participants include all Navy personnel who responded to the Post deployment health assessment (DD Form 2796) any time from January 1999 to September 2007. Data from AMSA provides mental health information of the respondents to DD Form 2796. Data from DMDC provides demographic and deployment history of the respondents. All observations will be merged by AMSA. The thesis will specifically focus on looking to study those patients identified as having received an ICD-9 Code of 309.81 (PTSD).

The main empirical strategy for this thesis will be a nonlinear regression model to determine whether multiple independent variables such as extended tour lengths and demographics have a positive or negative sign and what magnitude they have on the dependent variable of rates of post-traumatic stress disorder. Causality will not be the focus. Instead the analysis will be on the relationship that results when all other factors are held constant.

D. ORGANIZATION OF STUDY

The rest of the thesis is organized as follows: Chapter II provides Background on PTSD and Literature Review. Chapter III describes the psychological aspects of killing and combat with the intent of explaining significant differences in the propensity of naval personnel to develop PTSD compared to Army and Marine Corps veterans in the data set. Chapter IV will discuss the summary statistics from our data set. Chapter V lays out the detailed empirical methodology. Chapter VI presents results from the data analysis. Chapter VII provides the conclusion and recommendations. Within each of these sections there is a brief synopsis of the chapter's relevance to the thesis as a whole. This additional material will enable each chapter to stand alone. The Background chapter offers a brief summary of the evolution of mental health / PTSD treatment throughout our Nation's history with particular emphasis on Army veterans due to the lack of information on PTSD within the Navy. It ends with a section detailing current military policy regarding PTSD. The Literature Review chapter offers a further analysis on the various MHAT studies done by the United States Army in order to assess trends among veterans regarding PTSD as well as several other early studies done on PTSD, to include one from the Vietnam War. The Data Set chapter will look at the data being examined from AMSA and summary statistics. The Methodology chapter will focus on the econometric model specifications and the logistic regressions used in the analysis. The results chapter will focus on the statistical significance of our model and look at the various findings. The final chapter will focus on the conclusions and recommendations based on the analysis.

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II. LITERATURE REVIEW

A. INTRODUCTION

From shell shock to battle fatigue in past conflicts to post-traumatic stress disorder (PTSD) today the combat experiences of our military is horrendous and has tremendous impacts on the mental stability of those involved in the heaviest fighting. In an effort to acknowledge this threat to the combat readiness the U.S. military has supported research on PTSD for the first time through the Mental Health Advisory Teams Reports (MHAT I-IV, 2006). The military has also been supporting independent research through several research institutions.

In this chapter we will first review the background of PTSD, starting with the clinical definition of PTSD and the criteria used to classify it. This section will also look at the specific effects on combat veterans, both in present times and in historical settings. The next section will discuss the protocols currently available to manage the effects of this disease, and specifically look at the potential policy implications involved. The following section will look at historical examples of PTSD in United States military history, from the Civil War to Vietnam. Current policy regarding PTSD will then be discussed with examples from both the Army and the Navy. We will complete this chapter by looking at recent studies conducted with data from the Global War on Terror (both Iraq and Afghanistan) as well as looking at barriers to care that were identified in an American Psychiatric Association (APA) study.

B. BACKGROUND ON PTSD

1. Clinical Definition and Prevalence of Post-Traumatic Stress Disorder (PTSD)

Post-traumatic stress disorder (PTSD) is a type of anxiety disorder that is triggered by either a traumatic event or witnessing a traumatic event that happened to someone else. To be diagnosed with PTSD, the patient must meet criteria spelled out in

the Diagnostic and Statistical Manual of Mental Disorders (DSM). This manual is published by the American Psychiatric Association and is used by mental health professionals to diagnose mental conditions. For post-traumatic stress disorder to be diagnosed, several criteria must be met, including but not limited to:

- Experience or witness an event that involved death or serious injury
- Response to the event involved intense fear, horror or a sense of helplessness
- Reliving experiences of the event, such as having distressing memories, upsetting dreams, flashbacks or even physical reactions
- Avoidance of situations that remind the patient of the traumatic event
- Hyper awareness (i.e. feel constantly on guard or alert for danger, which may cause trouble sleeping)
- Symptoms last longer than a month
- The symptoms interfere with the patient's ability to go about his/her daily tasks

The International Statistical Classification of Diseases and Related Health Problems (most commonly known by the abbreviation ICD) provides codes to classify diseases as well as identifying signs, symptoms, abnormal findings, and external causes of injury or disease. The diagnostic code of PTSD in ICD-9 is 309.81. Recognizing this code is critical for this research, as we identify servicemen with PTSD using this specific code as determined by data on the Post Deployment Health Assessment.

Wars and the traumatic events witnessed by the military are an acknowledged leading cause for the large number of veterans who suffer from PTSD (King, D. W., King, L. A., Foy, D. W., Keane, T. M., & Fairbank, J. A., 1999; Riggs, D., Byrne, C.A., Weathers, F.W. & Litz, B.T., 1998). The severity of PTSD among Vietnam veterans in particular has been widely studied and the effects have been documented (*National Coalition for Homeless Veterans, 2007*), including:

- Significant number of Vietnam veterans have committed suicide with estimates ranging from 20,000 to 150,000 although precise numbers are impossible to gather due to various factors
- 33 percentage points of adult homeless are veterans with 47 percentage points serving in the Vietnam War Era
- 45 percentage points suffer from mental illness

The wars in Iraq and Afghanistan are the longest sustained military operations since the Vietnam War. A significant portion of this new generation of combat veterans now face the reality of suffering chronic PTSD based on the high levels of stress involved in combat operations as well as the intensity of combat for our deployed troops. The rates of PTSD from an early study done indicated that the estimated risk for posttraumatic stress disorder (PTSD) from service in the Iraq War for U.S. Army and Marine Corps veterans was 18 percentage points, and the estimated risk for PTSD from the Afghanistan mission for this same population was 11 percentage points (Hoge et al., 2004). Since then the additional factors of repeated deployments and increased tour lengths, especially among Army personnel, have only increased these rates (MHAT Studies I-IV, 2004-2006). Another cause for concern is the fact that PTSD often manifests itself long after the events occurred and veterans redeploy home.

There is evidence that once veterans develop military-related PTSD their symptoms remain chronic across the lifespan and are resistant to treatments that have been shown to work with other forms of chronic PTSD. As a result it is vitally important to provide early intervention to reduce the risk of chronic impairment in veterans. However, there are troubling initial signs that soldiers from the all-volunteer professional military are reluctant to seek help or that help may not be readily available to them. For example, Hoge et al. (2004) found that although approximately 80 percentage points of Iraq and Afghanistan soldiers who had a serious mental health disorder acknowledged that they had a problem only approximately 40 percentage points stated that they were interested in receiving help and only 26 percentage points reported receiving formal mental health care. This is a critical cause for concern as the continuing perceptions of stigma being attached to those identified with mental health issues is preventing treatment in many cases. This is troubling news for not only the individuals but has implications for their future interactions in society as well.

2. Disease Management of PTSD

There is not a simple cure or effective treatment for PTSD except through therapy and medication to minimize the symptoms. Chronic PTSD is a serious disorder that must

be taken into account by policy makers with regard to the combat readiness of the fighting force. This study's intent is to show the propensity of U.S. Navy personnel to develop PTSD as well as discuss policy implications of repeated deployments and extended tour lengths on the mental health and hence the combat readiness of our sailors. Chronic PTSD rates among our combat veterans needs to be further addressed by the Department of Defense and the Office of the Surgeon General prior to military members leaving the service and becoming further statistics for suicide and homelessness.

Mismanagement of this issue could cause great harm to the U.S. military and their families. Therefore, with the data gathered from DMDC and AMSA we propose to study United States Navy service members who have deployed during the Global War on Terror timeframe (2003-2007) in order to estimate the prevalence of PTSD rates with regard to deployment frequency and tour lengths, and assess risk factors for PTSD and discuss policy implications for the U.S. military in the future. There is evidence in previous literature that we should expect PTSD rates among sailors to be much lower than either soldiers or marines. Evidence to explain this difference will be discussed in the next chapter which discusses the psychological and sociological aspects of combat prior to an examination of our data sets.

3. PTSD Historical Examples

As the understanding of psychological stresses on the combat soldier have increased among the medical community there has been more effort to identify it and, even more recently, apply preventative measures to lessen the impact on deploying soldiers and their families. This stress among fighting men is not a new phenomenon. The reaction of personnel to the carnage of combat has been recognized since Ancient times. However, as understanding and knowledge has grown over the centuries it still remains an area of concern due to the lack of outward physical wounds, lack of understanding by peers and family and the machismo that pervades most armies, ancient or modern.

a. American Civil War

The American Civil War brought new horrors to the battlefield and imposed a higher level of psychological stress among combatants than previous conflicts. Widely considered as the first modern war, the Civil War produced new technology which extended the killing ranges of small arms and made cannon fire even more deadly than before. While killing became more efficient the care of the wounded soldiers remained primitive in the extreme. The practice of modern medicine was in its infancy and explanations for non-visible wounds were absent (Marlowe, 2001).

During this time period American society had much simpler expectations of how soldiers should behave. As such, soldiers were characterized as being either brave or cowardly (McPherson, 1997). This provided few options to soldiers who were suffering from mental disorders like PTSD. To many the only option available was either desertion or claiming physical illness. Many of the acknowledged reactions to combat stress are documented throughout diaries and manuscripts from the era. “Stragglers” in particular, seemed to be the catch all phrase for those soldiers who, according to Marlowe (2001),

...were described as sitting under trees, trembling, clutching their rifles, staring into the middle distance, jumping at any loud noise—the startle response that is today usually considered diagnostic of a combat stress reaction. They were described as incapable of any kind of proximate effective soldierly behavior until swept up by the provost guards, noncommissioned officers, or officers; organized; and brought back into their encampments.

When the Civil War ended any progress towards understanding the stress of modern warfare was soon forgotten by not only the medical community but society as well. Many veterans chose not to talk about their experiences and instead either reintegrated into society or, as many did, retreat into alcohol as a way to forget. Silence has often been one of the main reactions to combat stress. The veteran finds that the civilian version of war is not the same carnage that was the veteran’s reality. Anger and

frustration abound because non-veterans just do not understand the barbarism of war. It thus becomes much safer to simply say nothing and avoid the feelings.

b. World War II

Having forgotten the lessons from World War I and other previous conflicts, the United States military in the early 1940's believed that with selective service anyone with a predisposition to mental breakdowns should and would be "selected out" with the thought-process being that this would save the taxpayers millions of dollars in psychiatric services later on. Only those identified as being without mental weaknesses would be allowed to serve. This screening process began during the induction phase and continued through basic combat training and advanced training up until the soldiers shipped overseas and went into combat. Instructors and other cadre were tasked with identifying any recruits with potential mental disorders and eliminated from service. This approach obviously was subjective and the need for increasing numbers of soldiers often overshadowed any mental health issues noted. Of course, even the most confident supporters of this policy anticipated that it would only catch fifty percent of soldiers who would ultimately have mental breakdowns from the stress of combat (Marlowe, 2001).

Once major combat operations began for U.S. forces this reliance on screening and selective service quickly lost its central focus and support when men repeatedly exposed to long periods of combat, whether in the Pacific or in North Africa, began showing signs of severe reactions to combat stress. As the war progressed the Army mental health community adopted a new strategy of "every soldier has a breaking point" as their motto. The lessons of the First World War with respect to the handling and treatment of combat psychiatric casualties (treat quickly, rest briefly, and explain and act with the expectation that the soldier will return to his unit) were initially forgotten but soon became standard (Marlowe, 2001). Soldiers and Marines who broke down during the early phases of World War II were usually evacuated, and many became long-term

psychiatric patients. Reviewing the issue of psychiatric casualties from Guadalcanal an Army psychiatrist named Theodore Lidz (1946) noted that,

...even the non-psychiatric casualties showed emotional reactions of a severity that would have been considered incapacitating in later campaigns. In addition to anxiety and depression, symptoms included headaches, anorexia . . . tremors, insomnia, nightmares and palpitation which were individual symptoms or could all be present in one man.

By the end of World War II most mental health providers realized that prolonged combat-environment exposure could alter the soldier's ability to maintain a reasonable level of performance. The anticipated reality of returning veterans with mental health issues led to the passing of the National Mental Health Act (1945) which provided for an expansion of Veteran's Affairs mental health facilities throughout the United States.

c. Vietnam

The Vietnam era is arguably the most studied generation of veterans yet. A highly complex and difficult subject to tackle due to the wide variety of literature and study results the Vietnam War deserves an examination well beyond the scope of this section. Due to its identity as the first conflict where political realities had a major impact on veterans, increased media coverage and televised raw combat footage, increased racial tensions, and arguably the first morally ambiguous war of the twentieth century, this conflict continues to provide a plethora of data on mental health disorders. This war was certainly unique in that it fell into markedly different phases, each enmeshed in differing perceptions of the war, its nature, its legitimacy, and the manner in which it was fought. It produced markedly differing cohorts of psychological casualties through time. Its largest group of psychological casualties appeared to arise after the veterans returned home among those who served in the period of lowest combat intensity. This time frame also coincides with the period when virulent anti-war protests became common and feelings of guilt, frustration, or betrayal by the government became more common among veterans.

An issue with dealing with mental health in Vietnam centered on the lack of historical data to provide clues for the military psychiatrists. First and foremost these psychiatrists tended to be newly out of training and lacked the experience necessary to deal with the large number of cases that emerged (Huffman, 1970). Second they were only provided historical examples from conflicts like World War II or Korea where only the front-line combat soldiers were exposed to the trauma. In Vietnam, a large number of cases were composed of base camp soldiers, or rear-echelon troops, who never even saw combat. Huffman observed that the extreme conditions of the environment and the constant fear of death led to many of the same symptoms that combat troops suffered from (1970). Additional factors such as high levels of drug use among soldiers, the individual replacement system which provided no support structure, and finally the often abusive treatment that veterans received after coming “home” to a culture that had been polarized by the war, all produced many theories of mental health that ultimately coalesced into what we now term post-traumatic stress disorder (Marlowe, 2001).

C. CURRENT U.S. POLICY CONCERNING PTSD TREATMENT

The Army has taken steps in the past year to alert leaders at all levels of command to be aware of the possibility of PTSD among subordinates and to be able to recognize the symptoms as well as treatment options. Detailed guidance on implementation of the program was published on 17 July 2007 in an ALARACT titled, "Interim Guidance - Army Mild Traumatic Brain Injury (MTBI) / Post Traumatic Stress Disorder (PTSD) Awareness and Response Program." A chain-teaching package was distributed to all commands, and soldiers were required to attend this training in small groups conducive to discussion no later than October 2007. This training was approved for distribution by the Army Chief of Staff.

The intent of this training package is to de-stigmatize both the mental health disorder as well as provide instructions for soldiers and leaders on how to get help for those peers or subordinates suffering symptoms that are affecting work behavior and performance. The help identified in the training package are buddies, unit leadership, unit chaplains, mental health providers (both military and civilian), ARMY One-Source,

and the Veteran's Affairs Department (Battlemind Training Office, 2007). The training package does an excellent job of relating current events and examples as a way to legitimize the behavior and encourage soldiers to seek help if they need it.

The shortcomings in both the training package and in current Army publications are the lack of identifiable processes and options after being referred to mental health physicians. In addition there is no distinction between either voluntary or involuntary (command-directed) referrals. MEDCOM Regulation 40-38 (1999) states that the reported findings and treatment/disposition recommendations of the mental health evaluation remain the responsibility of the patient's mental health care provider. The mental health provider has only two options in general: return to duty with treatment (in- or outpatient) or without treatment; or initiate Medical Evaluation Board Proceedings (MEB) to have the soldier either medically retired or discharged. If the soldier is found fit for duty by the MEB Board then he is returned to service with no further mention made in his records of mental health treatment with regards to potential for promotion or eligibility to redeploy to a combat zone.

D. RECENT STUDIES FROM IRAQ AND AFGHANISTAN

As the Global War on Terror continues into its fifth year the data available on the mental health of our combat veterans is becoming more readily available. Trends in rates of PTSD and factors affecting its prevalence are becoming easier to apply to the military population as a whole.

1. Charles W. Hoge's Study on Combat Duty in Iraq and Afghanistan

The study by Charles Hoge conducted in 2004 and published in the New England Journal is arguably the cornerstone of the research done on PTSD during the Global War on Terror. For this study an anonymous survey was given to members of three Army units and one Marine unit either preparing to deploy or just having come back from Iraq or Afghanistan. The fact that the soldiers/Marines were analyzed so soon after return from deployment is significant because, in previous conflicts, mental health studies were done long after the experiences of combat and may have been biased due to poor memory

or suppression of painful memories. The most significant findings of this study are simply the positive linear relationship between combat experiences and mental disorders like PTSD as well as identifying the barriers to care that are common among the military community. This study provided the initial recognition of a significant detractor of military readiness.

The method used to gather data for the study were through surveys. The sample size that participated was a fairly significant number including 2,530 soldiers from an Army infantry brigade of the 82nd Airborne Division, whose responses were obtained prior to a year-long deployment to Iraq; 1,962 soldiers from an infantry brigade of the 82nd Airborne Division, whose responses were obtained after a six-month deployment to Afghanistan; 894 soldiers from an Army infantry brigade of the 3rd Infantry Division, whose responses were obtained after an eight-month deployment to Iraq; and 815 Marines from the 1st Marine Expeditionary Force who had also just returned from Iraq. However, there were significant numbers who could not take the survey due to other duties; this could cause selection bias among the sample. In addition, surveys rely on honest answers from the respondents. The results of the analysis could be skewed due to those soldiers and marines who were experiencing symptoms of PTSD opting out of taking the survey due to the fear of being discovered and the perception of potentially losing their careers. The authors acknowledge that there is a potential selection bias with their methodology. The authors themselves discovered that, of those whose responses met the screening criteria for a mental disorder, only 38 to 45 percent indicated an interest in receiving help, and only 23 to 40 percent reported having received professional help in the past year (Hoge, 2004). This clearly indicates a potential bias among those administered the surveys who were concerned with the stigma of mental health disorders like PTSD. Table 1 from Hoge's study illustrates this point that 65 percentage points of those surveyed felt they would be seen as weak and 63 percentage points felt they would

be treated differently by their leaders. Only 25 percentage points of those who met the screening criteria for a mental disorder felt that mental health providers would not work.

Table 1. Barriers to Mental Health Services (From Hoge, 2004).

Perceived Barriers to Seeking Mental Health Services among All Study Participants (Soldiers and Marines)		
Perceived Barrier	Respondents Who Met Screening Criteria for a Mental Disorder (N=731)	Respondents Who Did Not Meet Screening Criteria for a Mental Disorder (N=5422)
	<i>no./total no. (%)</i>	
I don't trust mental health professionals.	241/641 (38)	813/4820 (17)
I don't know where to get help.	143/639 (22)	303/4780 (6)
I don't have adequate transportation.	117/638 (18)	279/4770 (6)
It is difficult to schedule an appointment.	288/638 (45)	789/4748 (17)
There would be difficulty getting time off work for treatment.	354/643 (55)	1061/4743 (22)
Mental health care costs too much money.	159/638 (25)	456/4736 (10)
It would be too embarrassing.	260/641 (41)	852/4752 (18)
It would harm my career.	319/640 (50)	1134/4738 (24)
Members of my unit might have less confidence in me.	377/642 (59)	1472/4763 (31)
My unit leadership might treat me differently.	403/637 (63)	1562/4744 (33)
My leaders would blame me for the problem.	328/642 (51)	928/4769 (20)
I would be seen as weak.	413/640 (65)	1486/4732 (31)
Mental health care doesn't work.	158/638 (25)	444/4748 (9)

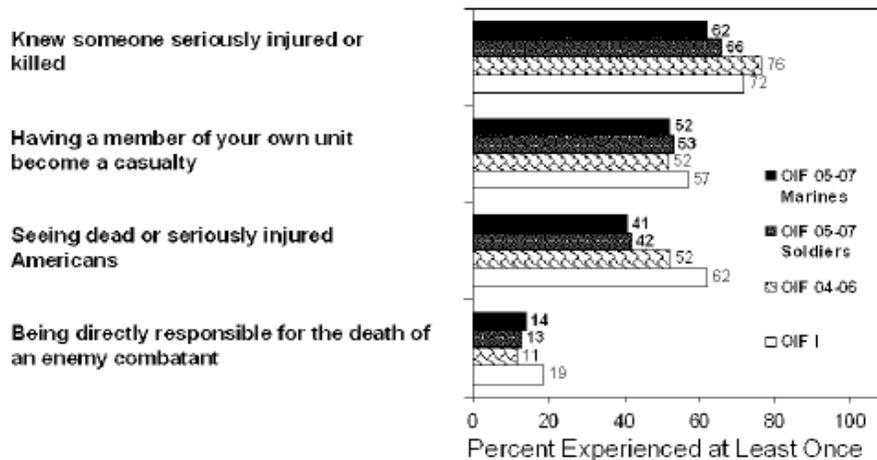
This study noted that Iraq veterans were facing more instances of combat than those in Afghanistan and, as a result, were producing higher rates of mental health issues. These rates increased as the exposure to combat increased. This positive relationship is generally what we would expect and reflect findings from previous studies (King, D. W., King, L. A., Foy, D. W., Keane, T. M., & Fairbank, J. A., 1999). Another aspect of this survey is that it focuses on PTSD among a specific sub-population of those deployed; the combat soldier. This study does not address the traditionally non-combat specialties like cooks, supply, finance, administrative, medical and others. Due to the unique nature of both Iraq and Afghanistan these non-combat specialties who may not be seeking the “thrill” of combat are exposed to the same dangers as infantrymen on a daily basis. There is the potential that these specialties may have even higher rates than infantrymen

due to the unexpected traumas of combat in Iraq and Afghanistan. As noted earlier many Vietnam veterans who developed PTSD were rear-echelon troops and not subjected to multiple periods of intense combat (Huffman, 1970).

2. Mental Health Assessment Team Surveys (MHAT)

The MHAT studies were established by the Office of the Army Surgeon General and requested by the Commanding General, Multi-National Forces-Iraq. The data for these reports came from surveys administered to soldiers and marines as well as focus groups and individual interviews that were conducted. This study is important because it was the first one conducted in the combat zone. The surveys revealed that the most common combat stressors were seeing dead human bodies, being attacked or ambushed, and knowing someone who was seriously injured or killed. The most common operational stressors were uncertain redeployment date, long deployments, being separated from family and lack of privacy (U.S. Army PAO News Release, accessed 9 February 2008 at http://www4.army.mil/ocpa/read.php?story_id_key=5798). The MHAT studies have revealed that combat operations in Iraq tend to be up close and personal. Table 2 is indicative of the high proportion of troops who have been exposed to trauma and may show a propensity towards developing PTSD:

Table 2. Combat Experiences of soldiers and marines during OIF 05-07 compared to soldiers in OIF1 and OIF 04-06 (in MHAT IV, 2007).



The findings of the MHAT IV study reveal that the level of combat is still the main determinant of a soldier's or marine's mental-health status. For soldiers, deployment length and family separations were the top non-combat deployment issues; due to shorter deployment lengths, Marines had fewer non-combat deployment concerns. As a result one of the MHAT's recommendations were for shorter deployments which would allow soldiers and marines better opportunities to "reset" mentally before returning to combat. Soldiers and marines reported general discontent with the enforcement of garrison-like rules in a combat environment. Overall, soldiers had higher rates of mental-health issues than marines but when matched for deployment length and deployment history, the mental-health rates were similar. Multiple deployments caused troops to report higher acute stress than servicemen on their first deployment. Deployment length was related to higher rates of mental-health problems.

3. APA Study on Barriers to Care

As noted above in the Current Policies section the United States military, and specifically the Army, has identified the need for research into the effects of post-traumatic stress disorder on the combat readiness of its numerous brigade-sized elements and weapon systems. However, the resulting programs and policies have thus far fallen short of being useful, effective or helpful in de-stigmatizing PTSD sufferers. The American Psychological Association, at the request of the Department of Defense, established the Task Force on Military Deployment Services for Youth, Families and Service Members in July of 2006 with the intent of identifying the mental health needs of soldiers and their family members both during and after deployment (Johnson, 2007). The programs identified in the APA study have been limited to certain installations (like Fort Lewis, WA and Schofield Barracks, Hawaii) and have not been coordinated at the DoD-level. Evidence of this is provided by Table 3 from the MHAT studies.

While Table 3 shows some improvement in the perceptions of service members about receiving mental health care there is still a significant portion of this population

that feels either stigma or difficulty in seeking help. This study by the American Psychiatric Association recommends that further research be conducted, especially in

Table 3. Perceived Barriers to Behavioral Health Services - Deployed Service Members (in MHAT IV, 2007).

	MHAT I (2003)	MHAT II (2005)
Difficult to get time off from work	43%	39%
I don't know where to get help	24%	22%
Behavioral health services not available	24%	n/a
I would be seen as weak	59%	54%
Unit leadership might treat me differently	58%	53%
Members of unit would have less confidence in me	n/a	49%
My leaders would blame me	46%	n/a
Difficult to get to location where behavioral health care provided	26%	20%
NOTE: n/a responses indicate that the item was not included in the questionnaire during its administration.		

the areas of researching mental health among special populations, such as women, minorities, and gays and lesbians. Any new policies would be best implemented by the Department of Defense. Further, the Department of Defense needs to formulate a clear plan for change that is compatible across all service branches. By providing careful oversight, mental health leaders could begin to reduce the barriers to quality care. The urgency with which this should be done cannot be overstated. Never before has our nation been engaged in a conflict requiring redeployment of service members who have already been diagnosed with PTSD to the same combat zone where they were originally traumatized. This policy was recently announced by the Assistant Undersecretary of Defense responsible for Health Affairs (Winkenwerder, 2006) and sets a dangerous precedent. The effectiveness and mental stability of these already traumatized service members is certainly suspect and sends a clear message that our Nation is willing to sacrifice the mental health of our sons and daughters for the sake of perceived military necessity.

E. SUMMARY

As the Global War on Terror continues the continued effort of researchers is paramount in making a difference in the lives of our veterans. The ability to identify demographic or service-unique characteristics that can lead to PTSD can focus mental health efforts from the medical community while promoting a willingness on the part of society to accept that PTSD is a result of combat trauma and provide the impetus to deal with these issues. In the next chapter we will be looking at the sociological and psychological aspects that are causes and indicators of PTSD. This information will be used to provide additional background data on the thought processes and aspects of combat that tend to help explain the prevalence of PTSD among our combat veterans. Following this qualitative analysis we will look in the following chapter at data on a rarely-studied population—the veterans of the U.S. Navy—and will be examining whether their rates of PTSD are similar to Army and Marine Corps veterans or if there are any trends that can be seen from deployment history and demographic information. It will provide new information on how experiences in Iraq and Afghanistan have affected our sailors and later on will provide policy recommendations for the Department of Defense as a whole.

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III. PSYCHOLOGICAL EXAMINATION OF COMBAT ON RATES OF PTSD

A. INTRODUCTION

This chapter will describe and discuss information about the sociological and psychological reasons why hostile deployments, combat and killing in general have such a significant impact on rates of post-traumatic stress disorder. This chapter will also provide background information designed to explain any significant differences in propensity to develop PTSD among the different branches of service (Navy, Army, Marine Corps, and Air Force) that we may find in the data being analyzed. LTC Dave Grossman's book, "On Killing," although written in 1995, provides us with an excellent model in order to examine how soldiers react to combat and how they can be trained to kill which potentially damages mental health for the long term. Additionally, through the use of more recent articles, we will also look at the impact of almost five years of war on a significant portion of our Nation's military strength and how LTC Grossman's book is just as important now as when he wrote it in 1995.

B. "THE SOLDIER'S DILEMMA"

In "On Killing," the author postulates that soldiers on the battlefield are faced with several choices, all of which have a tremendous impact on their mental health. Despite training, each soldier is ultimately responsible for his or her actions on the battlefield. The two obvious responses are to either fight or flee. Grossman identifies two additional options for the soldier in combat: posture or submit.

Throughout history and even in our own recent conflicts up to the Vietnam era, few soldiers actually had the will to kill when faced with the enemy. One of the most noted of military historians is S.L.A. Marshall, who discovered through his own research that only 15-20 percentage points of combat infantrymen in World War II actually fired at the enemy (1978). The remainder often never even fired their weapon at all. If they did shoot then it was often intentionally done over the heads or in the general direction

(without aiming) of the enemy with the intent of “scaring off” the enemy. This “posturing” is another one of the responses described by Grossman. The third response is flight. When confronted with the possibility of killing or being killed many soldiers will choose to flee if the opportunity presents itself. This option is usually performed by lone soldiers or soldiers who managed to get separated from their unit. Once back in the comfort of being surrounded by friends this option becomes less appealing as the desire to “not let your buddies down” becomes stronger.

Submission is the fourth response but arguably much rarer now during the Global War on Terror than in previous conflicts where the Geneva Conventions were upheld (for the most part) by our opponents. The current war against insurgents and terrorists has potentially eliminated this option from the soldier’s dilemma given the penchant in Iraq or Afghanistan for captured soldiers being beheaded or worse on television for propaganda purposes.

The military prior to Vietnam began to realize this aversion to killing and changed its training programs to improve the percentages of those willing to kill. Through operant conditioning (rewards for shooting and hitting man-shaped targets, punishment for missing) in basic training, the shooting percentages in Vietnam reached 90-95 percentage points. Over the following decades since the end of Vietnam and the Draft the men and women of the All-Volunteer Force have perhaps come close to perfecting the ability to kill. However, what has not been considered is the psychological damage done to soldiers after they redeploy home.

C. WHAT SEPARATES SAILORS FROM SOLDIERS – DISTANCE

As noted in the Literature Review chapter the majority of studies on PTSD has been done with soldiers and marines in mind. Put simply, this is due to the higher percentage of PTSD rates among ground combat troops which eliminates the Navy as well as the Air Force from the research. The question to ask is why? What factors in a hostile deployment cause this difference? Grossman suggests a simple answer to these questions by pointing out that sailors rarely kill their opponents at close range. Sailors today normally act as part of a crew of a ship with duties that may not change regardless

of whether the zone is hostile or not. In addition, the average sailor if he does pull the trigger and fires a shell or missile rarely sees the results at all, especially in modern warfare since the targets may not even be within visible range. Those sailors who have a view of battle from unmanned aerial vehicles or cameras attached to missiles still do not experience the same gut reactions as ground combat personnel do. The overload of sensory data is missing from the sailor's experience which is often a significant contributing factor to PTSD. Sailors will not smell burnt flesh and excrement, or hear the screaming, or see the blood pumping from open wounds of the enemy sailors they have killed with shell or missile. In essence, naval gunner's onboard ships are simply "servicing targets." This allows most sailors to boast of shooting down two airplanes or sinking a ship without carrying the emotional baggage of thinking about the people they killed while performing their duty.

As part of a crew, it is also much easier for sailors to attribute any killing done as being essential in preserving the safety of their comrades within the ship. The fear of letting buddies down is often quoted as being the biggest fear in combat. Another avenue of emotional escape for many sailors is that they are being ordered to target an enemy vessel by senior officers. This allows the passing of guilt from their shoulders to others (Grossman, 1995).

There is nothing personal for most sailors deployed to hostile zones. Even should a ship be hit by incoming shellfire or missiles the average sailor does not necessarily feel personally singled out for death. For a soldier or marine engaged in ground combat there is no doubt that the bullets impacting nearby are meant specifically for them and it becomes extremely personal at that point. Anger is the first emotion often felt by ground troops and helps ease the mental burden by justifying their response of shooting back. In addition most sailors do not face the death or severe wounding of comrades with such regularity as soldiers and marines do. In the course of a tour in Iraq or Afghanistan most soldiers and marines will see not only their buddies wounded and killed on multiple occasions but will also see horrors associated with the violent deaths of innocent civilians who got caught in the middle of a suicide bombing or an ambush on U.S. forces.

D. DESENSITIZATION TO HORROR

In “On Killing,” LTC Grossman points to the desensitization of our youth as a potential contributing factor to the murder rate and violent assaults committed in our country. As the youth of America today join the military they have already had years of experience in operant conditioning to kill through ultra-violent movies and video games. First person shooting games that glorify mass murder and carnage help desensitize our youth and convince them that killing is easy. Horror movies and action heroes who do not obey law and order simplify the equation for many immature teenagers into one where might makes right and violence does solve everything.

Many of the modern tools of war contribute to this desensitization of our military. With technological advances that make it possible to drop bombs and missiles with pinpoint accuracy it truly has made warfare “push button” in nature. Death and killing is observed through a television screen that helps distance emotionally the act from the actor. For many they see death on a screen and it seems no more real than the violent movie they may have seen the previous night.

Another technological advancement is the use of thermal imaging and night vision devices. These tools provide a huge advantage with regards to camouflage; darkness and terrain no longer hide the enemy from our weapon systems. In fact, because of these tools the American method of warfare has changed to fighting primarily at night. An additional positive in terms of engaging the enemy is that when using these devices enemies appear as greenish blobs or white heat spots. It is then much easier to “service targets” than if the target has a face that looks similar to ours. Technology may ease the mental resistance to killing but what it can not do is take away the emotional destruction that occurs afterwards (Grossman, 1995).

E. CURRENT INDICATIONS OF MILITARY-WIDE TRAUMA

The United States military has now been at war for five years. The level of stress on our military, especially the Army and Marine Corps, is unparalleled in our history. Multiple deployments and increased tour lengths have inevitably contributed to the

trauma that many veterans experience. As discussed above technology may make it easier to kill but a solution to post-deployment mental health issues has been sorely lacking. For those who have killed in combat the initial feelings of exhilaration at being alive are soon replaced by remorse, guilt and anger (Grossman, 1995). Remorse is powerful and an emotion that rarely goes away for combat veterans who have killed. In the moment of kill or be killed there is rapid reaction with little time to think. The killing is normally quick but remorse lasts for a lifetime, regardless of whether the killing was justified or not. Guilt and revulsion at the act soon follows as well. Once a soldier has returned to a place of safety it becomes quite normal to relive the experience only this time he or she has time to reflect on what could have happened (I could have died, he nearly got me, my wife would have been without a husband, my child without a father, what if the enemy soldier has a family, etc.). There is nothing to compare the rawness and power of these emotions and as such it should not be a surprise that many veterans have mental disorders like PTSD upon return from a combat zone. In addition this pressure on the mental health of veterans often leads to other significant actions with family and friends who can not understand the horror the service member has experienced. Throughout the literature review a common thread appears after the end of each conflict; a desire to forget about the trauma of war and an unwillingness to talk about what was experienced. This in turn has led to increases among the veteran populations concerning domestic violence and suicide, which I will now discuss.

1. Domestic Violence

Spousal abuse has always been an issue of concern for the military. In a New York Times article in February 2008 the authors note that domestic violence is not a new phenomenon in the military (New York Times, 2008). In 1998 a congressionally-mandated task force was established to look at domestic violence policy in the military and make recommendations designed to lower the rates of spousal and child abuse. The stress of military life even before the beginning of the Global War on Terror was such that the perception of the rising rates of domestic violence had to be addressed. This task force was unfortunately dissolved soon after GWOT began. The additional stress of

multiple deployments and longer tour durations has had huge impacts on families without problems let alone those with prior issues of anger and abuse. The NY Times article cites Christine Hansen, Miles Foundation Executive Director, which provides domestic violence assistance to military spouses, said “the organization’s work has tripled since the war in Iraq began” (New York Times, 2008). In FY 2003, 17,000 reported cases of spouse abuse occurred involving military personnel. Ninety-eight hundred were later substantiated after further investigation, giving a rate of substantiated aggression of 14.2 per 1000 according to the Department of Defense records (Family Advocacy Program, 2005). A 2006 study in *The Journal of Marital and Family Therapy* looked at veterans who sought marital counseling at a Veterans Affairs medical center in the Midwest between 1997 and 2003. Those given a diagnosis of PTSD were “significantly more likely to perpetrate violence toward their partners,” the study found. Domestic violence rates among veterans with posttraumatic stress disorder (PTSD) were identified as being higher than those of the general population. Couples in which the veteran was diagnosed with combat-related PTSD were compared with two other groups. The PTSD-diagnosed veterans perpetrated more violence than did those in the other groups (Sherman, M.D., Sautter, F., Jackson, M.H., Lyons, J.A., & Han, X., 2006).

Grossman’s model can also be used in the understanding of a serious sub-category of domestic violence; that of the murder-suicide. For the combat veteran the killing response stages are the same in domestic violence as they are in combat. Driven by anger and rage, the veteran may kill his or her spouse and children. At first the veteran is filled with the exhilaration of making the kill but is then immediately filled with the remorse and anguish of hurting someone they love. The overload of emotions becomes too much to handle and leads to suicide (Grossman, 1995).

The societal implications are enormous. The early identification and treatment of PTSD among veterans is vital to the stability of familiar relationships. If unchecked and not treated increasing rates of domestic violence will become more likely as the GWOT continues past its fifth year. Repeated deployments and increasing stress levels make a deadly combination that could lead to more domestic violence after returning from combat zones in Iraq or Afghanistan.

2. Suicide Rates

Suicide among veterans has been a hot topic since the Vietnam War ended. For Vietnam veterans, as mentioned in Chapter II, estimates range from 20,000 to 150,000 suicides (*National Coalition for Homeless Veterans, 2007*). Many researchers believe it may even be higher than this due to deaths being recorded by County-level coroners who might be inclined to define the cause of death as accidental or something else to ease the stigma for the surviving family. Although there is a wide variance due to lack of centralized data gathering at the Department of Veteran's Affairs this issue has again become an issue with news articles, specifically one done by CBS which is described below, describing an "epidemic" of suicides among Iraq and Afghanistan veterans. This issue has caused considerable alarm among Congress and the President.

In November 2007 President Bush signed the Joshua Omvig Suicide Prevention Act which is named for an Iowa soldier who committed suicide upon his return from Iraq. The bill requires mandatory psychological screening of veterans returning home. Those at higher risk of committing suicide would be referred for counseling. This legislation is essentially what the DD Form 2796 is meant to assess which has actually been in place since 2003. This bill primarily takes the discretion in the screening process out of the hands of Theater Combatant Commanders and makes it mandatory that all deployed soldiers receive the attention of healthcare providers. CBS News did an investigation asking all 50 states for death records that indicated suicide for both veterans and non-veterans. Forty-five states responded and this data was analyzed by Dr. Steve Rathbun, the department head and a Professor of Epidemiology and Biostatistics at the University of Georgia. He found in his analysis that "veterans were more than twice as likely to commit suicide in 2005 as non-vets. Veterans committed suicide at the rate of 18.7 to 20.8 per 100,000, compared to other Americans, who did so at the rate of 8.9 per 100,000" (CBS News, 2007). The VA and DoD have publicly questioned the validity of this study and object to the term "epidemic" based on flawed and incomplete data from death records from each state. Whether this increase in suicides is an "epidemic" or not is frankly not relevant. Any increase in the number of suicides among veterans is an indication that procedures need to be put in place to reverse this trend immediately.

F. PROJECTED FINDINGS OF DMDC / AMSA DATA SET

It is important to keep in mind that this thesis focuses only on Navy personnel who tend to have different combat experiences from the Marines or soldiers. Based on the literature review and findings from LTC Grossman's work I anticipate that the sailors in the data set will have significantly lower rates of PTSD than what would be found among soldiers and marines. This does not mean that this data is worthless, as it can surely point to trends, even among sailors, on what factors are significant in altering the rates of PTSD based on the effect of multiple deployments and increased tour lengths. Further examination of this data may provide helpful recommendations for all services within the Department of Defense. The next chapter in this thesis will examine the data provided by DMDC and AMSA in more detail and provide summary statistics for analysis.

G. SUMMARY

In this chapter we have defined and described the psychological aspects of combat, especially the act of killing, and applied it to explaining several things. First, that certain factors such as individual decisions made in combat to posture, fight, flee, and submit can help determine mental health issues after returning from deployment. Second, naval personnel may not have as high of a propensity to develop PTSD based on the distance involved in naval warfare versus the soldier or marine who is face to face with the aftermath of his or her decision to kill. The sailor has a better ability and opportunity to distance himself from the act of killing than ground troops do. Finally, we examined potential indicators that our military has become stressed to the point where combat readiness and efficiency are reduced, specifically through increases in rates of suicide and domestic violence. These acts of violence and aggression, whether aimed at the individual or at their family, often has at its root the mental anguish that servicemen experience after returning from deployments to hostile zones.

IV. DATA AND SUMMARY STATISTICS

A. INTRODUCTION

This chapter will describe and give information about the data, discuss limitations and present the summary statistics based on demographics and frequency distributions of the variables.

B. DATA SOURCE

The data for this thesis comes from both DMDC (Defense Manpower Data Center) and AMSA (Army Medical Surveillance Activity). It was constructed from two main datasets: The Active Duty Personnel Cohort File and the DD2796 Post-Deployment Health Assessment Survey. Both data files were sanitized of all identifying personal information such as Social Security Numbers by AMSA and unique identification numbers were used for each observation. This provided us with a sterile dataset with minimal risk to the human subjects while allowing for the clean merging of the two datasets. Due to the size of these files and the requirement to separately analyze officers and enlisted naval personnel two master datasets were created by merging the officer files from DMDC with the corresponding DD2796 data for one set and merging the enlisted files with the DD2796 data for the other dataset. From an original total of 13,433 officer observations and 119,126 enlisted observations from the DMDC and AMSA data file, 5,540 of them were deleted due to missing information or corrupted values, leaving 13,096 officer and 114,023 enlisted observations in the final datasets for the analysis.

1. The Active Duty Personnel Cohort File

The Active Duty Personnel Cohort File is built from the Active Duty Personnel Extract Files (PER), collected on a monthly basis, and contains one or more records for each unique combination of PER Member SSN, PER Service, and PER Personnel Type. Also included in this cohort file is the Active Duty Pay File which was helpful in determining deployment history for each service member. It has been tracking all active

duty personnel since December 1987. The dataset contained enough data elements to describe different demographic characteristics. Since the main focus of the study are naval personnel and their deployment lengths and types associated with the Global War on Terror, the data was collected in a way that deleted data prior to 2002 as well as deleting all observations for services other than the Navy. Included in this cohort file are monthly extracts from the Active Duty Pay File. The Active Duty Pay File provides data on all basic pays, special pays, as well as additional payments made on a monthly basis. Family Separation Allowance (FSA) and Hostile Fire Pay/Imminent Danger Pay (HFP/IDP), which are commonly used indicators of deployment, was used to create a deployment history for each service member. This also allowed the separation of hostile deployments from non-hostile deployments as well as deployment duration. The last information to be used in the analysis was collected in December 2006. Independent variables used for this study include sex, gender, education level, rank, marital status, and deployment history. DMDC has started gathering OIF/OEF deployment information for personnel since 2004. However, it is still relatively new and not yet useful for long term mental health analysis. DMDC has a similar file that tracks Desert Shield/Desert Storm deployment data and has proven to be important to studies surrounding this earlier conflict.

2. DD 2796 Post Deployment Health Assessments

The purpose of the DD2796 is to assess the active-duty servicemen's state of health after deployment outside the United States in support of military operations and to assist healthcare providers in identifying and providing present and future medical care. It was developed and first distributed in April 2003 shortly after OPERATION IRAQI FREEDOM (OIF) began. The DD 2796 is required per the decision of the Service component commander or commander exercising operational control if any health threats or exposures that warrant medical assessment occurred. Everyone required a DD Form 2796 must be administered with a trained health care provider during in-theater medical out-processing or within 30 days after returning to home station. This screening is used to review each active-duty servicemen's current health, mental health or psychosocial

issues commonly associated with deployments, possible deployment-related occupational/environmental exposures, and to discuss deployment-related health concerns. Positive responses require referrals for further medical evaluation. The health care provider documents referral needs and discusses resource options available.

The question evaluated in this thesis is associated with Question #12 on the DD 2796. In order to be diagnosed with PTSD, the active-duty servicemen must meet criteria spelled out in the Diagnostic and Statistical Manual of Mental Disorders (DSM) and have a diagnostic code in ICD-9 of 309.81. All four sub-questions of #12 (see Figure 1 below)

Figure 1. Question #12 of the DD Form 2796 (April 2003)

12. Have you ever had any experience that was so frightening, horrible, or upsetting that, IN THE PAST MONTH, you	
<u>No</u>	<u>Yes</u>
<input type="radio"/>	<input type="radio"/> Have had any nightmares about it or thought about it when you did not want to?
<input type="radio"/>	<input type="radio"/> Tried hard not to think about it or went out of your way to avoid situations that remind you of it?
<input type="radio"/>	<input type="radio"/> Were constantly on guard, watchful, or easily startled?
<input type="radio"/>	<input type="radio"/> Felt numb or detached from others, activities, or your surroundings?

are directly sourced from the DSM. For the purpose of this study, the propensity to develop PTSD was defined as responding positively to at least two of the four sub-questions. The remaining variables (have nightmares, avoiding situations, on guard, detached) are taken directly from the four sub-questions in Figure 1. The observations were coded as having a value of 1 if the response was “Yes” to the question; and the observation was coded 0 otherwise. This procedure is similar to that used by the MHAT studies to determine PTSD rates among its sample. When tabulated from our sample the results were given on the two tables on the following page.

Comparing these numbers with the MHAT studies we see that sailors in general have a much lower propensity to develop PTSD (2.14% for officers and 3.93% for

Table 4. Tabulated # of Navy Officers with propensity to develop PTSD

1=propensity to develop PTSD	Frequency	Percent	Cum.
0	12816	97.86%	97.86%
1	280	2.14%	100.00%
Total	13096	100.00%	

Table 5. Tabulated # of Navy Enlisted with propensity to develop PTSD

1=propensity to develop PTSD	Frequency	Percent	Cum.
0	109544	96.07%	96.07%
1	4479	3.93%	100.00%
Total	114023	100.00%	

enlisted sailors from Tables 4-5) than either combat soldiers or marines (generally in the 14-17% range according to the Hoge studies and the MHAT studies). On the surface this appears a valid conclusion given that the vast majority of sailors do not see face-to-face combat like the marines and soldiers do. The reasons for the disparity in percentages will be examined in the next chapter on the sociological and psychological aspects of PTSD among veterans. In addition, the large size of our sample (127,119 observations) compared to the MHAT studies (roughly 1,500 observations per yearly sample) seems to validate this initial conclusion. However, there are limitations in the data which will be discussed in the next section.

C. DATA RESTRICTIONS AND LIMITATIONS

The data for this analysis was limited to those observations from October 2002 until December 2006. Therefore deployments before and after this timeframe are not

within the scope of this analysis. Since the focus of this analysis was on OIF/OEF naval personnel it was felt that deployment and PTSD issues for those individuals would have had different causality factors.

Another shortcoming of reliance on the DD 2796 is in the timing of its administration. This form is given to each deployed servicemen by a healthcare provider during the redeployment process while still in the combat zone or within thirty days of arrival back at home station. Both administration scenarios are problematic. Service members are quick to realize that positive responses to many of the questions on the survey will possibly delay their redeployment. Thus many personnel will answer in such a way that mental health problems are not identified and adequately noted. In addition, the very nature of PTSD is that symptoms often do not manifest until months or even years after the traumatic event. The thirty day timeframe after redeployment is often a “honeymoon” period with family members and symptoms may be suppressed in the short term.

In these datasets the number and duration of deployments are identified by looking at the monthly pay records of every individual. Family Separation Allowance (FSA) and Hostile Fire Pay/Imminent Danger Pay (HFP/IDP) are utilized during this identification. Single sailors are not eligible to get FSA pay, so those service members without dependents have no values in their records if they were deployed to non-hostile areas in a particular month. Hostile deployments are captured in the data since they would have received HFP/IDP payments. In addition, it requires a deployment to last more than thirty continuous days in order to be eligible to receive the additional pay.

D. PRELIMINARY DATA ANALYSIS

1. Dependent and Explanatory Variables

The dependent variable **d96_ptsd** is defined as the propensity to develop PTSD by responding positively to at least two of the four sub-questions of Question #12. If a sailor met these criteria then the observation was coded as having a value of 1; and the

observation was coded 0 otherwise. This variable was the primary focus in our probit regression models due to all variables being binary in nature. The explanatory variables primarily consisted of demographic data (gender, ethnicity, age and marital status), current rank, and deployment history. These demographics were applied to both officer and enlisted datasets. Deployment history variables were built using the FSA/IDP data and were broken into several different categories. These variables will be discussed in greater detail in Chapter V as the regression models are defined and examined.

2. Data Description for Officers by GWOT Deployment / Demographics

Table 6-7 provides summary statistics background to the sample of naval officers detailing those who have deployed in support of the Global War on Terror and those who have deployed prior according to data. The percentage of officers who have deployed to GWOT is relatively high among our sample which should not be surprising since GWOT is now approaching its fifth year of conflict. Although the overall percentage of officers who have responded positively to question #12 on the DD 2796 in our sample is relatively low (less than 3 percentage points in all categories) Table 6 clearly shows an increase in the spectrum of potential mental health issues in the population of GWOT officers compared to those officers who deployed pre-GWOT. According to Table 6 even prior to the beginning of the Global War on Terror there were still significant

Table 6. Mental Health Outcomes Descriptive Statistics for Naval Officers

Dependent variables	<u>All Sample</u>		<u>Deployed pre-GWOT</u>		<u>Deployed GWOT</u>	
	mean	sd	mean	sd	mean	sd
PTSD from dd2796	2.10%	0.15	1.70%	0.13	2.30%	0.15
have nightmares	2.36%	0.15	2.14%	0.14	2.44%	0.15
avoid similar situations	1.93%	0.14	1.54%	0.12	2.09%	0.14
on guard	2.56%	0.16	2.58%	0.16	2.55%	0.16
feeling detached	1.94%	0.14	1.84%	0.13	1.98%	0.14
Total Observations	12568		3638		8930	

numbers of deployment personnel who experienced nightmares as well as feeling of being on guard or who startled easily.

Certainly these numbers become even more interesting as these two categories (pre-GWOT and GWOT) are further broken down in hostile versus non-hostile components for each category. You can see in Table 7 that deployment personnel to hostile zones, regardless of timeframe, suffer from the propensity to develop PTSD and

Table 7. Mental Health Outcomes for Officers by Hostile/Non-hostile

	<u>Deployed pre-GWOT (Non-hostile)</u>		<u>Deployed pre-GWOT (Hostile)</u>	
	mean	sd	mean	sd
PTSD from dd2796	0.80%	0.09	5.20%	0.22
have nightmares	1.28%	0.11	5.07%	0.22
avoid similar situations	0.89%	0.09	3.74%	0.19
on guard	1.10%	0.10	7.61%	0.27
feeling detached	1.10%	0.10	4.35%	0.20
Total Observations	2810		828	
	<u>Deployed GWOT (Non-hostile)</u>		<u>Deployed GWOT (Hostile)</u>	
	mean	sd	mean	sd
PTSD from dd2796	1.30%	0.11	4.90%	0.22
have nightmares	1.51%	0.12	4.83%	0.21
avoid similar situations	1.38%	0.12	3.92%	0.19
on guard	0.92%	0.10	6.75%	0.25
feeling detached	1.46%	0.12	3.32%	0.18
Total Observations	6427		2503	

other mental health issues at a much higher rate than those deployed to non-hostile areas. The increase from only .80% and 1.30% mean in non-hostile tours compared to 5.20% and 4.90% respectively in hostile tours certainly seems to confirm previous finding on the relationship between combat increasing rates of PTSD among veterans. Of additional note is the general increase in mental health symptoms even among non-hostile naval personnel from pre-GWOT to current GWOT operations. The data shows that perhaps the current operating environment is more stressful and conducive to mental strain (from .80% pre-GWOT to 1.30% GWOT) than in the past.

In Table 8 this set of summary statistics will examine the characteristics of the naval officer sample in terms of both demographics and deployment history. The rank

distribution remains relatively equal among both pre-GWOT and GWOT officers with junior officers (O1-O3) accounting for the largest percentage at roughly 61% of the

Table 8. Demographic/Deployment History of Naval Officers

	All Officer Observations		Officers deployed pre-GWOT (on or before 3/2003)		Officers deployed after GWOT (after 3/2003)	
	mean	sd	mean	sd	mean	sd
Environment of current deployment						
Non-hostile	74.53%	0.41	79.42%	0.38	72.37%	0.42
Hostile	25.47%	0.44	20.58%	0.40	27.63%	0.45
Deploy for 1-30 days	10.43%	0.31	9.87%	0.30	10.68%	0.31
Deploy for 31-180 days	14.77%	0.35	16.85%	0.37	13.84%	0.35
Deploy > 180 days	9.95%	0.30	4.75%	0.21	12.26%	0.33
Deployment History (based on 36 months prior to the current deployment)						
deployed at least once	52.98%	0.50	51.57%	0.50	53.60%	0.50
hostile deployment at least once	35.15%	0.48	31.46%	0.46	36.78%	0.48
non-hostile deployment at least once	37.97%	0.49	37.65%	0.48	38.12%	0.49
total non-hostile deployments (in months)	1.11	2.27	1.16	2.27	1.09	2.28
total hostile deployments (in months)	1.29	2.52	1.17	2.24	1.35	2.64
Rank Distribution						
Warrant Officers	4.19%	0.20	4.37%	0.20	4.11%	0.20
Junior Officers(O1-O3)	61.53%	0.49	60.36%	0.49	62.05%	0.49
Field Grade Officers (O4-O5)	29.45%	0.46	29.37%	0.46	29.49%	0.46
General Officers	0.00%	0.00	0.00%	0.00	0.00%	0.00
Gender						
Male	86.41%	0.34	86.90%	0.34	86.19%	0.35
Female	13.59%	0.34	13.10%	0.34	13.81%	0.35
Race/Ethnicity						
White	79.21%	0.41	78.96%	0.41	79.32%	0.41
Black	8.50%	0.28	8.51%	0.30	8.49%	0.29
Others	12.29%	0.33	12.53%	0.33	12.19%	0.33
Marital Status						
Single	23.51%	0.42	23.12%	0.42	23.68%	0.43
Single with dependents	13.44%	0.34	15.62%	0.36	12.46%	0.33
Any Married	58.22%	0.49	55.36%	0.50	59.52%	0.49
Education						
Bachelor's degree	47.87%	0.50	46.20%	0.50	48.61%	0.50
Master's and above	37.98%	0.49	39.52%	0.49	37.30%	0.48
Other educ. credentials	14.15%	0.35	14.28%	0.35	14.10%	0.35
Years of Service						
YOS	10.33	7.54	10.24	7.53	10.37	7.55
Sample size	13,096		4,024		9,072	

sample. Field grade officers are the next largest group with roughly 30 percentage points of the sample regardless of timeframe. Years of service and educational background also remains stable as well. The average years of service for the officers in this dataset are roughly 10-10.5 years both in general and when divided into the pre-GWOT and GWOT cohorts. Thus it appears that deployment demographics remain relatively stable between pre-GWOT and GWOT timeframes. This is probably explained by the relatively strict structure of manning combat vessels and other requirements in deployment packages.

In this dataset the overwhelming percentage of naval officers are white (79.21%) and male (86.14%). Minorities in particular make up a far smaller percentage than the general population the military tries to represent. One other note is the high percentage (37.98%) of naval officers who have obtained a Master’s Degree or higher. I would suspect that the educational background of Army or Marine officers compared to naval officers would be much lower due to higher operational tempo during GWOT and fewer opportunities for graduate education.

3. Data Description for Enlisted by GWOT Deployment / Demographics

Table 9-10 provides summary statistics background to the sample of enlisted sailors detailing those who have deployed in support of the Global War on Terror and those who have deployed prior according to data. The number of sailors who have deployed to GWOT is relatively high (77,731) compared to those who deployed prior to the start of GWOT (36,292). The large number of observations however should provide

Table 9. Mental Health Outcomes Descriptive Statistics for Enlisted Sailors

Dependent variables	<u>All Sample</u>		<u>Deployed pre-GWOT</u>		<u>Deployed GWOT</u>	
	mean	sd	mean	sd	mean	sd
PTSD from dd2796	3.90%	0.19	3.70%	0.19	4.00%	0.20
have nightmares	4.05%	0.20	4.05%	0.20	4.05%	0.20
avoid similar situations	3.74%	0.19	3.67%	0.19	3.77%	0.19
on guard	3.71%	0.19	3.67%	0.19	3.73%	0.19
feeling detached	3.50%	0.18	3.48%	0.18	3.51%	0.18
Total Observations	111498		34639		76859	

fairly reliable statistics on this population. In Table 9 the overall data supports the increase of developing PTSD and indicators for those who deployed after the beginning of the GWOT (4.00%) compared to pre-GWOT deployments (3.70%). However, there are relatively small incremental changes in each individual indicator. In fact, according to our sample, the incidence of having nightmares after deployment is the same (4.05%) for both those who deployed pre-GWOT and GWOT officers. The differences become more apparent when we break these statistics further down into hostile versus non-hostile

Table 10. Mental Health Outcomes for Enlisted by Hostile/Non-hostile

Dependent variables	<u>Deployed pre-GWOT (Non-hostile)</u>		<u>Deployed pre-GWOT (Hostile)</u>	
	mean	sd	mean	sd
PTSD from dd2796	3.00%	0.17	7.70%	0.27
have nightmares	3.21%	0.18	8.14%	0.27
avoid similar situations	3.21%	0.18	5.90%	0.24
on guard	2.54%	0.16	9.12%	0.29
feeling detached	3.07%	0.17	5.43%	0.23
Total Observations	28728		5911	

Dependent variables	<u>Deployed GWOT (Non-hostile)</u>		<u>Deployed GWOT (Hostile)</u>	
	mean	sd	mean	sd
PTSD from dd2796	3.00%	0.17	9.30%	0.29
have nightmares	2.91%	0.17	9.66%	0.30
avoid similar situations	3.12%	0.17	6.95%	0.25
on guard	2.13%	0.14	11.57%	0.32
feeling detached	3.11%	0.17	5.49%	0.23
Total Observations	63891		12968	

for both pre-GWOT and GWOT. In Table 10 we see that the difference again is between hostile versus non-hostile deployments. In general terms the number of hostile deployments for sailors is relatively low with roughly 19,000 sailors out of the total deployed population of 114,023 sailors in hostile zones. The propensity for developing PTSD and the individual indicators remain almost exactly the same for non-hostile deployments regardless of deployment timeframe. However, there are significant differences in the rates for hostile deployments. GWOT sailors have much higher indicators for PTSD overall as well as in each of the individual indicators compared to

Table 11. Demographic Data of Enlisted Naval Personnel from DMDC/AMSA

	All Enlisted Observations		Enlisted deployed pre-GWOT (on or before 3/2003)		Enlisted deployed after GWOT (after 3/2003)	
	mean	sd	mean	sd	mean	sd
Environment of current deployment						
Non-hostile	83.40%	0.31	83.70%	0.31	83.28%	0.31
Hostile	16.60%	0.37	16.30%	0.37	16.72%	0.37
Deploy for 1-60 days	9.70%	0.30	10.15%	0.30	9.47%	0.29
Deploy for 61-180 days	67.11%	0.47	57.76%	0.49	71.80%	0.45
Deploy > 180 days	23.03%	0.42	32.03%	0.47	18.50%	0.39
Deployment History (based on 36 months prior to the current deployment)						
deployed at least once	53.94%	0.50	55.24%	0.50	53.34%	0.50
hostile deployment at least once	40.98%	0.49	42.98%	0.50	40.04%	0.49
non-hostile deployment at least once	33.25%	0.47	30.15%	0.46	34.69%	0.48
total non-hostile deployments (in months)	1.27	2.88	1.30	2.92	1.25	2.85
total hostile deployments (in months)	1.50	2.47	1.60	2.33	1.45	2.53
Rank Distribution						
E1-E4	58.99%	0.49	60.30%	0.49	58.34%	0.49
E5-E7	39.00%	0.49	37.72%	0.48	39.62%	0.49
E8-E9	2.00%	0.14	1.96%	0.14	2.02%	0.33
Gender						
Male	88.10%	0.32	88.59%	0.32	87.83%	0.33
Female	11.90%	0.32	11.41%	0.32	12.16%	0.33
Race/Ethnicity						
White	55.60%	0.50	55.06%	0.50	55.92%	0.50
Black	21.60%	0.41	20.75%	0.41	22.03%	0.41
Others	22.70%	0.42	24.18%	0.43	22.05%	0.41
Marital Status						
Single	82.90%	0.38	89.56%	0.31	79.74%	0.40
Single with dependents	1.40%	0.14	1.54%	0.14	1.35%	0.14
Any Married	6.60%	0.25	6.42%	0.25	6.67%	0.25
Education						
High school graduate	85.60%	0.35	84.53%	0.36	86.15%	0.35
Bachelor's degree	5.90%	0.24	5.97%	0.24	5.88%	0.24
Master's and above	0.20%	0.05	0.21%	0.05	0.20%	0.05
Other educ. credentials	8.20%	0.28	9.28%	0.29	7.77%	0.27
Years of Service						
YOS	6.28	6.07	6.20	6.13	6.32	6.03
Sample size	114,023		36,292		77,731	

pre-GWOT hostile deployments. This could certainly be attributed to the heavier operational tempo and likelihood of experiencing a traumatic even in Iraq or Afghanistan compared to designated hostile zones prior to the beginning of GWOT.

In Table 11 this set of summary statistics examines the characteristics of the enlisted sailor sample in terms of both demographics and deployment history. The rank distribution remains relatively equal among both deployment timeframes. The one slight difference is in an increase of E5 to E7's in the GWOT deployment timeframe from 37.72% to 39.62% with a corresponding loss in the number of junior sailors from 60.30% to 58.34% during the same window. This gain is certainly positive and provides more experienced sailors to the fleet during the GWOT. It may also be an indicator of a slowdown in the number of new sailors being recruited and normal promotion rates for those already in causing overqualified sailors doing menial tasks on board usually reserved for the more junior sailors.

In terms of other demographics we find that the enlisted force is still predominantly white (55%) although much more equitable than within the officer ranks. The predominant sailor tends to be single (82.90%) and male (88.10%) and only has a high school education (85.60%). This low education achievement can almost certainly be traced to fewer opportunities for education both prior to enlisting and while deployed and fewer opportunities for higher education as a duty assignment (such as the Naval Postgraduate School for naval officers).

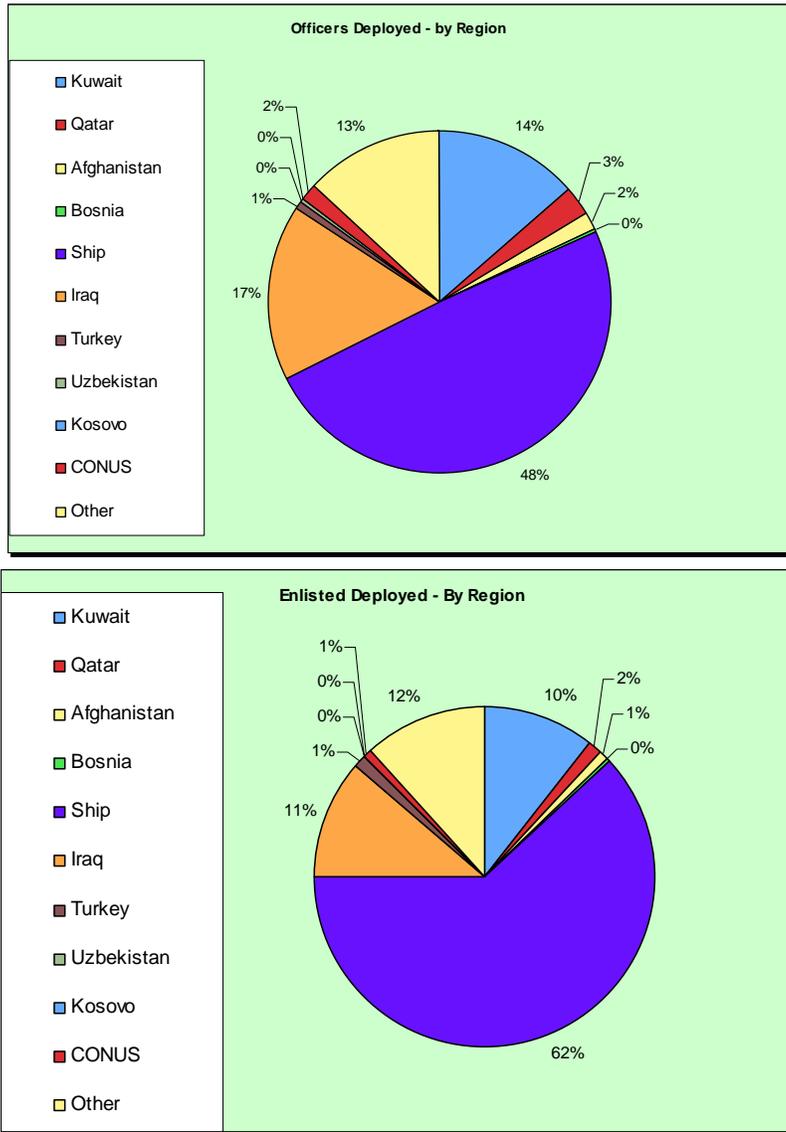
With deployment history we see that the average number of months deployed in the past 36 months has remained consistent throughout the two timeframes. The average sailor has only spent 1.27 months in a non-hostile deployment and 1.50 months during hostile deployments. In fact, according to our sample the average number of months decreased for hostile deployments in the past 3 years from 1.60 (pre-GWOT) to 1.45 months (GWOT).

4. Data Description for GWOT Deployment by Region

Another way of breaking the summary statistics into simpler terms is to look at the current deployments for both officer and enlisted samples through the use of Figure 2.

The largest number of deployments is not surprisingly those onboard a ship instead of deployments on land (48 percentage points for officers, 62 percentage points for enlisted). The next two largest percentages of deployed naval personnel is in both Iraq

Figure 2. Current Deployments by Region



and Kuwait. The Persian Gulf area is certainly the center of deployments within GWOT. Afghanistan has far fewer Naval personnel deployed (slightly more than 1000 personnel, mostly SEALs, Spec Ops support and medical support). It may be surprising to note

that, among deployed Naval personnel, 13% of officers and 12% of enlisted sailors (2078 officers, 15349 enlisted sailors) are deployed to other remote locations not included in the pie charts.

E. MAIN HYPOTHESIS

One of the main issues being analyzed is the frequency of PTSD among those U.S. Navy personnel who serve longer tour lengths than those with shorter tours. From an initial analysis of the datasets the results support the hypothesis that as the number and frequency of deployments increase, the propensity to develop PTSD is positively affected. In addition a secondary question is whether the coefficient of this positive correlation will increase after the start of Operation Iraqi Freedom in March 2003. Analysis reveals that there are differences in the propensity to develop PTSD between officers and enlisted personnel as well as hostile versus non-hostile zones both prior to GWOT and during GWOT. These differences will be further analyzed in the following chapters.

F. SUMMARY

The main focus of this chapter is to understand and to begin doing an initial analysis of the datasets provided by AMSA and DMDC. By looking at the preliminary findings, the hypothesis that the propensity of developing PTSD is positively correlated with hostile deployments to OIF/OEF as well as other demographic factors is supported by the data. Different demographic data and deployment history factors also have proven to be statistically significant in the propensity of naval personnel to develop PTSD. Results of demographic characteristics like age, education, marital status and gender support these findings and indicate that they might be the driving factors that contribute to the change in rates. The differences between the frequency and duration of hostile and non-hostile deployments can also be considered important variables in determining propensity for developing PTSD. In the following chapters probit models will be further defined and used to explain these differences.

V. ANALYTICAL METHOD / VARIABLE DEFINITIONS

A. VARIABLE DEFINITIONS

This chapter will describe and give information about the models used in the probit regressions and define both dependent and independent variables. The primary research objective is to analyze the effect of repeated deployment and other deployment characteristics on the rate of PTSD among Navy personnel. Secondary questions include identifying other potential risk factors for PTSD based on demographic and service characteristics. Finally we will identify policy implications for the DoD due to these risk factors for PTSD after combat deployments.

1. Dependent Variables Defined

a. Primary Variable

The primary variable is **d96_ptsd**. In our model this variable is binary, where propensity to develop PTSD equals 1 and no propensity for PTSD equals 0. The variable was defined as meeting the requirements for having a propensity to develop PTSD by responding positively to at least two of the four sub-questions of Question #12 on the DD Form 2796. These criteria meet the requirements set down in the ICD-9 medical handbook for 309.81 (PTSD).

b. Secondary Variables

(1) **d96_nightmares**. In our model a secondary dependent variable is defined as experiencing nightmares related to deployment. The variable is binary, where having nightmares equals 1 and a score of 0 otherwise. This variable is based on one of the four sub-questions of Question #12 on the DD Form 2796.

(2) **d96_avoid_situations**. A secondary dependent variable is defined as avoiding situations that trigger memories of trauma that occurred during

deployment. The variable is binary, where avoiding situations equals 1 and a score of 0 otherwise. This variable is based on one of the four sub-questions of Question #12 on the DD Form 2796.

(3) **d96_on_guard.** Another dependent variable is defined as being hyper-alert and borderline paranoia. Service members who responded positively to this question are always searching for hidden danger regardless of the location. The variable is binary, where being on guard equals 1 and a score of 0 otherwise. This variable is based on one of the four sub-questions of Question #12 on the DD Form 2796.

(4) **d96_detach.** A final dependent variable is defined as feeling emotionally detached from a loved one and society in general. It is an inability to feel connected to anything or anybody not directly related to the traumatic experience. The variable is binary, where feeling detached equals 1 and a score of 0 otherwise. This variable is based on one of the four sub-questions of Question #12 on the DD Form 2796.

2. Explanatory Variables Defined

a. *Current Deployment / Deployment History Variables*

These explanatory variables are critical in the analysis of this data set as we examine whether current deployments to Iraq and Afghanistan (GWOT) have a different impact on rates of PTSD compared to previous deployments. Another factor that we will examine is whether hostile or non-hostile has an impact on rates of PTSD. Finally we also look at whether duration of deployments has an influence.

(1) **GWOT.** This variable is defined as a current deployment that corresponds with the beginning of the Global War on Terror, specifically the beginning of OPERATION IRAQI FREEDOM in March 2003. The variable is binary, where being deployed from April 2003 onward equals 1 and a score of 0 indicating deployment prior to April 2003. This variable is expected to have a positive sign on the partial effect.

(2) **HOSTILE_DEPLOYMENT.** This variable is defined as a current deployment to a hostile zone. The variable is binary, where being deployed in a hostile environment equals 1 and a score of 0 indicating a current non-hostile deployment. This variable is expected to have a positive sign on the partial effect.

(3) **DEPLOYONCE36.** This variable is defined as having deployed at least once in the past 36 months. This variable makes no distinction between hostile and non-hostile deployments. It examines the deployment history for each observation to determine if any differences with current deployments are significant. The variable is binary with a positive response equals 1 if deployed at least once (hostile or non-hostile) in past 36 months; 0 otherwise. This variable is expected to have a positive sign.

(4) **CURR_DEP_DURATION.** This variable describes the length of current deployments in terms of total days deployed. There are three individual variables that comprise this grouping: CURR_DEP_DUR60 are those sailors who have deployed from 1-60 days. CURR_DEP_DUR180 are those who have deployed from 60-180 days and CURR_DEP_MORE180 are those with more than 180 days of deployment. Each is binary with a positive response equals 1 if deployed for the specified duration; 0 otherwise. This variable is expected to have a positive sign.

(5) **HOST_DEP_DURATION36.** This variable describes the length of hostile deployments in terms of total days deployed over the course of the past 36 months. There are three individual variables that comprise this grouping: HOST_DEP_DUR60 are those sailors who have deployed from 1-60 days. HOST_DEP_DUR180 are those who have deployed from 60-180 days and HOST_DEP_MORE180 are those with more than 180 days of deployment in the past 36 months. Each is binary with a positive response equals 1 if deployed for the specified duration; 0 otherwise. This variable is expected to have a positive sign.

b. Demographic Variables

(1) **Gender (MALE, FEMALE).** Males will be the control group and excluded from the actual regression. Females are represented in both enlisted and officer data sets.

(2) **Race (WHITE, BLACK, RACE_OTHER).** The variables for race are binary and consist of WHITE, BLACK, and RACE_OTHER. White observations are the predominant race, especially among officers. WHITE is the control group for the regressions. Black naval personnel are the next category of race. The remaining sailors were all other races and were grouped together to simplify the analysis. These variables are binary.

(3) **Marital Status (SINGLE, SINGLE_DEP, MARRIED).** The overwhelming majority of enlisted sailors are single and therefore SINGLE (with no dependents) is the control group for the regressions. All three categories are binary. The variable SINGLE_DEP is defined as single sailors who have dependent children in one form or another (single parent, divorced and sharing custody, etc.). The MARRIED variable includes both traditional couples (one service member, one civilian) and jointly married couples (both service members are in the Navy).

(4) **YOS.** Years of service are a continuous variable and are measured in years. It was calculated by taking the Pay Entry Basic Date (PEBD) data from the DMDC data set and subtracted from the date that the dataset was extracted on.

(5) **Education (HSG, BACHELORS, MASTERS OTHER_EDCREDS).** This variable is binary for all four categories and differs slightly in the officer and enlisted data sets. In order to be qualified for commission officers must be a high school graduate. Therefore this category was eliminated from the officer analysis. The control group for officers was BACHELORS and HSG for enlisted. The BACHELORS variable was defined as the observation having a four year undergraduate degree from an accredited college or university regardless of area of study. The MASTERS variable includes all sailors with graduate degrees to include both Masters

and doctoral degrees. The variable OTHER_EDCREDS refers to any education credentials other than those identified in the three other categories. The intent is to simplify the analysis of this variable.

(6) **RANK (JROFFICERS, FGOFFICERS, WARRANTS, E1E4_RANK, E5-E7_RANK, E8-E9_RANK)**. All variables are binary. The control group for the officer data set is JROFFICERS as they make up the majority of the sample. The control group for the enlisted data set is E1E4_RANK as they represent the majority in the sample. These variables were defined as the rank the observation holds at the time that the data was collected from DMDC.

B. ANALYTICAL METHOD

1. Theoretical Model

Due to the inherent shortcomings of the Linear Probability Model (LPM) which include intrinsic heteroskedasticity, predicted values are not constrained to be between zero and one, and the partial effect of any explanatory variable will be constant we will use a binary response model instead. This alternative model to the LPM, the probit model, will be used which is nonlinear and will require maximum likelihood estimation. This maximum likelihood estimation is advantageous in that the heteroskedasticity is already accounted for because it is based on the distribution of the dependent variables given the explanatory variables. The theoretical model is given as a function:

$$G(\beta_0 + x\beta), \text{ where } 0 < G(z) < 1$$

where: G = is the standard cumulative distribution function (cdf)

x_i = values of explanatory variables

- The cdf can be expressed as an integral in the probit model:

$$G(z) = \Phi(z) \equiv \int_{-\infty}^z \phi(v) dv$$

where: $\Phi(z)$ is the standard normal density

In general, the analysis will consist of looking at the effect of x on $P(y=1|x)$. The coefficients of the explanatory variables only give the sign of the partial effect (either positive or negative). The magnitude of the partial effects will depend on all of the x 's.

2. Model Specification

The different models being used in the analysis are listed below. A full description of each variable will be given in the next section of the chapter. Although there will be five models listed each model is being run on both enlisted and officer naval personnel. In the analysis chapter they will each be evaluated separately. The base model that we will use is described below:

$$P(y = 1|x) = \beta_0 + \beta_1 X_1 + \beta_2 X_2$$

where X_1 = deployment and deployment history data

where X_2 = demographic data and rank

The vector X_1 will change in each model. The differences will be listed and defined. The vector X_2 will remain constant across the probit regression models for both officer and enlisted data sets.

*a. Probit Model Including (GWOT*Hostile Deployment) Interaction*

The first model we will use deals specifically with the effect that a current hostile deployment to the Global War on Terror has on the propensity to develop PTSD among naval personnel. This model includes all demographic factors as well as an interaction term for the two variables that are being examined. The deployment variables will include:

GWOT = 0 if deployed prior to 4/2003; 1 if deployed after 4/2003

HOST_DEP = 0 if deployed to a non-hostile zone; 1 to a hostile zone

DEPLYONCE36 = 1 if deployed at least once (hostile or non-hostile) in past 36 months; 0 otherwise.

GWOT*HOST_DEP = interaction of two explanatory variables

where X_2 = demographic data and rank

b. Probit Model Including (GWOT*Current Deployment Lengths) Interaction

The second model we will use looks at current GWOT deployment duration lengths and examines what impact they have on propensity rates for developing PTSD among naval personnel. The control group for deployment duration lengths is the sailors who have currently deployed from one to sixty days. The second variable is the sailors who have currently deployed from 61 days to 180 days. The third variable is for those sailors who have currently deployed for more than 180 days. This model also includes all demographic factors (X_2) as well as an interaction term for the two variables that are being examined. The deployment variables will include:

CURR_DEP_DURATION = Control Group is CURR_DEP_DUR60,

CURR_DEP_DUR180 and CURR_DEP_MORE180 will be included (variables are binary).

GWOT*CURR_DEP_DURATION = interaction of two explanatory variables.

c. Probit Model Including (GWOT*Hostile Deployments in Past 36 Months) Interaction

The third model we will use looks at hostile deployment duration lengths over the course of the past 36 months of our study and examines what impact they have on propensity rates for developing PTSD among naval personnel. The control group for hostile deployment duration lengths is the sailors who have deployed to a hostile zone from one to sixty days in the past 36 months. The second variable is the sailors who have deployed to a hostile zone from 61 days to 180 days in the past 36 months. The third variable is for those sailors who have currently deployed for more than 180 days to a hostile zone in the

past 36 months. This model also includes demographic factors as well as interaction terms for GWOT and all hostile deployments in the past 36 months. The deployment variables will include:

HOST_DEP_DURATION36= Control Group is HOST_DEP_DUR60, HOST_DEP_DUR180 and HOST_DEP_MORE180 will be included (variables are binary)

GWOT*HOST_DEP_DURATION36 = interaction of two explanatory variables.

d. Probit Model Including DEPLOYONCE_HOST36 Variable

The fourth model we will use looks at those soldiers who have deployed at least once to a hostile zone over the course of the past 36 months of our study and examines what impact this has on propensity rates for developing PTSD among naval personnel. This model also includes all demographic factors as well as an interaction term for GWOT and the current deployment is hostile. The deployment variables will include:

DEPLOYONCE_HOST36= 1 if deployed at least once (hostile) in past 36 months; 0 otherwise.

*e. Probit Model Including (GWOT*DEPLOYONCE_HOST36) Interactions*

The final model looks at multiple interactions between hostile deployment and GWOT, GWOT and whether the observation deployed at least once to a hostile area in the past 36 months, and between GWOT and whether the soldier has deployed at least once in the past 36 months regardless of whether the zone was hostile or non-hostile. Our model examines what impact the Global War on Terror combined with deployments

(both hostile and total) has on propensity rates for developing PTSD among naval personnel and includes all demographic factors as well. The deployment variables will include:

GWOT*DEPLOYONCE_HOST36 = interaction of two explanatory variables.

GWOT*DEPLOYONCE36 = interaction of two explanatory variables.

C. SUMMARY

This chapter has provided further details into the probit models that will be used to analyze the data sets. It also provided the theoretical model that the probit models are based on. The second section dealt with descriptions of both dependent and explanatory variables so there is a clear understanding of what is being compared and analyzed in the next chapter.

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VI. RESULTS OF THE ANALYSIS

A. OVERVIEW

In this chapter we will examine results from various probit models examining the effects of current deployment and deployment history characteristics as well as demographics. The purpose of the models is to determine the effect of repeated deployments and other deployment characteristics on the rate of PTSD among Navy veterans. Secondary questions include identifying other potential risk factors for PTSD based on demographic and service characteristics. A total of five models were built with the intent of separating out any coefficient estimates or group of coefficient estimates had a significant impact on the propensity to develop PTSD. With probit models we will be looking at not only the coefficients to give us sign (positive or negative) and significance but also at the magnitude of the coefficient estimate's effects.

The five models being analyzed contain the same demographic and service information. What separates these models is the deployment variable type, specifically in hostile versus non-hostile, pre-GWOT versus GWOT, and deployment duration. In addition we will be analyzing the enlisted data set separately from the officer data set to ensure that one group does not corrupt the other group's findings. Both officers and enlisted will be analyzed using the probit models. As a reminder, the models that will be examined are the following:

- Model (1) with the effect that a current hostile deployment to the Global War on Terror has on the propensity to develop PTSD among naval personnel.
- Model (2) looks at current GWOT deployment duration lengths and examines what impact they have on propensity rates for developing PTSD among naval personnel.
- Model (3) analyzes hostile deployment duration lengths over the course of the past 36 months preceding the current deployment and

examines what impact they have on propensity rates for developing PTSD among naval personnel.

- Model (4) looks at those sailors who have deployed at least once to a hostile zone over the course of the past 36 months preceding the current deployment and examines what impact this has on propensity rates for developing PTSD among naval personnel.
- Model (5) examines multiple interactions between hostile deployment and GWOT, GWOT and whether the sailors deployed at least once to a hostile area in the past 36 months, and between GWOT and whether the sailors has deployed at least once in the past 36 months regardless of whether the zone was hostile or non-hostile.

B. PROPENSITY TO DEVELOP PTSD MODELS

1. Evaluation of Coefficients for Officer Data Set

There were a total of five dependent variables and 25 independent variables for the officer data set. There were a total of three of the ten demographic coefficient estimates that were statistically significant generally speaking according to our models. For the deployment/deployment history coefficient estimates there were only three of the fifteen that were found to be statistically significant for the naval officers. These coefficient estimates will be discussed in greater detail in the next section. Table 12 will demonstrate Model (1), the base model, coefficients and significance levels. Significant control coefficient estimates will only be discussed later in the chapter for Model (1) as they remain the same in each subsequent model.

a. Model (1) Including Key and Control Variables

The initial model that was analyzed looked at the effect that a current hostile deployment to either Iraq or Afghanistan for the Global War on Terror has on the propensity to develop PTSD among naval officers. This model was general in nature and

was meant to act as a base model where the subsequent models could be sub-divided into more specific deployment characteristics. For officers currently deployed to GWOT

Table 12. Probit Model (1) for Naval Officers (Including Control Variables)

Model 1: GWOT*hostile deployment	
Deployed after GWOT	0.007** (0.003)
Hostile Deployment	0.041*** (0.010)
Deployed at least once in 36 months prior to current deployment	-0.001 (0.002)
GWOT*Hostile Deployment	-0.005 (0.005)
Female	0.015*** (0.005)
Black	0.001 (0.004)
Other Race	0.006 (0.004)
Master's Degree	0.004 (0.003)
Other Education Credentials	0.006 (0.005)
Married	0.005* (0.003)
Single with Dependents	0.004 (0.005)
Warrant Officers	0.003 (0.008)
Field Grade Officers	0.006** (0.003)
Years of Service	0.00006 (0.0002)
Observations	10361
Standard Errors in parentheses	
* significant at 10% ** significant at 5%	

this coefficient estimate was statistically significant at the .05 level. The expected sign of the coefficient estimate was positive as anticipated. The coefficients indicate that the average officer with service in GWOT may have a higher than normal propensity to develop PTSD than those who deployed prior to the beginning of GWOT although it

seems to be a relatively small difference. The coefficient estimate for hostile deployment had a more statistically significant outcome at the .01 level. The average naval officer's probability of developing PTSD if deployed to a hostile zone has a 4.1 percentage point higher risk than those with deployments to a non-hostile zone. The coefficient estimate that describes those officers who deployed at least once in 36 months prior to current deployment was not statistically significant in this model. These findings are confirmed by previous studies (MHAT I-IV, 2006; King, D. W., King, L. A., Foy, D. W., Keane, T. M., & Fairbank, J. A., 1999; Riggs, D., Byrne, C.A., Weathers, F.W. & Litz, B.T., 1998) that hostile deployments are a major factor in the propensity to develop PTSD among active-duty servicemen.

The interaction coefficient estimate for GWOT and hostile deployment was also not significant. This coefficient estimate was looking at whether a hostile deployment to GWOT was statistically different from those who had deployed prior to April 2003. This result seems to indicate that for the average naval officer the particular campaign is not as relevant as whether it is hostile or not.

There were ten control variables of which only three were generally statistically significant for naval officers. Being female was significant at the .01 level with a positive sign. This finding indicates that for the average female naval officer the propensity to develop PTSD is higher than for males by 1.5 percentage points. For the marital status control group single was the base group. The coefficient estimate for married was also significant although at a lower .10 level. For the officer data set the majority of the sample was married and could account for the significance. The sign was positive although the magnitude of the difference was only 0.5 percentage points. The coefficient estimate for singles with dependents was not significant. For the rank control group the base group was junior officers in the grade of O1-O3. The coefficient estimate for field grade officers was significant at the .05 level but the magnitude was very small at 0.6 percentage points. The warrant officers coefficient estimate was not significant. When years of service were calculated, it was determined that this coefficient estimate was not significant.

b. Model (2) – Model (5) Key Variables

In the following four models the deployment characteristics were further broken down into unique sub-groups. The demographic data was left out of Table 13 in

Table 13. Probit Regression Models (2-5) for Naval Officers

Model 2: GWOT*Current Deployment Lengths		Model 4: Deployonce_host36	
	0.001 (0.010)		0.007** (0.003)
Deployed after GWOT		Deployed after GWOT	
Deployed at least once in 36 months prior to current deployment	-0.002 (0.003)	Deployed at least once in 36 months prior to current deployment	0.004 (0.003)
Current Depl lasted 60-180 days	0.01 (0.008)	Hostile Deployment	0.041*** (0.010)
Current Depl lasted > 180 days	0.005 (0.011)	GWOT*Hostile Deployment	-0.005 (0.005)
GWOT*Current Depl 60-180 days	0.001 (0.011)	Deployed at least once to hostile area in 36 months prior to current deployment	-0.007** (0.003)
GWOT*Current Depl >180 days	0.028 (0.022)		
Model 3: GWOT*Hostile Deployments in Past 36 months		Model 5: GWOT*deployonce_host36	
Deployed after GWOT	0.008*** (0.003)	Deployed after GWOT	0.007* (0.004)
Deployed at least once in 36 months prior to current deployment	-0.001 (0.003)	Hostile Deployment	0.041*** (0.010)
Hostile Deployment Duration 60-180 days	-0.004 (0.007)	Deployed at least once in 36 months prior to current deployment	0.003 (0.006)
Hostile Deployment Duration >180 days	0.005 (0.014)	GWOT*Hostile Deployment	-0.005 (0.005)
GWOT*Hostile Deployment Duration 60-180 days	-0.001 (0.008)	Deployed at least once to hostile area in 36 months prior to current deployment	-0.005 (0.006)
GWOT*Hostile Deployment Duration >180 days	-0.009 (0.008)	GWOT*Deployed at least once to hostile area in 36 months prior to current deployment	-0.002 (0.007)
Observations	10361	GWOT*Deployed at least once in 36 months prior to current deployment	-0.001 (0.007)
Standard Errors in parentheses			
* significant at 10% ** significant at 5% *** significant at 1%			

order to focus on the primary independent variables. The models were generally divided into deployment duration and hostile versus non-hostile deployments both currently and over the past 36 months.

Model (2) looks at current GWOT deployment duration lengths and examines what impact they have on propensity rates for developing PTSD among naval personnel. In Model (2) none of the deployment coefficient estimates were statistically significant. This indicates that for the average officer that deployment length had little to no impact on the propensity to develop PTSD. Even the interaction coefficient estimates that included deployment to GWOT did not produce any substantive difference.

Model (3) analyzes hostile deployment duration lengths over the course of the past 36 months. None of the deployment coefficient estimates were statistically significant. The results are surprising in that for naval officers the length of deployments, even in hostile zones, did not have a significant effect on the propensity to develop PTSD. For officers at least the data supports the findings that duration in hostile areas is not as significant a factor as other coefficient estimates. The only coefficient estimate that had any significance was GWOT which has a positive sign but a magnitude of only 0.8 percentage points at the .01 level.

Model (4) looks at those officers that have deployed at least once to a hostile zone over the course of the past 36 months, to include GWOT. This model does comparisons between those who have deployed to a hostile zone and those who have not. The results of this model indicate that hostile deployments regardless of campaign title are significant factors in the propensity to develop PTSD. Experiencing trauma is the key indicator of increasing PTSD rates as supported by this data. The coefficient estimate for hostile deployment remains the most statistically significant at the .01 level with a positive sign and a magnitude of 4.1 percentage points. Thus for the average naval officer the probability of developing PTSD increases by 4.1 percentage points if the current deployment was hostile compared to non-hostile deployment. The coefficient estimate for GWOT was also significant at the .05 level with a positive sign. For officers who have been deployed at least once in 36 months prior to current GWOT deployment the coefficient estimate was not significant in this model. However, if an officer has been

deployed at least once to a hostile region during the 36-month look-back window, his probability of developing PTSD is lowered by 0.7 percentage points ($p\text{-value}<0.01$) compared to those who had not been deployed to a hostile region.

Model (5) examines multiple interactions between hostile deployment and GWOT, GWOT and whether the officers deployed at least once to a hostile area in the past 36 months prior to current deployment, and between GWOT and whether the observation has deployed at least once in the past 36 months prior to current deployment regardless of whether the zone was hostile or non-hostile. The results of this model again indicate that hostile deployments are the most significant factor in the propensity to develop PTSD with a positive sign and a magnitude of 4.1 percentage points ($p\text{-value}<0.01$). Whether the deployment happens before or after GWOT does not change the probability of developing PTSD.

2. Evaluation of Coefficients for Enlisted Sailors Data Set

There were a total of five dependent variables and 25 independent variables for the enlisted data set. There were a total of eight of the eleven demographic coefficient estimates that were statistically significant according to our models. In general, for the deployment/deployment history coefficient estimates there were only eleven of the fifteen that were found to be statistically significant for sailors. These coefficient estimates will be discussed in greater detail in the next section. Table 14 will demonstrate Model (1), the base model, coefficients and significance levels. Significant control variables will only be discussed later in the chapter for Model (1) as they remain the same in each subsequent model.

a. Model (1) Including Key and Control Variables

The initial model that was analyzed looked at the effect that a current hostile deployment to either Iraq or Afghanistan for the Global War on Terror has on the propensity to develop PTSD among sailors. This was the base model again used to help sub-divide deployment characteristics into more specific groups. The propensity to develop PTSD does not increase after the start of GWOT. Table 14 shows that hostile

deployment was significant as expected at the .01 level. The data results indicate that for the average sailor the propensity to develop PTSD increases by 4.6 percentage points if deployed to a hostile zone compared to deployment to a non-hostile zone. For sailors

Table 14. Probit Model (1) for Enlisted Sailors (Including Control Variables)

Model 1: GWOT*hostile deployment	
Deployed after GWOT	-0.003 (0.001)
Hostile Deployment	0.046*** (0.004)
Deployed at least once in 36 months prior to current deployment	0.002* (0.001)
GWOT*Hostile Deployment	0.009*** (0.003)
Female	0.014*** (0.002)
Black	0.007*** (0.002)
Other Race	0.007*** (0.002)
Bachelors Degree	0.001 (0.003)
Master's Degree	0.002 (0.014)
Other Education Credentials	0.009*** (0.002)
Married	0.007*** (0.003)
Single with Dependents	0.001 (0.004)
Junior NCOs (E5-E7)_rank	-0.010*** (0.002)
Senior NCO's (E8-E9)_rank	-0.017*** (0.004)
Years of Service	-0.0004*** (0.0001)
Observations	98680
Standard Errors in parentheses	
* significant at 10% ** significant at 5%	
*** significant at 1%	

who had been deployed at least once during the preceding 36 months, there was also a positive sign and a .10 level of significance although the magnitude was quite small at 0.2 percentage points.

The interaction term between GWOT and hostile deployment indicator was also statistically significant at the .01 level but the magnitude was only 0.9 percentage points. Thus compared to sailors who were deployed to hostile zone before GWOT, sailor deployed to a hostile area after GWOT starts has a higher propensity to develop PTSD by 0.9 percentage points.

There were ten control coefficient estimates of which eight were statistically significant for sailors. This finding indicates that the female sailor has a higher probability to potentially develop PTSD than males by 1.4 percentage points. For the race control group white was the base group. The coefficient estimates for black and other races were significant at the .01 level but only had a magnitude of 0.7 percentage points each. Education had little impact on the average sailor's propensity to develop PTSD. The only coefficient estimate that proved significant was those sailors who had alternate educational credentials compared to those sailors with a high school diploma. The coefficient estimate for other educational credentials was significant at the .01 level with a positive sign and a magnitude of only 0.9 percentage points. In the marital status control group singles were the base group with well over 80 percent of the sample. The coefficient estimate for married sailors was also significant although at a .01 level with a magnitude of 0.7 percentage points. For the enlisted data set the majority of the sample was single. The coefficient estimate for singles with dependents was not significant.

The rank and years of service coefficient estimates were significant and were negative in sign as expected. It is reasonable to assume that as sailors increase rank and years of service their maturity and ability to cope with trauma and stress will improve thus lowering the propensity of these groups to develop PTSD. The base group for rank was the junior sailors in the rank of E1-E4 who constituted a majority of the sample. The coefficient estimate for junior NCOs (E5-E7) was significant at the .01 level and had a negative sign. Thus for the average sailor in the rank of E5-E7 the probability that they would develop PTSD decreases by 1 percentage points compared to junior sailors in the ranks of E1-E4. The coefficient estimate for senior NCOs (E8-E9) was also significant at the .01 level and had a negative sign. Thus for the average sailor in the rank of E8-E9 the probability that they would develop PTSD compared to the junior sailors decreases by 1.7

percentage points. Although statistically significant at the .01 level the coefficient estimate for years of service had a negligible magnitude of -0.1 percentage points. Thus for the average sailor each additional year of service results in the probability of developing PTSD declines by 0.1 percentage points.

b. Model (2) – Model (5) Key Variables

In Table 15 the four models were again divided into unique sub-groups for the deployment characteristics. The demographic data was left out of the models in order to focus on the primary independent variables. The models were divided into deployment duration and hostile versus non-hostile deployments both currently and over the past 36 months.

Model (2) looks at current GWOT deployment duration lengths and examines what impact they have on propensity rates for developing PTSD among naval personnel. In Model (2) several of the deployment coefficient estimates were statistically significant. This indicates that for the average sailor that deployment length did have an impact on the propensity to develop PTSD. Compared to sailors whose deployment duration is fewer than 30 days, those with longer duration has a higher probability to potentially develop PTSD (1.6 percentage points if duration is 60-180 days; 1.8 percentage points if more than 180 days). Moreover, long deployment after GWOT starts increases the propensity to develop PTSD by 2.7 percentage points. This difference between officers where deployment lengths were not significant (Table 13) and enlisted sailors where it was (Table 15) could be explained by other factors to include the younger age of the average sailor compared to officers. It could also perhaps be explained by the different tasks assigned on board the typical naval vessel. The tasks of officers may in some manner have a mentally stimulating effect whereas the monotonous routine for the average sailor may increase the effect of a traumatic experience as the deployment gets longer in duration.

Model (3) analyzes hostile deployment duration lengths over the course of the past 36 months. These results were surprising in that the expected significance of hostile

Table 15. Probit Regression Models (2-5) for Enlisted Sailors

Model 2: GWOT*Current Deployment Lengths		Model 4: Deployonce_host36	
Deployed after GWOT	-0.0004 (0.005)	Deployed after GWOT	-0.001 (0.001)
Deployed at least once in 36 months prior to current deployment	0.002 (0.001)	Deployed at least once in 36 months prior to current deployment	0.046*** (0.004)
Current Depl lasted 60-180 days	0.016*** (0.004)	Hostile Deployment	0.005*** (0.002)
Current Depl lasted > 180 days	0.018*** (0.005)	GWOT*Hostile Deployment	0.009*** (0.003)
GWOT*Current Depl 60-180 days	-0.004 (0.005)	Deployed at least once to hostile area in 36 months prior to current deployment	-0.004** (0.002)
GWOT*Current Depl >180 days	0.027*** (0.007)		
Model 3: GWOT*Hostile Deployments in Past 36 months		Model 5: GWOT*deployonce_host36	
Deployed after GWOT	0.001 (0.002)	Deployed after GWOT	-0.005** (0.002)
Deployed at least once in 36 months prior to current deployment	0.0009 (0.002)	Hostile Deployment	0.046*** (0.004)
Hostile Deployment Duration 60-180 days	-0.004 (0.003)	Deployed at least once in 36 months prior to current deployment	0.001 (0.003)
Hostile Deployment Duration >180 days	-0.001 (0.005)	GWOT*Hostile Deployment	0.009*** (0.003)
GWOT*Hostile Deployment Duration 60-180 days	0.003 (0.003)	Deployed at least once to hostile area in 36 months prior to current deployment	-0.005 (0.003)
GWOT*Hostile Deployment Duration >180 days	0.014** (0.007)	GWOT*Deployed at least once to hostile area in 36 months prior to current deployment	0.002 (0.004)
Observations	98680	GWOT*Deployed at least once in 36 months prior to current deployment	0.006 (0.004)
Standard Errors in parentheses			
* significant at 10% ** significant at 5% *** significant at 1%			

deployments combined with duration lengths overall did not occur. The only coefficient estimate that was significant was the interaction term for those who deployed to GWOT and the hostile deployment duration was greater than 180 days. This coefficient estimate had a positive sign at the .05 level, and it indicated that the probability of the average sailor developing PTSD increases by 1.4 percentage points if they are currently deployed to GWOT and they have been deployed in a hostile zone for more than 180 days compared to those who have not met this criteria. For sailors the data supports the overall findings that duration in hostile areas is not as significant a factor as other coefficient estimates. Concerns over deployment lengths by the Department of Defense may be overlooking the real reason for increasing rates of PTSD, which could be the number of times a active-duty servicemen is exposed to trauma and battlefield horrors.

Model (4) looks at those sailors who have deployed at least once to a hostile zone over the course of the past 36 months preceding the current deployment, to include GWOT. The results of this model indicate that hostile deployments are significant factors in the propensity to develop PTSD. Experiencing trauma is the key indicator of increasing PTSD rates as supported by this data. The coefficient estimate on the variable for hostile deployment remains the most statistically significant at the .01 level with a positive sign and a magnitude of 4.6 percentage points. Thus for the average sailor the probability of developing PTSD increases by 4.6 percentage points if the current deployment was hostile compared to a non-hostile deployment. The coefficient estimate for GWOT was not significant. The significance of deploying at least once in the 36 months prior to the current deployment was also at the .01 level with a small magnitude of 0.5 percentage points. The interaction coefficient estimate for GWOT and hostile deployment was significant at the .01 level with a positive sign and a magnitude of 0.9 percentage points. The findings of the coefficient estimate for deployed at least once to hostile area in 36 months prior to current deployment were unexpected since a positive sign was anticipated. The findings were significant at the .05 level with a negative sign and a magnitude of 0.4 percentage points. The coefficients indicate that for the average sailor the propensity to develop PTSD decreases by 0.4 percentage points if they have deployed at least once to a hostile zone within the 36 months prior to the current

deployment compared to those who have not deployed to a hostile zone. This is contradicting the majority of the findings from the other models and past studies. With the low percentage of the coefficient it does not lead to a strong argument against conventional wisdom concerning hostile deployments having a positive effect on propensity to develop PTSD.

Model (5) examines multiple interactions between hostile deployment and GWOT, GWOT and whether the sailors deployed at least once to a hostile area in the past 36 months, and between GWOT and whether the sailor has deployed at least once in the past 36 months regardless of whether the zone was hostile or non-hostile. The coefficient estimate for hostile deployment was the most statistically significant at the .01 level with a positive sign and a magnitude of 4.6 percentage points. The interaction coefficient estimate for GWOT and hostile deployment was significant at the .01 level with a positive sign and a magnitude of 0.9 percentage points.

C. SECONDARY DEPENDENT VARIABLE MODELS

1. Evaluation of Coefficients for Naval Officer Data Set

There were a total of four secondary dependent variables for the officer data set. These variables will be discussed in greater detail. Table 16 will demonstrate the first three models with coefficients and significance levels. Control variables will not be discussed due to emphasis on deployment characteristics. Table 17 will show the remaining two models.

In Model (1) the findings indicate that the coefficient estimate for GWOT was significant at the .05 level only for the avoiding situations that reminded the officer of the deployment. The sign was positive but the magnitude of the coefficient was only 0.7 percentage points. The coefficient estimate for hostile deployment as expected was found significant in all of the secondary dependent coefficient estimates at the .01 level. The coefficient estimate for being deployed at least once in 36 months prior to current deployment was also significant for being on guard (Dep. Var. 4) at the .05 level although

with a negative sign and a coefficient of only 0.5 percentage points. The interaction coefficient estimate for GWOT and hostile deployment was not significant.

Table 16. Secondary Variables for Officers (Models 1-3)

Probit Models	(2) Have Nightmares	(3) Avoid Situations	(4) On Guard	(5) Feeling detached
Model 1				
Deployed after GWOT	0.002 (0.004)	0.007** (0.003)	-0.004 (0.004)	0.004 (0.003)
Hostile deployment	0.029*** (0.009)	0.029*** (0.009)	0.044*** (0.009)	0.033*** (0.009)
Deployed at least once in 36 months prior to current deployment	-0.001 (0.003)	-0.003 (0.003)	-0.005** (0.002)	-0.001 (0.003)
GWOT*Hostile Deployment	0.001 (0.006)	-0.004 (0.005)	0.007 (0.006)	-0.007 (0.004)
Model 2				
Deployed after GWOT	0.002 (0.009)	0.002 (0.009)	-0.002 (0.013)	-0.011 (0.011)
Deployed at least once in 36 months prior to current deployment	-0.002 (0.003)	-0.003 (0.003)	-0.007** (0.003)	-0.001 (0.003)
Current Depl lasted 60-180 days	0.005 (0.008)	0.003 (0.008)	0.018** (0.009)	0.004 (0.008)
Current Depl lasted > 180 days	-0.008 (0.009)	-0.002 (0.009)	0.012 (0.015)	-0.002 (0.009)
GWOT*Current Depl 60-180 days	-0.005 (0.010)	0.003 (0.010)	-0.003 (0.013)	0.009 (0.010)
GWOT*Current Depl >180 days	0.032 (0.022)	0.023 (0.020)	0.038 (0.028)	0.039 (0.025)
Model 3				
Deployed after GWOT	0.006* (0.003)	0.006** (0.003)	0.004 (0.003)	0.002 (0.003)
Deployed at least once in 36 months prior to current deployment	-0.002 (0.004)	-0.004 (0.003)	-0.008** (0.004)	-0.001 (0.003)
Hostile Deployment Duration 60-180 days	-0.003 (0.007)	-0.011* (0.006)	-0.008 (0.007)	-0.007 (0.006)
Hostile Deployment Duration >180 days	0.029 (0.020)	0.012 (0.016)	0.031 (0.020)	-0.004 (0.011)
GWOT*Hostile Deployment Duration 60-180 days	0 (0.009)	0.018 (0.017)	0.004 (0.011)	0.012 (0.012)
GWOT*Hostile Deployment Duration >180 days	-0.017*** (0.005)	-0.007 (0.008)	-0.018*** (0.004)	-0.007 (0.010)
Observations	10361	Standard Errors in parentheses		
* significant at 10% ** significant at 5% *** significant at 1%				

In Model (2) the coefficient estimate for being deployed at least once in 36 months prior to current deployment was significant for being on guard at the .05 level with a negative sign and a 0.5 percentage point coefficient. The coefficient estimate for being currently deployed for 60-180 days was also significant at the .05 level with a positive sign. Thus for the average officer the probability of constantly feeling on guard increases by 1.8 percentage points for those who have currently deployed from 60-180 days compared to those officers who deployed less than 60 days.

The results for Model (3) include significance of the coefficient estimate GWOT for a 0.6 percentage points increase in the propensity to have nightmares and avoiding situations that remind the average officer who has deployed to GWOT of the deployment trauma. The results for the coefficient estimate for being deployed at least once in 36 months prior to current deployment was significant at the .05 level with a negative sign. This coefficient could be constructed given the small percentage of officers who were positive for both coefficient estimates. A hypothesis would be that for those officers in Special Operations, Medical Service, and other specialty assignments that these individuals are more likely to be mentally prepared for hostile deployments. This argument is supported by Grossman who believes that there will always be 2 percentage points of a population that tends to gravitate towards these life-threatening assignments and have the ability to turn their emotional mechanisms off and on dependent on the situation (1995).

Model (4) is shown on Table 17. With a significance at the .05 level and a positive sign the coefficient estimate for GWOT indicates a 0.7 percentage points increase in the propensity to avoid situations that remind the average officer who has deployed to GWOT. The coefficient estimate for hostile deployment was found significant in all of the secondary dependent coefficient estimates at the .01 level. The remaining coefficient estimate that was statistically significant was for those deployed at least once to a hostile area in the 36 months prior to the current deployment. The

negative sign was unexpected but again may be attributed to different branches or jobs that are outside the scope of this thesis.

Table 17. Secondary Variables for Officers (Models 4-5)

Probit Models	(2) Have Nightmares	(3) Avoid Situations	(4) On Guard	(5) Feeling detached
Model 4				
Deployed after GWOT	0.002 (0.004)	0.007** (0.003)	-0.004 (0.004)	0.004 (0.003)
Deployed at least once in 36 months prior to current deployment	0.029*** (0.009)	0.029*** (0.009)	0.044*** (0.009)	0.033*** (0.009)
Hostile Deployment	0.001 (0.004)	-0.001 (0.004)	-0.001 (0.003)	0.002 (0.003)
GWOT*Hostile Deployment	0.001 (0.006)	-0.004 (0.005)	0.007 (0.006)	-0.007 (0.004)
Deployed at least once to hostile area in 36 months prior to current deployment	-0.003 (0.004)	-0.002 (0.003)	-0.006** (0.003)	-0.004 (0.003)
Model 5				
Deployed after GWOT	0.004 (0.005)	0.005 (0.004)	-0.007 (0.005)	0.002 (0.004)
Hostile Deployment	0.030*** (0.009)	0.028*** (0.009)	0.043*** (0.009)	0.033*** (0.009)
Deployed at least once in 36 months prior to current deployment	0.004 (0.007)	-0.005 (0.007)	-0.007 (0.006)	0.002 (0.006)
GWOT*Hostile Deployment	0.001 (0.006)	-0.003 (0.005)	0.008 (0.006)	-0.007 (0.004)
Deployed at least once to hostile area in 36 months prior to current deployment	-0.003 (0.007)	-0.002 (0.007)	-0.001 (0.006)	-0.010* (0.006)
GWOT*Deployed at least once to hostile area in 36 months prior to current deployment	-0.001 (0.008)	-0.001 (0.008)	-0.007 (0.006)	0.011 (0.010)
GWOT*Deployed at least once in 36 months prior to current deployment	-0.004 (0.007)	0.006 (0.008)	0.009 (0.007)	0.001 (0.007)
Observations	10361	Standard Errors in parentheses		
* significant at 10% ** significant at 5% *** significant at 1%				

For model (5) the coefficient estimate for hostile deployment was found significant in all of the secondary dependent coefficient estimates at the .01 level with positive signs. For the average officer a hostile deployment compared to a non-hostile deployment increased the probability of having nightmares by 3 percentage points,

avoiding situations by 2.8 percentage points, being on guard 4.3 percentage points, and feeling detached 3.3 percentage points.

2. Evaluation of Coefficients for Enlisted Sailors Data Set

There were a total of four secondary dependent variables for the enlisted data set. These variables will be discussed in greater detail. Table 18 will demonstrate the first three models with coefficients and significance levels. Control variables will not be discussed due to an emphasis on deployment characteristics. Table 19 will show the remaining two models.

In Model (1) the findings indicate that the coefficient estimate for GWOT was significant at the .05 level only for having nightmares and the .01 level for being on guard. The sign was negative but the magnitude of the coefficient was only 0.3 percentage points and 0.5 percentage points respectively. The coefficient estimate for hostile deployment as expected was found significant in all of the secondary dependent coefficient estimates at the .01 level. The coefficient estimate for those who deployed at least once in the 36 months prior to current deployment was also significant at the .05 level and had a positive effect with a magnitude of 0.3 percentage points. The interaction coefficient estimate for GWOT and hostile deployment was significant for every secondary dependent coefficient estimate except feelings of detachment.

In Model (2) the coefficient estimate for GWOT was significant for having nightmares at the .10 level with a negative sign. The magnitude was fairly small at 0.8 percentage points. Those deployed at least once in 36 months prior to current deployment were also significant for having nightmares at the .10 level with a positive sign and a 0.2 percentage point coefficient. The coefficient estimates of current deployments have yielded significant results for enlisted sailors quite different from those among the officer population. The coefficient estimate for current deployments lasting from 60-180 days was significant in all four dependent coefficient estimates and often at the .01 level while current deployments lasting more than 180 days was significant in three of four categories and was also significant at the .01 level with a positive sign.

Thus for the average sailor the probability of developing these four symptoms increased in general the longer the current deployment lasted.

Table 18. Secondary Variables for Enlisted Sailors (Models 1-3)

Probit Models	(2) Have Nightmares	(3) Avoid Situations	(4) On Guard	(5) Feeling detached
Model 1				
Deployed after GWOT	-0.003** (0.001)	-0.001 (0.001)	-0.005*** (0.001)	-0.001 (0.001)
Hostile deployment	0.046*** (0.004)	0.027*** (0.003)	0.061*** (0.004)	0.023*** (0.003)
Deployed at least once in 36 months prior to current deployment	0.003** (0.001)	0.002 (0.001)	0.002 (0.001)	-0.004 (0.001)
GWOT*Hostile Deployment	0.013*** (0.003)	0.008** (0.003)	0.018*** (0.003)	0.001 (0.003)
Model 2				
Deployed after GWOT	-0.008* (0.005)	0.003 (0.004)	-0.001 (0.005)	-0.005 (0.005)
Deployed at least once in 36 months prior to current deployment	0.002* (0.001)	0.001 (0.001)	-0.0005 (0.001)	-0.0001 (0.001)
Current Depl lasted 60-180 days	0.009** (0.004)	0.013*** (0.004)	0.017*** (0.003)	0.008** (0.003)
Current Depl lasted > 180 days	0.007 (0.004)	0.017*** (0.005)	0.012** (0.005)	0.012*** (0.005)
GWOT*Current Depl 60-180 days	-0.00005 (0.005)	-0.006 (0.005)	-0.012** (0.005)	0.004 (0.005)
GWOT*Current Depl >180 days	0.046*** (0.009)	0.011* (0.006)	0.049*** (0.009)	0.013** (0.006)
Model 3				
Deployed after GWOT	-0.002 (0.002)	-0.0001 (0.002)	-0.001 (0.002)	-0.002 (0.001)
Deployed at least once in 36 months prior to current deployment	0.001 (0.002)	-0.00005 (0.002)	-0.002 (0.002)	-0.002 (0.002)
Hostile Deployment Duration 60-180 days	-0.004 (0.003)	0.001 (0.003)	-0.001 (0.003)	0.0005 (0.003)
Hostile Deployment Duration >180 days	0.003 (0.005)	-0.002 (0.005)	0.007 (0.005)	-0.0006 (0.005)
GWOT*Hostile Deployment Duration 60-180 days	0.006* (0.003)	0.003 (0.003)	0.002 (0.003)	0.005 (0.003)
GWOT*Hostile Deployment Duration >180 days	0.012* (0.007)	0.01 (0.006)	0.009 (0.006)	0.009 (0.006)
Observations	96674		Standard Errors in parentheses	
* significant at 10% ** significant at 5% *** significant at 1%				

In Model (3) only two coefficient estimates proved to be significant. When GWOT was joined with deployment lengths the result was significant. For the interaction coefficient estimate GWOT and hostile deployments that lasted 60-180 days the results were significant at the .10 level with a positive sign. This finding can be interpreted that the average sailor's propensity to have nightmares increased if deployed to GWOT and to a hostile area for 60-180 days by 0.6 percentage points. What is interesting is that this magnitude doubles for those sailors who deployed to both GWOT and to a hostile zone for more than 180 days. The interaction coefficient estimate for GWOT and deployed to hostile area for more than 180 days was significant at the .10 level and had a positive effect of 1.2 percentage points.

Model (4) is shown on Table 19. With significance at the .05 level for having nightmares and at the .01 level for being on guard with a negative sign the coefficient estimate for GWOT indicates a 0.3 percentage points and 0.6 percentage points decrease in the probability for the average sailor deployed to GWOT. This finding can be explained that many of the sailors who deployed to GWOT were aboard ships and not subject to the same trauma as ground troops. The coefficient estimate for hostile deployments as expected was found significant in all of the secondary dependent coefficient estimates at the .01 level. Another coefficient estimate that was statistically significant was for those sailors deployed at least once to a hostile area in the 36 months prior to current deployment at the .01 level for nightmares and avoiding situations while at the .10 level for being on guard. The interaction coefficient estimate for GWOT and hostile deployment was also significant at the .01 level for having nightmares and being on guard. The results indicate that for the average sailor deployed to GWOT and in a hostile area the probability that they will have nightmares increase by 1.3 percentage points, avoiding situations will increase by 0.8 percentage points and being on guard increase by 1.8 percentage points. The coefficient estimate for being deployed at least

once to a hostile area in the 36 months prior to current deployment was significant at the .05 level for avoiding situations and being on guard. The signs were negative with relatively small effects.

Table 19. Secondary Variables for Enlisted Sailors (Models 4-5)

Probit Models	(2) Have Nightmares	(3) Avoid Situations	(4) On Guard	(5) Feeling detached
Model 4				
Deployed after GWOT	-0.003** (0.001)	-0.001 (0.001)	-0.006*** (0.001)	-0.0002 (0.001)
Deployed at least once in 36 months prior to current deployment	0.046*** (0.004)	0.027*** (0.003)	0.061*** (0.004)	0.023*** (0.003)
Hostile Deployment	0.005*** (0.002)	0.005*** (0.002)	0.003* (0.002)	.02*** (0.002)
GWOT*Hostile Deployment	0.013*** (0.003)	0.008** (0.003)	0.018*** (0.003)	0.0001 (0.003)
Deployed at least once to hostile area in 36 months prior to current deployment	-0.003* (0.002)	-0.004** (0.002)	-0.004** (0.002)	-0.001 (0.002)
Model 5				
Deployed after GWOT	-0.008*** (0.002)	-0.003* (0.002)	-0.008*** (0.002)	-0.005** (0.002)
Hostile Deployment	0.045*** (0.004)	0.027*** (0.003)	0.060*** (0.004)	0.023*** (0.003)
Deployed at least once in 36 months prior to current deployment	0.002 (0.003)	0.005 (0.003)	0.002 (0.003)	-0.004 (0.003)
GWOT*Hostile Deployment	0.014*** (0.003)	0.008** (0.003)	0.018*** (0.003)	0.001 (0.003)
Deployed at least once to hostile area in 36 months prior to current deployment	-0.007** (0.003)	-0.007** (0.003)	-0.005* (0.003)	-0.001 (0.003)
GWOT*Deployed at least once to hostile area in 36 months prior to current deployment	0.005 (0.004)	0.005 (0.004)	0.003 (0.004)	0.001 (0.004)
GWOT*Deployed at least once in 36 months prior to current deployment	0.005 (0.004)	0.001 (0.004)	0.001 (0.003)	0.008* (0.004)
Observations	96674		Standard Errors in parentheses	
* significant at 10% ** significant at 5% *** significant at 1%				

For Model (5) the coefficient estimate for hostile deployment was found significant in all of the secondary dependent coefficient estimates at the .01 level with positive signs. For the average sailor a hostile deployment increased the probability of having nightmares by 3 percentage points, avoiding situations by 2.8 percentage points, being on guard 4.3 percentage points, and feeling detached 3.3 percentage points.

GWOT also was a significant coefficient estimate in this model across all four dependent coefficient estimates. The sign and magnitude of coefficients indicate that for average sailors the probability of developing these symptoms decreases with deployment to GWOT. When combined into an interaction term the coefficient estimate for GWOT and hostile deployment was significant for three of the four dependent coefficient estimates. All signs were positive and significant at the .01 level for having nightmares and being on guard. The coefficient estimate for being deployed at least once to a hostile area in the 36 months prior to current deployment was significant for three of the four coefficient estimates although at lower levels of significance (.05 levels for nightmares and avoiding situations, .10 levels for being on guard). The signs were all negative indicating that for the average sailor the probability of developing these symptoms decreases with at least one deployment to a hostile zone within the past 36 months compared to those without a hostile deployment in the past 36 months prior to current deployment.

D. STUDY LIMITATIONS

A potential problem with these two data sets from DMDC and AMSA is that there is potential for introducing measurement error bias into our models because of variables that are not interpreted the same way across the sample. It is highly probable that many of the sailors who deployed in support of GWOT but served offshore in the Persian Gulf counted the deployment as non-hostile. There are also probably sailors who deployed on land to Kuwait or Qatar and counted the tour as non-hostile since they were not physically in Iraq. There is also reason to suspect that many of the responses to the DD Form 2796 were filled out with the intention to deceive health-care workers to avoid either stigma or delaying redeployment.

E. SUMMARY

In this chapter we examined results from various probit models that looked at the effects of current deployment and deployment history characteristics as well as demographics. The purpose of the models was to determine the effect of repeated deployments and other deployment characteristics on the rate of PTSD among Navy

personnel. Secondary questions include identifying other potential risk factors for PTSD based on demographic and service characteristics. The findings from these models seem to indicate that, as expected, officers and enlisted naval personnel are distinct and must be considered separately for each of the models. Deployment duration had little impact on officers but considerable impact on enlisted sailors, especially in hostile areas. Hostile deployments had the largest overall effect on both officers and enlisted in increased propensity to develop PTSD. Whether deployed currently or over the past 36 months made little difference unless it was to a hostile area.

The next chapter will provide conclusions and policy recommendations based on the findings from this study. Some of these recommendations may be unique to naval personnel but the intent is to apply the results to the Department of Defense in general.

VII. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSIONS

Post-traumatic stress disorder (PTSD) is a type of anxiety disorder that has tremendous impacts on the mental stability of those involved in the Global War on Terrorism. This study, although very narrow in scope, has provided some information about the potential rates of PTSD in sailors after multiple deployments to Iraq or Afghanistan as well as the impact of increased tour lengths on those rates. These findings can offer further support for the mental health of our veterans being a priority for further study with emphasis on treatment or preventative measures.

The primary research question was to analyze the effect of repeated deployment and other deployment characteristics on the rate of PTSD among Navy veterans. The first finding of interest is that officers and enlisted sailors have different factors that affect their propensity to develop PTSD. Certainly the fact that enlisted sailors tend on average to be younger, single and just high-school-educated sets them apart from officers. The officers on average tend to be older at entry into the military, have higher educational achievement and also tend to be married. All of these factors contribute to the different effects of the deployments for officers and enlisted sailors. Across both groups, however, female personnel had a slightly higher propensity to develop PTSD than their male counterparts. Another interesting demographic finding is that education had little to no bearing for either group in determining PTSD rates. The only exception is for other educational credentials which had a 0.9 percentage point increase in the probability of developing PTSD compared to a sailor with a high school diploma.

Rank also had some interesting findings from the data analysis. For naval officers being a Field Grade (O4-O6) compared to being a junior officer (O1-O3) increased the probability of developing PTSD by 0.6 percentage points which may be indicative of the higher stress on this group coming from being commanders of vessels during wartime. Senior rank had just the opposite effect on enlisted sailors. Sailors are less likely to develop PTSD the more senior they are in terms of rank. Thus for the average sailor in

the rank of E5-E7 the probability that they would develop PTSD decreases by 1 percentage point compared to junior sailors (E1-E4). The variable for senior NCOs (E8-E9) was also significant at the .01 level and had a negative sign. Thus for the average sailor in the rank of E8-E9 the probability that they would develop PTSD decreases by 1.7 percentage points compared to that of junior sailors (E1-E4).

The one deployment characteristic that stands alone in its impact on PTSD rates, regardless of being officer or enlisted is that of being deployed to a hostile area. Significant at the .01 level across all models for both data sets, it should come as no surprise that hostile deployments are certain to produce traumatic events that increase the probability of developing PTSD. For officers the duration of deployments did not seem to be a significant factor overall in determining the propensity for PTSD. However, if an officer has been deployed at least once to hostile region during the prior 36 months, the probability of developing PTSD is lowered by 0.7 percentage points ($p\text{-value} < 0.01$). This is important in that it may be illustrating a self-selection—that those who endure hostile deployment well will tend to be mentally prepared for another hostile deployment.

Compared to sailors whose deployment duration is fewer than 30 days, those with longer duration have a higher probability to potentially develop PTSD (1.6 percentage points if duration is 60-180 days; 1.8 percentage points if more than 180 days). Moreover, having a long deployment after GWOT started increased the propensity to develop PTSD by 2.7 percentage points. This difference between officers where deployment lengths were not significant and enlisted sailors where it was could be explained by other factors to include the younger age of the average sailor compared to officers. It could also perhaps be explained by the different tasks assigned on board the typical naval vessel. The tasks of officers may in some manner have a mentally stimulating effect whereas the monotonous routine for the average sailor may increase the effect of a traumatic experience as the deployment gets longer in duration. Further research is recommended with a breakdown by job descriptions. In other studies on the GWOT that the Army conducted, combat soldiers (infantry, armor) tend to have higher rates of PTSD than non-combat specialties. It would be useful to determine if there are

naval specialties with a higher propensity to develop PTSD so that naval mental health providers could concentrate on preventative measures for those at a higher risk.

B. RECOMMENDATIONS

There are several recommendations to be made based on the literature review and the data analyzed in this study. The first is that further research into the causes and effects of PTSD on combat veterans needs to remain a focus within the Department of Defense. Our society cannot afford to ignore the potential long-term damage that PTSD can cause. The struggling veterans of the Vietnam war are ample proof of the effects that untreated PTSD can cause between the high suicide rates and homelessness.

Deployment duration seems to be significant for the enlisted force. Continued efforts at minimizing deployment length must obviously remain secondary to military effectiveness. However, understanding that prolonged tours have a detrimental effect on the mental health of our military is essential in attempts to minimize the damage being done. As opportunities arise the need to shorten deployment lengths is the key in retaining a mentally healthy fighting force.

Although the actual percentage of naval personnel with the propensity to develop PTSD is relatively small it should not be discounted when added to the entire Department of Defense structure. The Marine Corps and the Army have significantly higher PTSD rates and these recommendations are applicable cross-service.

Perhaps the most important recommendation is to expand the scope and duration of the DD Form 2796. It must be administered several times over the course of at a minimum of a year after deployment to help identify those whose symptoms manifest longer after the deployment ends. The current timing of when the form is administered undermines the validity of any mental health findings. Desire in avoiding anything to potentially delay redeployment is paramount in most service member's mind.

As more data continues to be gathered during the Global War on Terrorism it is essential to continue to identify trends and potential populations that need to be isolated and given priority for mental health services. While AMSA is the repository for all DD

Form 2796 and other deployment data it should be noted that many veterans use TRICARE services to avoid the potential stigma associated with mental disorders. TRICARE data as well as from the Veterans Affairs should be gathered by Department of Defense analysts for trends among those seeking mental health services outside of military facilities. Under-reporting of this issue is significant given survey-based data due to the associated stigma. Additional research by linking deployment information with actual medical records from TRICARE and the VA would be extremely useful in conjunction with the AMSA data in determining true rates of PTSD for those seeking help.

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