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ANALYSIS OF RELATIONSHIP BETWEEN DIVERSITY, INCLUSION AND NAVY UNIT PERFORMANCE

by

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These results suggest that while diversity influences performance, it is not the determining factor. The data indicates that additional variables, including leadership quality, training, and crew resource management, may also significantly impact unit performance. Consequently, this study recommends that future research expand to include additional external variable factors, providing a more comprehensive view of the determinants affecting a navy unit's performance. Understanding the intricate relationship between diversity and performance is essential for developing effective strategies for overall Navy unit performance.

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These results suggest that while diversity influences performance, it is not the determining factor. The data indicates that additional variables, including leadership quality, training, and crew resource management, may also significantly impact unit performance. Consequently, this study recommends that future research expand to include additional external variable factors, providing a more comprehensive view of the determinants affecting a navy unit's performance. Understanding the intricate relationship between diversity and performance is essential for developing effective strategies for overall Navy unit performance.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

BMD	Ballistic Missile Defense
CMA	Critical Mission Areas
DMDC	Defense Manpower Data Center
DEI	Diversity, Equity, and Inclusion
DEOMI	Defense Equal Opportunity Management Institute
DOD	Department of Defense
DRRI	Defense Race Relations Institute
FDNF	Forward Deployed Naval Forces
ISIC	Immediate Superior in Command
LDO	Limited Duty Officer
MA	Mission Area
MAGs	Management Advisory Groups
OFRP	Optimized Fleet Response Plan
ORM	Operational Risk Management
PDE	Person-Data Event Environment
TF1N	Task Force One Navy
TORIS	Training and Operational Readiness Information Services
TYCOM	Type Commanders
VBSS	Visit, Board, Search, and Seizure
WAC	Women's Army Corps
WIS	Women in Submarines

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—LCDR Dara Faraday

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—LCDR Nicky Glover

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—LCDR Tyree Harris

I. INTRODUCTION

Admiral Mike Gilday asserted, "When a diverse group of individuals comes together to do a job, they can do it better because of their differences" (U.S. Navy, n.d.). The primary objective of this research is to test that hypothesis by investigating the correlation between specific dimensions of diversity, such as race/ethnicity, gender, age, educational level, and cultural diversity, and the performance of Naval units measured through objective metrics. Here, "dimensions of diversity" encompass an expansive spectrum ranging from race, ethnicity, gender, age, educational level, and cognitive classifications (Utah State University Extension, n.d.). The study recognizes that the concept of 'diversity' has evolved from focusing on demographic variables to encompassing cognitive and experiential facets (Anca & Aragón, 2018). This shifting landscape prompts questions about which specific dimensions of diversity are most crucial for optimizing Naval unit effectiveness, a concern corroborated by the U.S. Navy's focus on diversity as a performance driver (Department of Navy [DON], 2021).

A. BACKGROUND

The evolution of Diversity, Equity, and Inclusion (DEI) within the U.S. Navy is a narrative of intentional progression and transformation aimed at embracing a broad spectrum of experiences, competencies, and perspectives. The Navy has meticulously pursued integrating DEI into its organizational fabric, driven by the understanding that diversity is a strategic enabler that can enhance operational effectiveness. The U.S. Navy has innovated and instituted various initiatives incorporating many experiences, skills, and viewpoints. Seminal documents and mandates have guided the evolution, notably the Department of Defense (DOD) 1020.05. The DOD publication 1020.05 (DOD, 2020) provides evident diversity and inclusion (D&I) guidance for all DOD components. This guidance emphasizes actionable and quantifiable D&I policies.

B. HISTORICAL CONTEXT

The evolution of diversity and inclusion in the U.S. military has been strongly influenced by societal and legislative changes, beginning with the Civil Rights Act of 1964.

Although not directly applicable to the military, the Civil Rights Act 1964 was a societal catalyst for equality. Following this legislative milestone, the DOD initiated Project 100,000 in 1966 to recruit individuals who would otherwise have been disqualified, aiming for a more diversified force (Vietnam War 50th, n.d.). In 1969, the Army further institutionalized its commitment to inclusion by establishing an Equal Opportunity Program to ensure fair treatment for all personnel, irrespective of race, color, religion, gender, national origin, or sexual preference (Crittenden, 2021). Concurrently, the late 1960s and early 1970s saw the Women's Army Corps (WAC) expand roles for women, reflecting the broader feminist movement of the time (Morden, 1990). Fast-forwarding to 2018, the DOD outlined the military's ongoing reforms in reports, which included revamped recruitment strategies and the introduction of leadership training programs like those provided by the Defense Equal Opportunity Management Institute (Defense Equal Opportunity Management Institute, n.d.), formally known as Defense Race Relations Institute (DRRI). These transformative steps have been part of a broader, nationwide shift towards increased diversity and inclusion, making it both logical and imperative for the military to undergo similar changes as a reflection of the broader American society.

1. African American Sailors in the Navy

In line with the broader military's efforts following the enactment of the Civil Rights Act of 1964, the U.S. Navy has made substantial policy changes to enhance racial and gender diversity. A pivotal moment came with the founding of the DRRI in 1971, an initiative that paralleled the Army's Regulation 600–20 by focusing on the fair treatment of all personnel within the military. Individual milestones have also marked the Navy's progress, such as Master Chief April D. Beldo becoming the first black woman assigned as a Command Master Chief to an aircraft carrier, the USS Carl Vinson (CVN 70), and the first African American female Command Master Chief (U.S. Navy, 2023) of a Recruit Training Command. Before her 2017 retirement, she commented on the opportunities she received based on her abilities: "The opportunities that I have been afforded based on my ability to perform have just…I just can't even talk about it" (NAVFAC EXWC, 2016, para. 2). She further emphasized the untapped potential of some sailors: "There are sailors who don't even know what their potential is because they allow other people to tell them what

their destiny is" (NAVFAC EXWC, 2016, para. 2). She concluded that "it is not the person. It's about the positions we are afforded to serve in" (NAVFAC EXWC, 2016, para. 2). Her leadership roles affirm the Navy's commitment to diversity, an evolution that aligns with broader military changes.

2. Women's Contributions in the Navy

Mirroring these broader military initiatives, the U.S. Navy also intensified its focus on gender diversity, especially following 1964. A watershed moment came in 1993 with the repeal of the DOD's Combat Exclusion Law, which broadened the roles available to women in the Navy. This commitment to gender diversity and equality was further emphasized by the inception of the Women in Submarines (WIS) Program in 2010 when Secretary of Defense Robert M. Gates lifted the longstanding ban on females serving aboard submarines. Subsequently, in a landmark move, the first female officers began assignments to the Ohio-class ballistic missile submarines a year later (Stoner, 2021). Building upon this legacy, Lieutenant Commander Dara Faraday, a co-author of this thesis, broke barriers as Ensign Faraday in 2014 by becoming the first female limited duty officer (LDO) in the Supply Corps to serve on a submarine. Her pioneering role opened doors for other female ensigns to serve in comparable positions (U.S. Navy, 2018).

C. MODERN INITIATIVES FOR DEI

On July 1, 2020, the Navy initiated Task Force One Navy (TF1N) to address current challenges of ensuring and promoting a diverse and effective Navy workforce. Utilizing what it terms a "Culture of Excellence" governance structure, TF1N aims to remove obstacles to equality while promoting long-term opportunities that contribute to naval effectiveness (DON, 2022, p. 4).

The final TF1N report provides crucial data that aligns with the core objectives of this thesis. For example, the report breaks down the Navy's racial composition as follows: 2% American Indian or Alaska Native, 6% Asian, 18% Black or African American, 5% Declined to Respond, 7% Multiple Races, 1% Native Hawaiian or other Pacific Islander, and 62% White, summing up to a total force of 332,990 (DOD, 2021). Although the enlisted force shows greater racial and ethnic diversity than the general U.S. population, it

lags in gender representation, with women accounting for only 20% of the force as opposed to 51% in the U.S. population. These data points are particularly relevant to this research, which aims to assess the impact of diversity dimensions like race and gender on the performance of naval units. The TF1N report also highlights a significant gap in addressing women's issues, especially after the disbandment of the Office of Women's Policy. The recommendation to appoint an advisor for Women's Policy within the OPNAV N17, as part of the Inclusion and Diversity (I&D) branch, further resonates with the thesis' focus on policy implications. This advisor would work closely with Management Advisory Groups (MAGs) that ideally mirror the Navy's diverse composition, ensuring a comprehensive approach to representation.

D. PURPOSE

Continuing the U.S. Navy's ongoing effort to bolster diversity, the Navy's Culture and Force Resilience Office (N17) initiated this study to assess the correlation between specific dimensions of diversity and the performance levels of Navy units, using quantifiable, objective metrics. The primary research objective is to analyze the composition of average and above average-performing Navy units concerning specific dimensions of diversity: race/ethnicity, gender, age, educational level, and cultural diversity (specifically focusing on non-US-born personnel), and family status (married/not married). This study aims to provide objective data on how these dimensions impact the objective performance metrics of Navy units, thereby exploring potential advantages in mission readiness that could be achieved fleet-wide by fostering diversity. The Navy has emphasized promoting diversity throughout its ranks. Still, research is needed to understand how diversity can impact a naval unit's objective and measurable performance, which informs war-fighting readiness. The findings in this research can enable further research into specific DEI variables' effects on navy units' objective, measurable performance in other operational communities and other branches of service. DOD-wide DEI training and recruiting efforts can be tailored to hone the DEI variables correlating to high-performing naval units. Moreover, the outcomes of this research could influence existing DOD-wide DEI initiatives by providing guidance or steering them toward more effective diversity reforms.

E. RESEARCH QUESTIONS

The primary research objective is to examine the composition of average and above-average performing Navy units in terms of specific dimensions of diversity. The study empirically assesses the levels of variability within these diversity dimensions and evaluates how these dimensions relate to operational performance.

- Is there a relationship between unit diversity and performance in the DDG class?
- How do dimensions of diversity relate to performance in above-performing and average-performing units?

F. RESEARCH DESIGN

This study focuses on the relationship between diversity and operational performance within the context of guided-missile destroyers (DDGs). Dimensions of diversity, including race, ethnicity, gender, age, educational level, and cultural diversity within the Navy, were formulated through a thorough review of existing literature. The data span six years and encompass 72 DDGs, 22% of the U.S. Navy fleet. The aim is to furnish actionable insights into how these diversity dimensions correlate with unit effectiveness. Performance metrics were sourced from the Training and Operational Readiness Information Services (TORIS) database. These metrics encompass performance determinants like Battle Effectiveness (Battle E) Winner, Mission Area (MA) Score. These factors are grouped into binary categories like Battle "E" winner versus non-Battle "E" winner and Above- or Average MA Score for enhanced analytical clarity. This allows for a detailed classification of ships based on their cumulative performance scores over a specific duration. This study aims to connect these diversity and performance variables using statistical techniques like Pearson's correlation and t-tests. The ultimate objective of this study is to explore how various diversity metrics within a ship's crew may influence these specific performance determinants over a year. By utilizing t-tests, we can effectively compare means between groups and understand any significant differences that arise in relation to these diversity dimensions.

G. ORGANIZATION OF STUDY

The remaining composition of this thesis contains four chapters. Chapter II is a literature review covering known studies relating to the relationship between diversity and organizational performance. Chapter III gives detail on the methodology and the empirical analysis used to attain our statistical results. Chapter IV provides data and results, and Chapter V describes summary findings, limitations and interpretation of results, and finally a conclusion of the study conducted.

II. LITERATURE REVIEW

Diversity is an intricate concept that spans a multitude of characteristics and attributes unique to individuals. While diversity has been a topic of significant attention within academia, there has been less emphasis on exploring it specifically within military contexts. However, studying diversity in these unique settings is particularly valuable due to military organizations' distinct operating environments and hierarchical structures. These characteristics make military units intriguing cases for evaluating the implications of diversity on unit performance. As Milliken and Martins (1996) pointed out, the challenge in understanding diversity stems from the various disciplinary boundaries, diverse definitions, potential dependent variables, and its applicability across different settings.

Diversity encompasses both surface-level attributes, such as race, age, and gender, which are readily observable, as well as deep-level attributes, including values, attitudes, and skills, which require more interaction and time to discern (Harrison et al., 1998). Studies within the military sector have often narrowed their focus to specific dimensions of diversity, such as race or gender, researchers have commonly restricted their scope to certain ranks or branches. This leaves gaps in the broader understanding of diversity's implications for military performance. Notably there are no studies that explore 'deep-level' characteristics within a military context.

This chapter aims to bridge these gaps by offering a comprehensive review of studies that examine diversity within military organizations and its effects on organizational performance. In this review, we delve into four primary areas. The first area concerns defining diversity for research in both military and broader organizational settings. The second explores existing research specifically within military environments, shedding light on the unique experiences and manifestations of diversity in such settings. The third area reviews research on the empirical relationships between personnel diversity and organizational performance, gleaning insights from both military-centric and general organizational studies. Lastly the final examines the prevailing theories and explanations that account for how and why diversity influences organizational outcomes, offering a critical lens through which to interpret the findings of diversity research in military units.

In this chapter, we aim to provide a clear and direct analysis of the relationship between diversity and performance in military settings.

A. DEFINING DIVERSITY FOR PURPOSES OF THIS STUDY

For the purposes of this research, it's paramount to ground our understanding of diversity in well-established definitions. According to the DOD Diversity and Inclusion Management Program Instruction, the DOD (2020) delineates diversity as "All the different characteristics and attributes of individuals from varying demographics that are consistent with the DOD's core values, integral to overall readiness and mission accomplishment, and reflective of the nation we serve." Further adding depth to this understanding, Richard and Miller (2013) delved into the conditions where diversity, particularly visible attributes such as race, gender, and age, might influence organizational performance. Their insights on the dual nature of diversity—where it can either serve as a competitive advantage or a source of internal conflict—aligns with the overarching aim of this project: discerning how diversity molds performance dynamics within military entities.

To further provide a comprehensive understanding of diversity, it's crucial to differentiate between surface-level and deep-level diversity. Surface-level diversity, as Harrison et al. (1998) stated, refers to the readily observable attributes of individuals, such as their race, gender, and age. In contrast, deep-level diversity delves deeper, shedding light on the underlying attributes that make up an individual, encompassing aspects like values, attitudes, and educational backgrounds (Harrison et al., 1998). The distinction is crucial because relying solely on surface-level characteristics provides an incomplete picture of diversity. Surface-level characteristics, like age or ethnicity, are immediately observable but might not capture the depth of individual experiences, values, or cognitive styles. Overlooking deep-level characteristics, such as beliefs, values, and thought processes, can miss essential dynamics that influence group cohesion, problem-solving, and decision-making. By expanding the definition and study of diversity beyond just surface-level traits, we gain a more comprehensive understanding of how varied attributes interact and affect outcomes in military settings, as illustrated by Milliken and Martin (1996).

B. DIVERSITY STUDIES IN MILITARY ORGANIZATIONS

Bullock (2012) conducted a study to understand the impact of interracial contact in the military on race relations. The research aimed to test the Contact Hypothesis, which posits that interactions with ethnically diverse individuals in a supportive environment can reduce prejudice and reshape the perception of 'different' as not being deficient. The study found that interracial contact in the military positively influenced race relations. However, the duration and intensity of service did not significantly alter these perceptions. Contrary to expectations, veterans of varying lengths of service reported similar positive attitudes towards racial diversity. Bullock (2012) also noted an effect he termed 'humanization and individuation of the cultural other,' where soldiers from diverse racial and ethnic backgrounds formed close, familial-like relationships, transcending racial barriers. The military's diverse setting, which aligns with the conditions of the Contact Hypothesis, amplifies the benefits of interracial contact. The study, while focused on the diversity variable of race within the Army, did not encompass the larger population of armed forces soldiers and excluded ranks E-1 through E-3 and all commissioned officers.

Research conducted by Arkes et al. (2020) studied how increased diversity within the Navy, specifically in underrepresented groups, could impact retention. The study utilized both qualitative and quantitative methods consisting of surveys, semi-constructed interviews, and quantitative analysis of personnel data examining the relationship between diversity and retention for sailors on all ships and submarines other than large deck ships (amphibious assault ships and carriers). On the qualitative front, Arkes et al. (2020) found that sailors from underrepresented racial and ethnic backgrounds reported feeling differentiated treatment in areas such as grooming standards and guidance, which often lacked sensitivity to their distinct cultural backgrounds and experiences. Quantitatively, the research provided effects of diversity during Sailors first ship assignments, highlighting the significance of demographic commonalities Their statistical analysis indicated that both Black and White sailors exhibited higher retention rates when there were more Black individuals among enlisted superiors and peers. Additionally, while Hispanic Sailors retention didn't show a similar trend, both White and Black sailors were more likely to reenlist with a higher percentage of Hispanics in superior roles. Lastly Arkes et al. (2020)

concluded that male retention rates improved with more female officers and enlisted peers, although this trend was not observed for female sailors. This indicates that having officers and supervisors from diverse backgrounds is crucial, as their shared experiences can positively influence retention. In essence, representation matters.

Masar (2006) critically evaluated the U.S. Navy's decision to adopt a broader definition of 'diversity', examining its potential repercussions on recruitment and retention. Masar's research question revolved around the implications of the Navy's departure from a focused Affirmative Action instruction towards a more encompassing 'diversity' definition. Using a qualitative method of analysis, she examined historical data, legislative directives, and military policies on diversity and affirmative action. Masar highlighted that the broader terminology, while appearing inclusive, could diminish the Navy's proactive efforts to recruit and retain specific underrepresented groups, notably women and minorities. A notable finding was the renaming of the Navy's Minority Affairs office to the Diversity Directorate, signifying a potential dilution of targeted recruitment strategies. This examination is crucial to the present project as it underscores the unintended consequences that linguistic and policy shifts can have on organizational goals, emphasizing the need for clarity in policy terminology to ensure effective implementation.

Within military organizations, this literature underscores the following key conclusions. Bullock (2012) illustrated that diversity, particularly interracial contact, fosters bonds resembling familial ties which can transcend racial barriers. Arkes et al. (2020) demonstrated that demographic representation in leadership roles positively influences retention rates, particularly when sailors identify with the racial and ethnic backgrounds of their superiors. Masar (2006) cautioned about the potential pitfalls of shifting diversity definitions, emphasizing the importance of maintaining clarity in diversity policies to prevent diluting targeted recruitment efforts. These studies highlight the tangible benefits of diversity on retention, the influence of demographic representation in fostering unity, and the challenges posed by ambiguous policy definitions in military organizations.

C. DIVERSITY IMPACTS ON ORGANIZATIONAL PERFORMANCE

As Milliken and Martin (1996) stated, research regarding diversity is challenging due to the range of disciplinary boundaries, varying definitions, many potential dependent variables, and applicability to various settings and groups. Academic literature often does not distinguish between social and functional diversity concepts, leading to some degree of uncertainty in the definition of diversity (Simons & Rowland, 2011).

To further understand the intricate mechanisms of diversity and its impacts, we can refer to Figure 1. The Milliken and Martin (1996) figure presents a comprehensive model illustrating how diversity in group composition can influence individual, group, and organization-level outcomes. On the left side, the diagram differentiates between "observable attributes" like age, race, and gender, and "underlying attributes" that require a more in-depth exploration, such as personality and cultural values. These attributes feed into paradigm homogeneity, which refers to the degree of overlap in the schematic frameworks, causal beliefs, and assumptions of group members. Transitioning horizontally, the model presents the short-term consequences, categorized into affective, cognitive, symbolic, and communication related effects. These capture details such as satisfaction, commitment, and the quality of ideas produced within diverse groups.

The model's far right (Figure 1) details long-term effects, showing diversity's impact on individual, group, and organizational outcomes, highlighting factors like absenteeism, turnover, and strategic shifts. Analyzing this model reveals the cascading effects of diverse attributes, both positive and negative, on an organization's trajectory, highlighting the complex relationship between diversity and its potential impacts. In the context of a Navy warship, understanding these relationships could enable leaders to proactively address the multifaceted effects of diversity, thereby optimizing ship performance and strengthening crew unity.

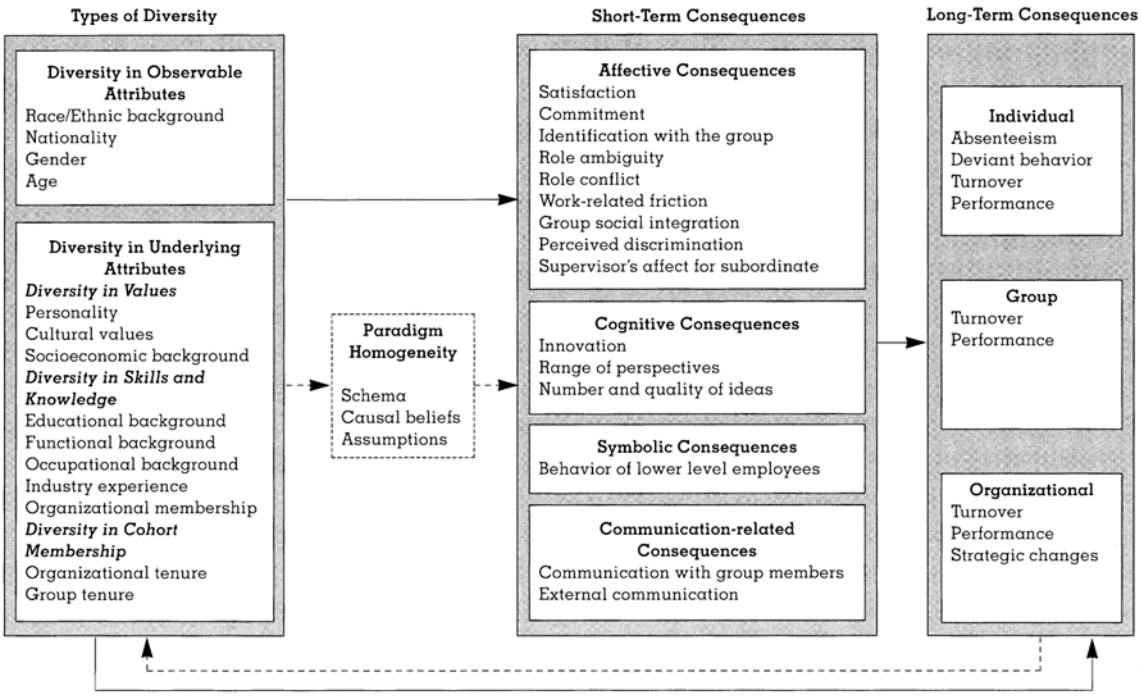


Figure 1. Effects of Diversity in Organizational Groups. Reproduced from Milliken and Martin (1996).

In a study conducted by Ely (2004), group diversity encompassing tenure, age, sex, and race was examined to determine its impact on the performance of 486 retail bank branches. The study also investigated if an employee's completion of the company's diversity training influenced these dynamics. Data were sourced from archival records on employee diversity, satisfaction surveys, and branch performance metrics. The results showed no strong correlations between diversity variables and performance. While tenure and age diversity showed negative effects, effective team processes, which refer to how team members interact and collaborate, mitigated these adverse effects. The research also found a direct positive correlation between quality team processes and several performance indicators, including new sales and customer satisfaction. Although racial diversity wasn't linked to performance issues, branches with more Hispanic and Black employees had lower customer satisfaction scores and overall performance. Ely (2004) mentioned that based on social categorization and social identity theories, actors in diverse variable groups might tend towards conflict. This tendency is due to individuals categorizing themselves and others based on group characteristics, leading to misunderstandings and reduced trust,

which can affect group performance. On the other hand, Ely (2004) highlighted that diversity can grant competitive advantages to organizations. Such advantages come in the form of pooled resources, broader networks, diverse viewpoints, prevention of groupthink, and enriched insights. The study didn't have data on the racial and economic attributes of customers, which might have provided further insights.

A study by Pitts (2005) aimed to discern the effects of race and ethnicity on three objective measures of public education performance within the Texas school district. This analysis drew from data sets of 1995 and 1999, covering 2,500 school districts in Texas, which the state requires schools to report annually. These data sets were then evaluated based on diversity, performance, and environmental factors. The results did not indicate a uniform relationship between racial diversity and organizational performance. Out of the 12 relationships tested, seven demonstrated significant correlations. However, the direction of these relationships (positive or negative) was not consistent, and the influence of diversity fluctuated based on the specific performance indicator assessed. Pitts (2005) thus recommended in-depth empirical research on the relationship between diversity and organizational performance across various contexts. Such research could help pinpoint specific aspects of diversity that notably affect performance.

Ali et al. (2011) explored the nuanced relationship between gender diversity and organizational performance, particularly within firms in the services and manufacturing sectors of the Australian Securities Exchange (ASX). They used data from 150 for-profit organizations, they classified them based on their production type, distinguishing between organizations manufacturing goods and those providing services. Manufacturing organizations transformed raw materials into tangible goods, whereas service organizations delivered intangible or perishable products to their customers. Organizational performance was assessed by comparing operating revenue against headcount to calculate employee productivity. Gender diversity was evaluated using Blau's Index, where a score of 0 represents an all-male workforce, and .5 signifies a balanced male-to-female workforce, as noted by Ali et al. (2011). While Ali et al. (2011) found no evident linear relationship between gender diversity and performance in manufacturing firms, service organizations displayed a pattern whereas gender diversity increased, productivity rose until it hit a peak,

after which further increases in gender diversity caused a decline in performance. The differentiation in outcomes between manufacturing and service organizations suggests that the impact of gender diversity on performance may vary based on the nature of the organization's operations. This, as Ali et al. (2011) highlight, underscores the need to tailor diversity management strategies to the specific operational context, ensuring optimal performance while upholding Equal Employment Opportunity principles.

These findings are crucial for managers, especially in areas with lenient Equal Employment Opportunity (EEO) laws, highlighting the benefits and challenges of gender diversity across different organizational types (Ali et al., 2011).

Drawing from the insights of the literature reviewed in this subsection, diversity both in terms of observable and underlying attributes has varied effects on organizational outcomes. These effects can manifest as both strengths and challenges, influenced by the specific context of an organization's operations. This is evident from the different results observed in the manufacturing and service sectors of the Ali et al. study (2011). For U.S. Navy warships, which blend both technical and strategic functions, understanding these subtle interplays of diversity allow a framework for potentially explaining diversity's effects on measures of quantitative performance. It can be argued that recognizing and addressing the intricacies of diversity can foster a Navy culture that optimizes ship performance and cultivates a cohesive unified crew. The literature emphasizes the need to comprehend the multiple dimensions of diversity and to apply tailored strategies to maximize its benefits.

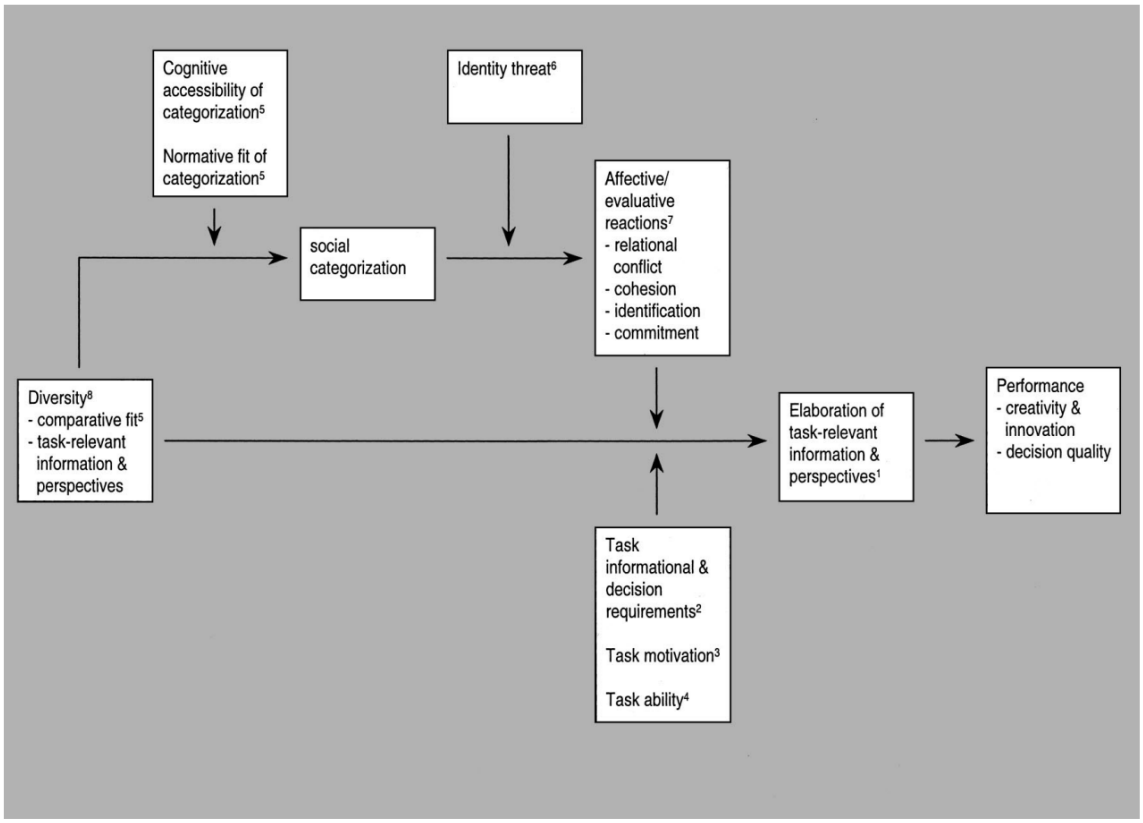
D. KNOWN EXPLANATIONS FOR DIVERSITY'S EFFECTS

Van Knippenberg et al. (2004) in their research on work Group Diversity and group performance aimed to address the inconsistency in findings relating to work group diversity and performance. The authors introduced an innovative framework termed the categorization-elaboration model (CEM), which merges insights from the domains of information processing and social categorization related to diversity in workgroups and their performance. Additionally, Van Knippenberg et al.'s (2004) social categorization perspective suggests that individuals organize themselves and peers into categories based

on perceived similarities and distinctions, often resulting in a bias towards their own group. The information processing perspective suggests that diverse groups with their wide range of unique skills and perspectives often outperform homogeneous groups, as their diversity leads to more thorough information processing and prevents premature consensus. The CEM was developed to incorporate factors often overlooked in diversity studies, such as biases between groups and the refinement of information pertinent to tasks. Van Knippenberg et al. (2004) advocate for the discarding of efforts to correlate the varied effects of diversity with specific diversity types and instead posed that all facets of diversity have the potential to engender both beneficial and detrimental outcomes. The research approach taken by Van Knippenberg et al. (2004) included an exhaustive review of related literature and crafting the CEM to elucidate the influence of diversity on team efficacy.

In Figure 2 the CEM offers a visual representation of the complex interplay between the diversity within a workgroup and its performance metrics. The concept of "comparative fits" within the model is indicative of the degree to which individuals in a group perceive alignment or disparity among themselves. This perceived similarity or difference can influence how individuals categorize themselves and others within the group. Within the model, "comparative fits" is a reference regarding whether a particular categorization mirrors or matches the perceived similarities and differences among group members. This concept aids in understanding how individuals within a diverse group might align or differ from one another, serving as a foundational aspect for subsequent social categorization processes in the model. Beginning with "Diversity," the model shows how varied comparative fits and task-relevant information & perspectives can influence social categorization processes. This categorization can be shaped by factors such as the cognitive accessibility of categorizations and the normative fit of these categorizations. The model also introduces the concept of "Identity threat" and its influence on affective/evaluative reactions. These reactions encompass various interpersonal dynamics, from relational conflict and cohesion to identification and commitment. The framework further emphasizes the critical roles played by knowledge pertinent to the task, the drive to perform, and the requisite capabilities. Finally, the outcome of these intertwined processes

is reflected in group performance, emphasizing aspects like creativity, innovation, and decision quality (Van Knippenberg et al., 2004).



Work group diversity and group performance: An integrative model and research agenda. *Journal of Applied Psychology, 89*(6), 1010.

Figure 2. The Categorization-Elaboration Model of Work Group Diversity and Group Performance. Reproduced from Van Knippenberg et al. (2004).

The overarching takeaway from this model is its comprehensive depiction of the multifaceted interactions between diversity elements and performance outcomes. It underscores the reality that while diversity brings forth a range of perspectives its management and the processes it triggers are crucial in determining group performance. Through the CEM, Van Knippenberg et al. (2004) emphasize the balance between social categorization and information processing, showing that the impact of diversity isn't one-dimensional but a product of various interacting factors.

The key findings of this study offer a refined perspective on how work-group diversity triggers information-processing and social categorization processes. The authors conclude that an understanding of these processes, coupled with a careful management of diversity, can contribute to effective performance in workgroups (Van Knippenberg et al., 2004). This study adds to what is known about the impacts of diversity, how groups function and perform, and provides a model to help interpret similar research. The CEM, with its detailed view of how diversity affects outcomes, can be used as a guide for future studies examining the effects of diversity in military groups and their performance.

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III. METHODOLOGY

This chapter describes the collection and analysis of personnel and performance metrics from 72 Destroyer Guided Missile ships (DDGs) spanning the years 2017 to 2022. This study encompasses a total of 418 evaluations, factoring in that certain ships were commissioned within this six-year timeframe of observation. Notably, these DDGs constitute approximately 22% of the entire U.S. Navy fleet. Ship crew composition data for characteristics such as race, gender, and educational background were calculated from quarterly demographic data stored in the Defense Manpower Data Center (DMDC) and aggregated for each year of observation. This approach offers a detailed snapshot of the crew composition for each DDG annually. We also collected performance indicators obtained from yearly assessments such as the Battle Effectiveness (Battle E) Award and the evaluation of 26 possible mission areas. The Battle E and mission areas evaluations encompass a wide range of operational capabilities and skills, providing a comprehensive view of each ship's overall performance and readiness in various aspects of naval operations. The "PROCEDURE" section outlines our method of comparing groups with above-average performance to those with average performance to identify relationships between unit diversity and operational effectiveness. Based on this foundation, our study aims to validate the subsequent Research questions:

1. Is there a relationship between unit diversity and performance in the DDG class?
2. How do dimensions of diversity relate to performance in both above-performing and average-performing units?

A. DATA COLLECTION

1. Performance Data

a. Afloat Training Group (ATG), The Optimized Fleet Response Plan (OFRP) Cycle, and Training and Operational Readiness Information Services (TORIS)

ATG, anchored firmly within the Navy's operational framework, holds the vital task of training and evaluating naval units. This group ensures ships are equipped and ready to face many operational challenges. ATG executes evaluations across 26 mission areas within a notional 36-month schedule for DDGs' Optimized Fleet Response Plan (OFRP). The OFRP is segmented into five distinct phases: Basic, Advanced, Integrated, Sustainment, and Maintenance. The majority of ATG's 26 mission area assessments are carried out during the Basic, Advanced, and Integrated phases. Nevertheless, certain assessments may be performed during any phase as required. The notional schedule and description of the phases are provided in Table 1.

Table 1. The notional schedule for the 36-month OFRP for DDGs derived from COMNAVSURFPAC/COMNAVSURFLANT INSTRUCTION 3502.7C

Basic Phase (–Months 1–5)	Development of unit core capabilities and skills.
Advanced (–Month 6)	Hone advanced tactics techniques and procedures with other units and conduct mission-specific training.
Integrated (–Months 7–11)	Synthesize individual units and staffs into carrier strike groups, expeditionary strike groups, amphibious ready groups, surface action groups, or other combined-arms forces.
Sustainment (–Months 12–28)	Designed to sustain and enhance warfighting as either a group, multi-unit or unit.
Maintenance (–Months 29–36)	Optimal period for repairs, upgrades, force reconstitution and platform modernization.

Naval vessels, as part of their operational mandate, are subjected to consistent evaluations. These evaluations range from pre-scheduled drills to sudden and unanticipated checks. High scores on the 26 evaluated areas are an indicator of a ship's readiness level, its operational efficiency, and its proficiency in executing its core mission objectives. The outcomes of these 26 evaluations are stored in the TORIS database, a repository of performance evaluations. TORIS is designed to streamline reporting and minimize the time required to update the ship's status (Lieutenant, USN, personal communication, August 25, 2023).

TORIS plays a vital role in real-time operations spanning a variety of Navy command structures. This includes entities like Type Commanders (TYCOM), Immediate Superior in Command (ISIC), ATGs, and the Naval Information Warfare Training Group's Commander. These command structures extensively rely on the data from TORIS, using the database as a barometer to gauge the readiness levels of different naval units. It also serves as a checkpoint to ensure these units adhere to the stipulated training certification standards across various mission requirements.

Our research methodology, enriched by the data from the TORIS database and insights from ATG evaluations, is robust and in-depth. We explore the relationship between unit diversity and the overall operational readiness of naval units using established and accepted measures of performance. Our study's findings are operationally relevant and grounded in empirical evidence.

b. Mission Areas Descriptions

The U.S. Navy's operational prowess is anchored in its innovative technology and rigorous inspection standards. At the heart of this system are the 26 Mission Areas inspections vital to the Navy, with scores documented in TORIS. Table 2 shows brief descriptions of the 26 Mission Areas inspection categories.

Table 2. Mission Areas derived from COMNAVSURFPAC/COMNAVSURFLANT INSTRUCTION 3502.7C

3M (3M) Inspection	The 3M inspection is key to a ship's lifespan, scrutinizing equipment upkeep and maintenance for enduring efficiency.
Air Warfare (AW) Inspection	Evaluates the ship's capabilities against aerial threats, ensuring effective anti-air warfare operations.
Anti-Terrorism (AT) Inspection	This inspection gauges a ship's readiness for terrorist threats, focusing on emergency protocols and anti-terrorism drill effectiveness.
Anti-Submarine Warfare (ASW) Inspection	Reviews the ship's abilities to detect and engage underwater threats such as submarines.
Ballistic Missile Defense (BMD) Inspection	Ensures the ship's readiness against incoming ballistic missile threats.
Communications (COMMS) Inspection	Assesses the effectiveness of the ship's communication systems with other naval units, aircraft, and shore stations
Cryptography (Crypto) Inspection	Reviews the secure transmission and receipt of sensitive or classified information.
Cyber (CYBER) Inspection	The inspection ensures cyber resilience on ships by evaluating penetration tests and the security of sensitive data.
Damage Control (DC-I) Inspection	This metric assesses a crew's readiness for at-sea emergencies, focusing on damage control drills and emergency gear preparedness.
Electronic Warfare (EW) Inspection	Evaluates the ship's capabilities in using electronic systems for defensive and offensive operations.
Explosive Safety Inspection	This inspection verifies the safe handling of shipboard explosives, evaluating storage protocols and handling training effectiveness.
Fleet Support Operations Medical (FSOM)	This inspection assesses health and emergency readiness, focusing on medical response times and the thoroughness of health screenings.
Intelligence (Intel) Inspection	Assesses the ship's systems and personnel in gathering, analyzing, and disseminating intelligence information
Mobility Air (MOB-A) Inspection	Reviews the ship's aviation facilities and its capability to handle, launch, and receive aircraft.
Mobility Damage Control Warfare (MOB-D) Inspection	The MOB-D Inspection assesses a naval unit's damage control capability to ensure operational readiness and crew safety.
Mobility Engineering (MOB-E) Inspection	Evaluates the ship's propulsion and steering systems ensuring safe maneuvering.
Mobility Navigation (MOB-N) Inspection	Assesses the accuracy and effectiveness of the ship's navigation systems and procedures.
Mobility Seaman (MOB-S) Inspection	Evaluates the crew's capabilities in essential maritime tasks related to movement.
Search and Rescue (SAR) Inspection	The SAR inspection ensures the ship's readiness for search and rescue operations, evaluating rescue equipment and drill effectiveness.
Strike Warfare (STW)	Reviews the ship's readiness to engage in combat

Strike Warfare–Naval Surface Fire Support (STW-NSFS)	Verifies the ship's capabilities to provide fire support to ground forces from the sea.
Supply Management (SUP) Inspection	This inspection ensures a ship's sustainability through efficient resource management, including inventory control and resource allocation strategies.
Cruise Missile Tactical Qualification (CMTQ)	Assesses the ship and crew's proficiency in tactics and procedures associated with cruise missile operations.
Surface Warfare (SUW) Evaluation	Assesses the ship's readiness to combat and defend against enemy surface vessels.
Visit, Board, Search, and Seizure (VBSS) Evaluation	Reviews the readiness of the ship's VBSS team to conduct boarding operations in compliance with international law
Visual Information (VI) Inspection	Assesses the ship's capabilities in gathering, processing, and disseminating visual information effectively

Graded on a 1–100 scale, with 100 signifying the highest possible score, each of the 26 mission areas consists of 10–21 Certification Events (CE) assessed by ATG during mission area evaluations. The mission area score recorded in TORIS reflects the combined CE scores. These evaluations are essential in ensuring that naval ships and their crews are equipped with the latest technologies and proficient in their effective use, maintaining the Navy's readiness for maritime defense challenges. By comparing the diversity statistics of above average performers against those of average performers, we aim to delve into the impact of crew diversity on the Navy's operational effectiveness over a year.

c. COMNAVSURFOR/COMNAVSURFPAC Battle Effectiveness Award Overview

The Battle Effectiveness Award, often referred to as the Battle "E," stands as a mark of honor in the U.S. Navy. Awarded annually, it recognizes naval units that consistently demonstrate outstanding battle readiness and operational prowess throughout the year, with a focus on areas like maritime warfare, engineering, command and control, and logistics (Lieutenant, USN, personal communication, August 25, 2023).

Eligibility for the Battle E awards demands day-to-day demonstrated excellence in addition to superior achievement during certifications and qualifications conducted throughout the competitive period. All DDGs enter the competitive year on 1 January with a clean slate and will close out on 31 December of the same calendar year. A prior year's

certification events, assessments, and inspections will not carry over to the following competitive year (Lieutenant, USN, personal communication, August 25, 2023).

Ships that consistently perform in a highly effective manner in all warfare areas will typically be competitive for the Battle "E" award. The Battle "E" award is not a qualification award or an award for mere excellence; it is awarded to the BEST ships in the organization (Lieutenant, USN, personal communication, August 25, 2023).

Satisfactory assessed Mission Area scores must be recorded in TORIS for Battle "E" eligibility within the award calendar year. These evaluations assess the degree to which units comply with essential readiness standards spanning various domains, from Anti-Terrorism and Cyber Security to Search and Rescue. While a high score in ATG Mission Area inspections is foundational for Battle "E" eligibility, the following criteria must also be met: (1) earn four of five Command Excellence awards; (2) satisfactory completion of Certification Exercises; (3) for non-Forward Deployed Naval Forces (FDNF) ships, certify and recertify in at least 80 percent of the unit's mission areas. (4) no Class "A" mishaps; (5) all Integrated and Advanced Phase Certification events assessed T-2 Overall; (6) consistently demonstrate a high level of safety awareness and operational risk management (ORM) in all phases of shipboard operations; and (7) maintain Current 3M certification (Lieutenant, USN, personal communication, August 25, 2023).

Between 2017 and 2022, 59 distinct DDGs (just 14% of all eligible DDGs) earned the Battle Effectiveness Award, a testament to their commitment to excellence. Our research is centered on discerning a potential link between unit diversity and the exceptional performance that leads to receiving the Battle "E." By comparing the diversity statistics of award recipients against those of non-recipients, we delve into the relationship between crew diversity and the Navy's operational efficiency over a year.

2. Demographic Data

Crew demographic data were sourced from the Person-Data Event Environment (PDE) and Defense Manpower Data Center (DMDC). The Person-Data Event system is a centralized repository for personnel data across the DOD, including DMDC personnel records. The collection of demographic information about Navy personnel is a systematic

process integrated into various stages of a sailor's career. Upon enlistment and during in-processing, sailors provide personal information, which they can update periodically or at significant career milestones such as promotions or transfers. These updates ensure that personal data is current and comprehensive. Moreover, while sailors are attached to a ship, this data is compiled on a quarterly basis to maintain an up-to-date record that reflects any changes in personnel demographics, career progression, or family status. This continuous data collection allows for a dynamic and accurate reflection of the Navy's personnel composition at any given time. The data collected from ships can be compiled into detailed crew profiles highlighting both surface-level attributes, and deep-level traits. Table 3 lists and describes crew demographic variables collected and aggregated for each ship yearly.

Table 3. Demographic Categories

Gender	
Proportion Female	Proportion identifying as Female.
Age	
Average Age	Mean age of the ship's crew members.
Racial and Ethnic Composition	
Proportion of White Individuals	Proportion identifying as White.
Proportion of American Indian Individuals	Proportion identifying as American Indian.
Proportion of Asian American Individuals	Proportion identifying as Asian American.
Proportion of African American Individuals	Proportion identifying as African American.
Proportion of Pacific Islander Individuals	Proportion identifying as Pacific Islander
Proportion of Mixed-Race Individuals	Proportion identifying with multiple racial backgrounds.
Proportion of Non-White Individuals	Cumulative metric of proportion identifying as non-White.
Nationality	
Percent Non- U.S	Proportion of crew members who are not married.
Marital Status	
Proportion Unmarried	Proportion of crew members who are not married

Educational Background	
Proportion with Higher Education Degrees	Proportion of crew members with degrees from higher education institutions.
AFQT Category 1	Proportion of crew members who scored in the 99–93 ASVAB Score percentile.
AFQT Category 2	Proportion of crew members who scored in the 92–65 ASVAB Score percentile.
AFQT Category 3A	Proportion of crew members who scored in the 64–50 ASVAB Score percentile.
AFQT Category 3B	Proportion of crew members who scored in the 49–31 ASVAB Score percentile.
AFQT Category 4	Proportion of crew members who scored in the 30–10 ASVAB Score percentile.
AFQT Category 5	Proportion of crew members who scored in the 9–1 ASVAB Score percentile.

B. PROCEDURE

1. MA Score Analysis

We refined the raw 26 MA in TORIS, initially scored on a scale from 1 to 100, into a binary indexed format represented by 1s and -1s, which we will refer to as the 'MA Score'. This binary system simplifies the classification of Destroyers (DDGs) by distinguishing those with above-average performance (MA Score of +1) from those with average performance (MA Score of -1). The conversion to a binary index, the MA Score, streamlines the analysis, enabling a comprehensive review of performance across all 26 Mission Areas within a year. To carry out this analysis, we took the following steps:

Step 1: For each of the 26 MAs, we first calculated the mean score across all evaluations conducted over our six-year period of observation. As an illustration, when considering all the units involved from 2017–2022, the Anti-Submarine Warfare category produced an average score of 89.02% across 104 different evaluations.

Step 2: We assigned an MA Score of +1 to all units surpassing the mean in a specific Mission Area, and an MA Score of -1 to all units that either met or fell short of the mean. Units that did not undergo an evaluation for a particular Mission Area within the designated study year were not scored.

Step 3: We totaled these MA Scores across all Mission Areas (MAs) for each ship in a specific year. This cumulative MA Score then guided the classification of ships into two distinct categories: 'high performers' (those who received a netted MA Score of 3 or more) and 'average performers' (those who netted an MA Score of 2 or less). For example, a ship evaluated on 13 MAs in 2017 that scored above average in seven MAs and below in six would have a cumulative MA Score of 1, placing it in the 'average performers' category.

Step 4: We compared the above average performing and average performing ships, as designated by their MA Scores from Steps 1–3, on our key diversity indicators in Table 3. We employed a t-test analysis to examine the potential link between Mission Area performance, as indicated by the MA Score, and Diversity factors. This statistical method is specifically designed to determine if notable differences exist between the means of two distinct groups. We focused on any significant differences in crew composition on diversity indicators for ships scoring above (high MA Score) vs. average (low MA Score). We used standard cut-offs for statistical significance, such that a p value below 0.05 would suggest a statistically significant difference, indicating that Diversity factors differed between above average- and average-performing ships based on their MA Scores. Conversely, a p-value greater than 0.05 would indicate no statistically significant relationship between ship performance, as indicated by the MA Score, and crew composition.

2. Battle "E" Analysis

Step 1: In our Battle E evaluation, naval units were separated into two clear categories: Winners (n = 59), indexed with a Battle E score of +1, and non-winners (n = 359), indexed with a Battle E score of 0. Fourteen DDGs evaluations not yet commissioned were excluded from this assessment.

Step 2: We conducted a t-test analysis to delve into the possible correlation between Battle "E" performance, as indicated by the Battle E score, and Diversity factors. We compared Battle "E" winners and non-winners, as designated by their Battle E scores from Step 1 above, on our key diversity indicators in Table 3. A p-value below 0.05 would suggest a statistically significant difference, indicating that Diversity factors differed

between Battle “E” winners and non-winners. Conversely, a p-value greater than 0.05 would indicate no statistically significant relationship between ship performance in Battle E and a diverse crew composition.

Additional comprehensive analyses are available in the tech report via Helzer, Lester, and Tick (2024).

IV. DATA ANALYSIS

This chapter presents the results of our analysis of the relationship between ship diversity and performance data across a fleet of 72 DDGs, which constitutes the entire active DDG population in the U.S. Navy fleet, from 2017 to 2022. This analysis endeavors to answer two principal questions:

1. Is there a relationship between unit diversity and performance in the DDG class?
2. How do dimensions of diversity relate to performance in above-average and average performing units?

Our analysis below involves several key steps. First, we describe our data set using descriptive statistical analysis. Next, we conduct t-tests and correlation analyses to test relationships between ship performance and diversity metrics. Last, the discussion of the results allows us to then draw our conclusions based on our data and analyses.

A. DESCRIPTIVE STATISTICAL ANALYSIS

Table 4 provides a detailed summary of diversity metrics for the DDG fleet, measured in ship-years, with each row aggregating data from 2017–2022 for each ship. These metrics showcase both surface-level and deep-level attributes of diversity within the fleet. It is important to note that, while an initial projection based on 72 ships over 6 years would yield 432 observations, the actual count stands at 418. This deviation is not an oversight but rather a reflection of the operational realities of naval fleets. Specifically, it accounts for the absence of data for certain vessels not in continuous service throughout six years. Such instances are not uncommon in dynamic operational environments and are critical in providing a realistic depiction of crew diversity.

The dataset, comprising 418 ship-year observations, offers a comprehensive view of diversity trends over time. For instance, the percentage of women in the crew composition varies across the fleet, with some DDGs having as low as 1.3% women, while others have up to 30%. This underscores the variability in gender representation within the fleet.

Table 4. Summary Statistics for Crew Diversity Metrics in Our Sample

Metric	Mean	Standard Deviation (SD)	Minimum	Maximum
%F	0.190	0.049	0.013	0.298
%African American	0.213	0.032	0.087	0.316
%AmIn	0.019	0.008	0.000	0.046
%Asian	0.072	0.023	0.019	0.154
%White	0.605	0.037	0.451	0.706
%PI	0.013	0.007	0.000	0.048
%Mixed	0.078	0.018	0.032	0.134
%nonwhite	0.395	0.037	0.294	0.549
%nonUSborn	0.130	0.023	0.067	0.200
Age_med	25.23	0.899	24.00	31.00
%unmarried	0.577	0.064	0.409	0.733
%higheredDeg	0.133	0.019	0.077	0.243
AFQTCat1%	0.056	0.015	0.013	0.110
AFQTCat2%	0.425	0.031	0.344	0.531
AFQTCat3A%	0.278	0.029	0.177	0.375
AFQTCat3B%	0.239	0.041	0.083	0.350
AFQTCat4%	0.000	0.000	0.000	0.000
AFQTCat5%	0.000	0.001	0.000	0.007

The analysis of crew diversity metrics within the DDG fleet, as summarized in Table 4, yields several key findings:

1. **Gender Representation:** The data indicates that women constitute approximately 20% of the sample, on average. This figure provides insight into the gender balance within the fleet.

2. **Ethnic Diversity:** The representation of different ethnic groups shows considerable variation. Notably, non-white crew members make up nearly 40% of the sample, highlighting the fleet's ethnic diversity.

3. **Demographic Details:** The median age of the crew members is observed to be around 25 years, and the majority are unmarried. This demographic information sheds light on the age and marital status composition of the crew.

4. **Educational Background:** Regarding educational attainment, the data reveals variability, with an average of 13% of crew members holding advanced degrees. This percentage reflects the level of higher education within the fleet.

These observations collectively provide a comprehensive overview of the diversity within the DDG fleet, underscoring areas of both diversity and uniformity.

B. ANALYSIS OF SHIP PERFORMANCE METRICS

The performance of the DDGs was evaluated using key indicators derived from COMNAVSURFPAC and ATG TORIS data, focusing on the distinction between Battle E winners and the corresponding MA Score. Table 5 dissects the performance attributes of the DDG fleet using two pivotal metrics: the Battle E distinction and the MA SCORE. The Battle E metric, a dichotomous indicator, reflects the attainment of the Battle Effectiveness award, with a mean of 0.141, indicating that approximately 14% of the ships were recipients of this honor. The MA SCORE, a composite numerical indicator, encapsulates the ships' operational prowess, with a mean score of 2.141, signifying the fleet's overall performance level.

1. Distribution of Battle E Winners

As illustrated in Figure 3, 59 out 359 (14.1%) of DDGs have been awarded the 'Battle E,' which serves as a binary indicator of operational excellence among commissioned DDGs.

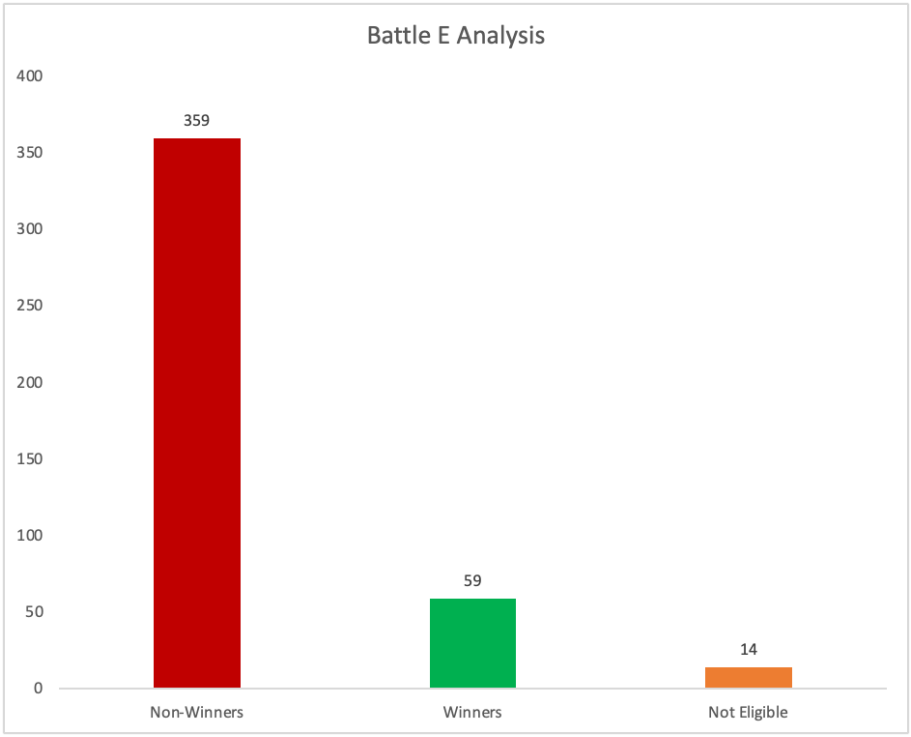

Figure 3. Distribution of DDG Battle E Winners and Non-Winners

2. Distribution of Above Average and Average Performing Units (MA Scores)

In the interest of data accuracy, ships not evaluated in a specific MA within the year of assessment were excluded from the scoring to prevent skewing results based on incomplete data. Consequently, 169 ships were removed from the performance calculation. Of the 263 evaluated ship assessments, 171 were designated 'Average' performers, while 92 achieved 'Above average' performer status.

It's important to acknowledge that some ships might have been omitted from the Above-average performers category due to a lack of evaluation, an absence not indicative of their capabilities. Figure 4 illustrates the distribution of DDGs across these performance categories. The average MA score for the fleet was 2.14, indicating the overall certification levels among the DDG class (see Table 5).

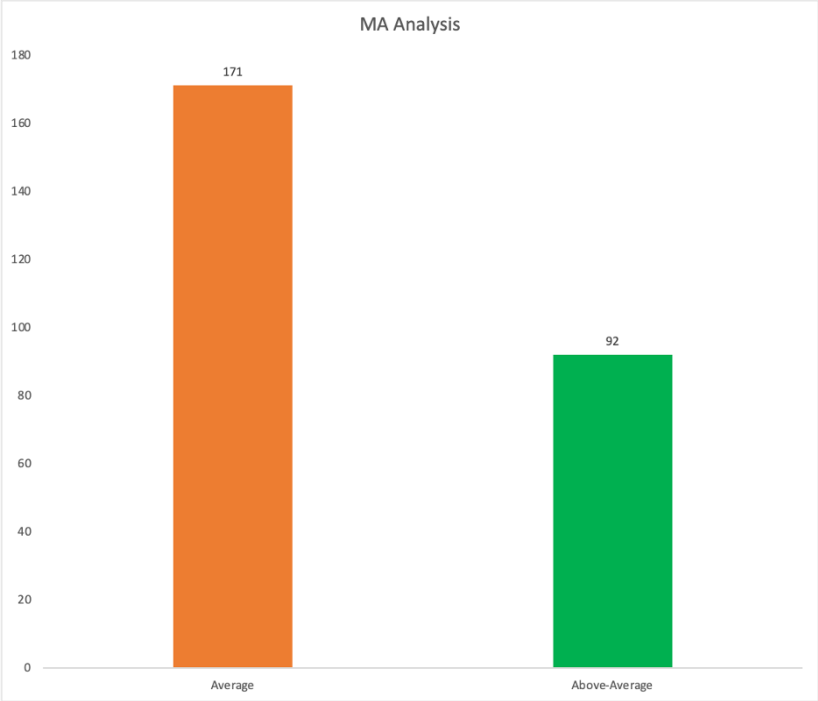

Figure 4. Distribution of DDG Average and Above-Average performers.

Table 5. Summary Statistics for Ship Performance Metrics

Metric	Mean	Standard Deviation (SD)	Minimum	Maximum
MA SCORE	2.141	3.904	-8.0	19.0
Battle E	0.141	-	0.0	1.0

The analysis of crew diversity metrics within the DDG fleet, as summarized in Table 5, yields several key findings:

1. **Performance Range and Operational Effectiveness:** The MA SCORE across the fleet exhibits significant diversity, with an average of 2.14 and a range extending from -8 to 19. This wide range indicates that performance varies extensively among the ships and underscores the varying degrees of operational effectiveness within the fleet. Ships with higher scores are

likely to employ best practices and achieve a level of efficiency that sets them apart, demonstrating high levels of operational excellence. Conversely, the presence of ships with negative MA SCOREs suggests scope for improvement in meeting the desired performance standards.

2. **Recognition of Excellence**: With approximately 14% of ship-year observations receiving the Battle E award, as reflected by the means of the Battle E metric, it becomes evident that a tangible segment of the fleet is recognized for exceptional performance. The distinction of being a Battle E winner highlights ships that have surpassed standard operational criteria and have set a benchmark for excellence.

3. **Scope for Improvement**: The presence of ships with negative MA SCOREs suggests that not all ships are meeting the desired standards of performance. These scores point to potential areas for operational improvement.

4. **Benchmarking Success**: The binary Battle E metric, with its clear dichotomy of winners and non-winners, serves as a benchmark for success within the fleet. It provides a goal for ships to aspire to and a clear indicator of top-tier performance that other ships can strive to achieve.

These findings collectively illustrate the range of operational performance within the DDG fleet, highlighting areas of excellence and opportunities for improvement.

C. CORRELATION ANALYSIS

We use correlation analysis to explore potential statistical associations between crew diversity metrics and the key performance indicators, the Battle E award and MA scores. Presented in Table 6 the calculated correlation coefficients delineate the nature and extent of the linear relationships between diversity metrics and performance variables. Positive correlation coefficients, such as the one observed for the relationship between %African American and Battle E awards ($r = 0.095$, $p = 0.052$), imply that ships with a greater proportion of African American crew members have higher rates of receiving the

Battle E award. Conversely, negative correlations, such as those between %F and both performance indicators (r = -0.119 for Battle E with p = 0.013, and r = -0.083 for MA Scores with p = 0.144, respectively), suggest that ships with higher percentages of female crew members are less likely to receive the Battle E award or score above average on MA Scores.

Table 6. Correlation Coefficients

Diversity Metric	Performance Indicator	Correlation Coefficient	Significance (p-value)
%F	Battle E	-0.121	0.013
Age_Med	Battle E	0.028	0.586
%African American	Battle E	0.095	0.052
%AmIn	Battle E	-0.090	0.048
%Asian	Battle E	-0.085	0.055
%White	Battle E	-0.001	0.983
%PI	Battle E	-0.039	0.389
%Mixed	Battle E	-0.002	0.966
%nonwhite	Battle E	0.001	0.980
%nonUSborn	Battle E	-0.028	0.553
%unmarried	Battle E	-0.035	0.475
%higheredDeg	Battle E	-0.001	0.986
AFQTCat1%	Battle E	-0.005	0.922
AFQTCat2%	Battle E	0.035	0.432
AFQTCat3A%	Battle E	0.019	0.659
AFQTCat3B%	Battle E	-0.010	0.824

Diversity Metric	Performance Indicator	Correlation Coefficient	Significance (p-value)
AFQTCat5%	Battle E	-0.079	0.000
%F	MA Scores	-0.083	0.144
Age_Med	MA Score	0.001	0.817
%African American	MA Scores	-0.067	0.988
%AmIn	MA Scores	0.042	0.653
%Asian	MA Scores	0.013	0.678
%White	MA Scores	0.021	0.663
%PI	MA Scores	-0.037	0.463
%Mixed	MA Scores	0.045	0.926
%nonwhite	MA Scores	-0.021	0.663
%nonUSborn	MA Scores	0.088	0.764
%unmarried	MA Scores	0.006	0.999
%higheredDeg	MA Scores	0.075	0.064
AFQTCat1%	MA Scores	0.081	0.094
AFQTCat2%	MA Scores	0.116	0.908
AFQTCat3A%	MA Scores	-0.052	0.212
AFQTCat3B%	MA Scores	-0.101	0.979
AFQTCat5%	MA Scores	-0.038	0.42

The correlation analysis aims to uncover the presence and strength of these relationships to better understand how diversity dimensions are linked with ship performance. It is important to note the significance levels associated with these

correlations, as indicated by their p-values. For instance, the correlation between %AmIn and Battle E status ($r = -0.090$, $p = 0.048$) is statistically significant, suggesting a negative relationship. However, not all observed correlations imply a strong or statistically significant relationship. For example, the correlation between %White and Battle E status ($r = -0.001$, $p = 0.983$) is very weak and not statistically significant.

D. ASSESSMENT OF THE FEMALE CREW PROPORTION

To analyze the operational performance of the DDG class, we conduct t-tests to evaluate if there is a statistically significant difference in diversity metrics between ships with above-average MA scores and those with average scores, as well as between Battle E winners and non-winners. Our objective is to assess whether variations in diversity metrics, such as the proportion of female crew members, age, race, and education composition, s with variations in performance indicators.

The t-tests are instrumental in distinguishing whether ships with different performance ratings, categorized as above-average and average based on MA scores, show significant differences in their diversity metrics. If the t-tests yield a significant result, such as a significantly higher mean percentage of female crew members on above-average performing ships compared to average performers, it would indicate a correlational relationship between gender diversity and operational performance. A similar analysis is applied to the race composition of ships winning the Battle E award compared to those that do not see if diversity corresponds with recognition for excellence.

The purpose of this analysis is to identify any significant patterns that suggest a ship's diversity profile might relate to its performance. This analysis is not premised on a prior hypothesis. Still, it is an exploratory step to understand potential associations between crew diversity and performance effectiveness, as evidenced by MA score categorizations and Battle E awards.

Finally, we interpret the results to draw conclusions about the relationship between diversity and performance and to make informed recommendations for future operational strategies.

Tables 7 and 8 illustrate the t-test comparisons between diversity metrics by Battle E Winners and Non-Winners and MA Score category, with corresponding p-values.

Table 7. T-Test Comparisons between Diversity Battle E Winners and Non-Winners.

Diversity Metric	T-Test (Battle E Winner)	P-Value (Battle E Winner)
%F	-2.49	0.013
Age_med	0.547	0.586
%African American	1.976	0.052
%AmIn	-2.008	0.048
%Asian	-1.949	0.055
%White	-0.021	0.983
%PI	-0.867	0.389
%Mixed	-0.043	0.966
%nonwhite	0.025	0.980
%nonUSborn	-0.596	0.553
%unmarried	-0.719	0.475
%higheredDeg	-0.018	0.986
AFQTCat1%	-0.098	0.922
AFQTCat2%	0.790	0.432
AFQTCat3A%	0.443	0.659
AFQTCat3B%	-0.223	0.824
AFQTCat5%	-3.991	0.000

The analysis of comparisons between diversity metrics by Battle E Winners vs. Non-Winners category, as summarized in Table 7, yields several key findings:

1. **%F:** Statistically significant ($p = 0.013$), suggesting ships with a lower proportion of female crew members are winners of Battle E.

2. **%AmIn:** Statistically significant ($p = 0.048$), suggesting ships with a lower proportion of American Indian/Native American crew members are winners of Battle E.

3. **%Black:** Marginally significant ($p = 0.052$), suggesting ships with a higher proportion of African American crew members are winners of Battle E.

4. **%Asian:** Marginally significant ($p = 0.055$), suggesting ships with a lower proportion of Asian crew members are winners of Battle E.

5. **AFQTCat5%:** Highly significant ($p < 0.001$), strongly associated with Battle E status.

The analysis of comparisons between diversity metrics by MA Score category, as summarized in Table 8, yields two key findings:

1. **%higheredDeg:** Marginally significant ($p = 0.064$), suggesting ships with a higher proportion of crew with advanced degrees tend to have above-average MA scores

2. **AFQTCat1%:** Marginally significant ($p = 0.094$), suggesting ships with a higher proportion of crew that fall in the AFQTCat1% tend to have above-average MA scores. above-average MA scores.

Table 8. T-Test Comparisons between Diversity Metrics by MA SCORE Category

Diversity Metric	T-Test (MA SCORE)	P-Value (MA SCORE)
%F	-1.469	0.144
Age_med	0.232	0.817
%African American	0.015	0.988
%AmIn	-0.45	0.653
%Asian	-0.416	0.678
%White	0.437	0.663

Diversity Metric	T-Test (MA SCORE)	P-Value (MA SCORE)
%PI	-0.735	0.463
%Mixed	0.093	0.926
%nonwhite	-0.437	0.663
%nonUSborn	0.301	0.764
%unmarried	0.002	0.999
%higheredDeg	1.861	0.064
AFQTCat1%	1.682	0.094
AFQTCat2%	-0.116	0.908
AFQTCat3A%	-1.251	0.212
AFQTCat3B%	0.027	0.979
AFQTCat5%	0.809	0.42

E. ASSESSMENT OF THE FEMALE CREW MEMBERS

Through correlational analysis, we find a significant relationship between the proportion of female members in a ship, %F metric, and the ship's Battle E Winner status. With 418 observations in our sample, we find a small negative correlation between these two variables, with $r(416) = -0.121$, $p = 0.013$, which shows a statistically significant relationship. This indicates that ships with a larger proportion of female members tend to have a slightly lower chance of winning the Battle E award; although the relationship is statistically significant, it is small in magnitude.

Figure 5 illustrates the comparison of %F between ships that won Battle E and those that did not win Battle E. We use a between-subjects t-test to compare the average proportion of females on ships that were awarded the Battle E distinction ($M = 17.60\%$, $SD = 5.91\%$) with the average proportion of females on ships that were not awarded ($M = 19.27\%$, $SD = 4.67\%$). The analysis reveals a significant difference in the %F between groups, $t(70.40) = -2.49$, $p = .039$.

Our analysis indicates a meaningful difference between the proportion of female members on ships that received the Battle E award and those that did not, with the award-

winning ships having a slightly lower proportion of females on average. The statistical significance of this difference suggests it is unlikely due to chance.

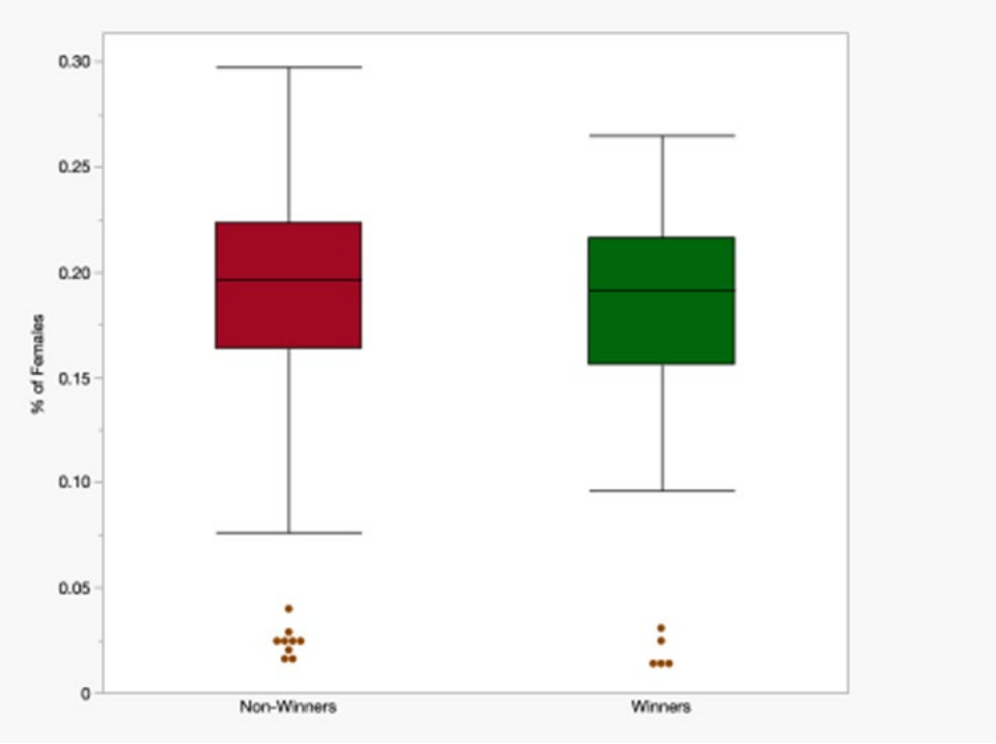

Figure 5. Analysis of Battle E Winner and Female Crew Proportion from 2017–2022

Upon closer examination of the Battle E winners, we identify a subset of ships representing outliers with a notably low percentage of female crew members. Specifically, the MITSCHER (DDG 57) and RAMAGE (DDG 61) fall well below the lower quartile range for %F, suggesting an exceptional case within the winners' cohort. These ships present %F values as low as 1.33% and 2.46%, respectively. These outliers contribute towards the lower %F mean among Battle E winners. This warrants further qualitative analysis to understand the unique characteristics or circumstances that may account for their performance in relation to the diversity of their crew.

Through correlational analysis, we examine the relationship between the proportion of female members on ships, represented by the %F metric, and the ships' MA scores. With

259 observations in our dataset, we uncover a small negative correlation between these two variables, with $r(257) = -0.083$, $p = 0.184$, indicating that the correlation is not statistically significant. This suggests that the proportion of female members is not strongly related to the MA scores of the ships.

Figure 6 showcases the comparison of %F between ships with above-average MA scores and those with average MA scores. Employing a between-subjects t-test, we compare the average proportion of females on ships recognized with above-average MA scores ($M = 18.60\%$, $SD = 4.91\%$) to those with average scores ($M = 19.53\%$, $SD = 4.65\%$). The analysis results do not demonstrate a significant difference in the %F between the two groups, with a t-value of $t(257) = -1.469$ and a p-value of .144.

The findings from our analysis suggest no substantial difference in the proportion of female members between ships based on their MA performance levels. The %F metric is not a significant factor in the performance outcomes as measured by the MA scores within our sample.

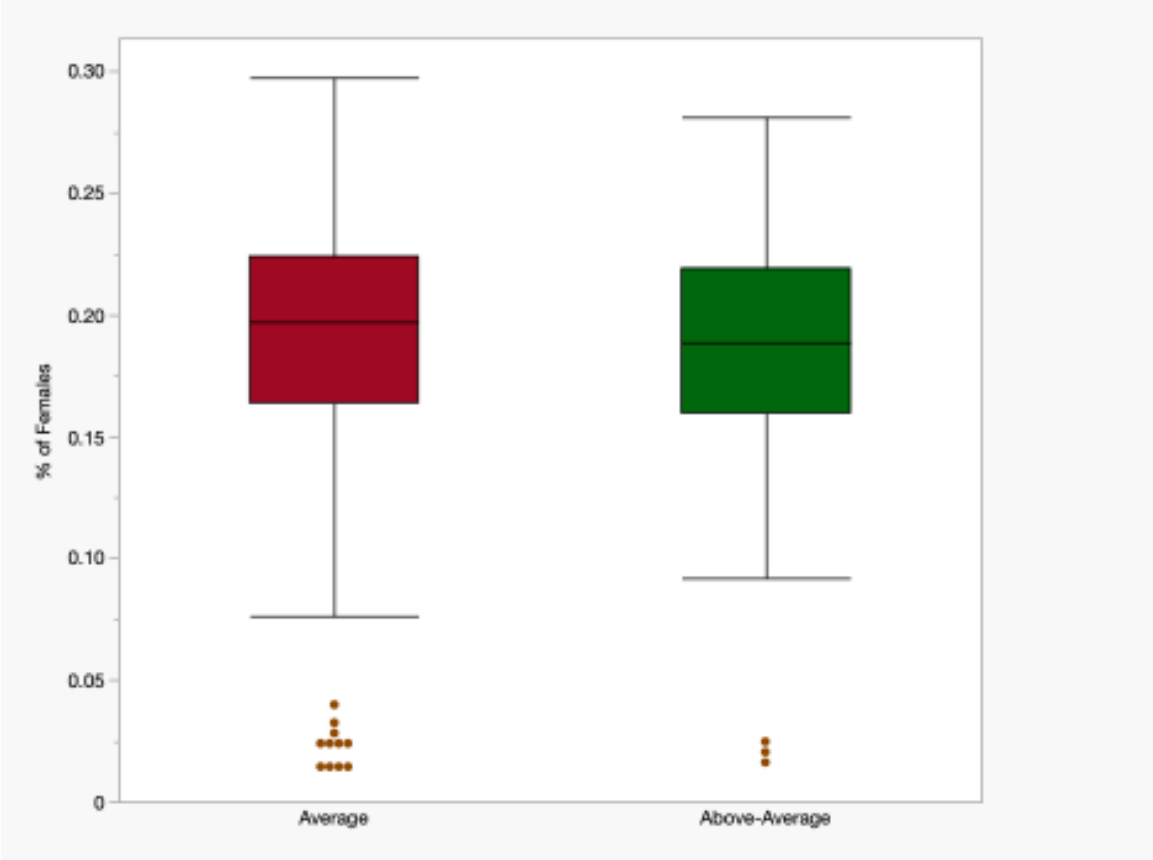

Figure 6. Analysis of MA Scores Evaluation and Female Crew Proportion from 2017–2022

F. ASSESSMENT OF THE PROPORTION OF AFRICAN AMERICAN CREW MEMBERS (%B)

Through correlational analysis, we find a significant relationship between the proportion of African American crew members in a ship, %African Americans metric, and the ship's Battle E Winner status. With 418 observations in our sample, we find a small positive correlation between these two variables, with $r(416) = 0.095$, $p = 0.052$, which shows a marginally significant correlation. This indicates that ships with a larger percentage of African American crew members tend to have a slightly higher chance of winning the Battle E award.

Figure 7 illustrates the comparison of %African Americans between ships that won Battle E and those that did not win Battle E. We use a between-subjects t-test to compare the average proportion of African American crew members on ships that were awarded the

Battle E distinction (M = 22.04%, SD = 3.16%) with the average proportion of African American members on ships that were not awarded (M = 21.16%, SD = 3.21%). The analysis reveals a marginally significant difference in the %African Americans between groups, $t(79.04) = 1.98$, $p = .052$.

Our analysis has shown a meaningful difference between the proportion of African American members on ships that received the Battle E award and those that did not, with the award-winning ships having a slightly higher percentage of African American members on average. This difference, while marginally significant, suggests that other factors might contribute to whether a ship wins the Battle E distinction.

Upon closer examination of the non-Battle E winners, we identified a subset of ships representing outliers with a notably low percentage of African American crew members. Specifically, the FITZGERALD (DDG 62) and the SHOUP (DDG 86) fall well below the lower quartile range for the percentage of African Americans. The FITZGERALD (DDG 62) displayed values as low as 8.658% and 10.241% in different years, while the SHOUP (DDG 86) had figures ranging from 10.669% to 12.281%. Additionally, the BULKELEY (DDG 84) and COLE (DDG 67) also exhibited lower proportions of African American crew members, with 29.602% and 30.439%, respectively.

These outliers significantly contribute to the lower average percentage of African Americans among the non-Battle E winners. This observation prompts a need for further qualitative analysis to understand the unique characteristics or circumstances of these specific ships that may account for their performance in relation to the diversity of their crew.

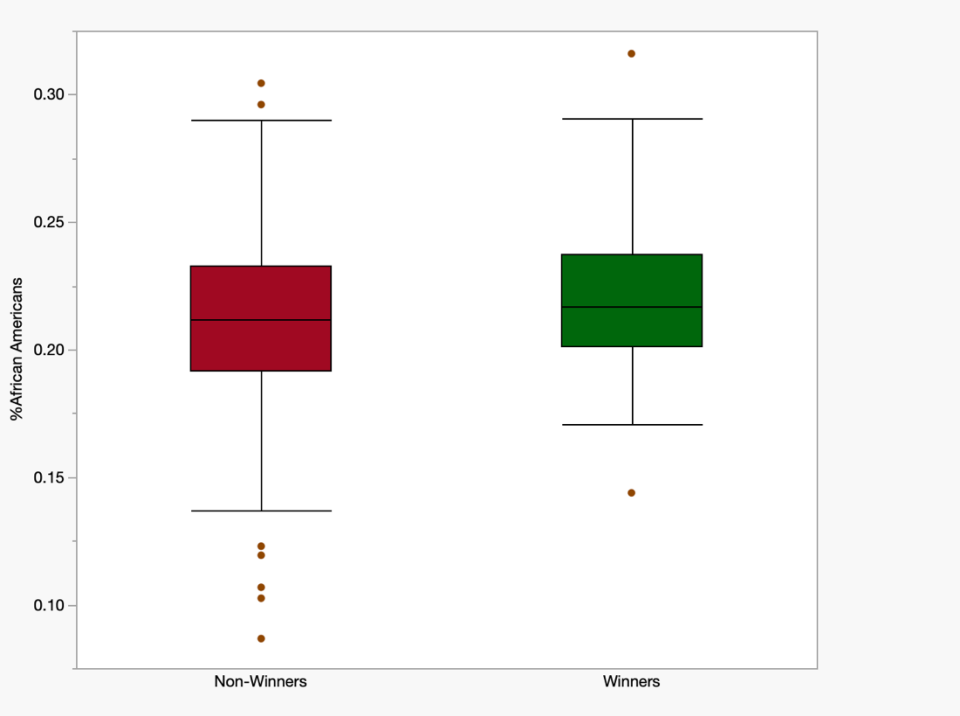

Figure 7. Analysis of Battle E Winner and African American Crew Proportion

Through correlational analysis, we examine the relationship between the proportion of African American crew members on ships, represented by the % African American metric, and the ships' MA scores. With 263 observations in our sample, we uncover a small negative correlation between these two variables, with $r(261) = -0.067$, $p = 0.280$, indicating that the correlation is not statistically significant. This suggests that the proportion of African American crew members is not strongly related to the MA scores of the ships.

Figure 8 illustrates the comparison of % African Americans between ships with above-average MA scores and those with average MA scores. Employing a between-subjects t-test, we compare the average percentage of African American crew members on ships recognized with above-average MA scores ($M = 21.37\%$, $SD = 2.48\%$) to those with average scores ($M = 21.36\%$, $SD = 3.15\%$). The analysis results do not demonstrate a

significant difference in the % African Americans between the two groups, with a t-value of t(261) = 0.015 and a p-value of 0.988.

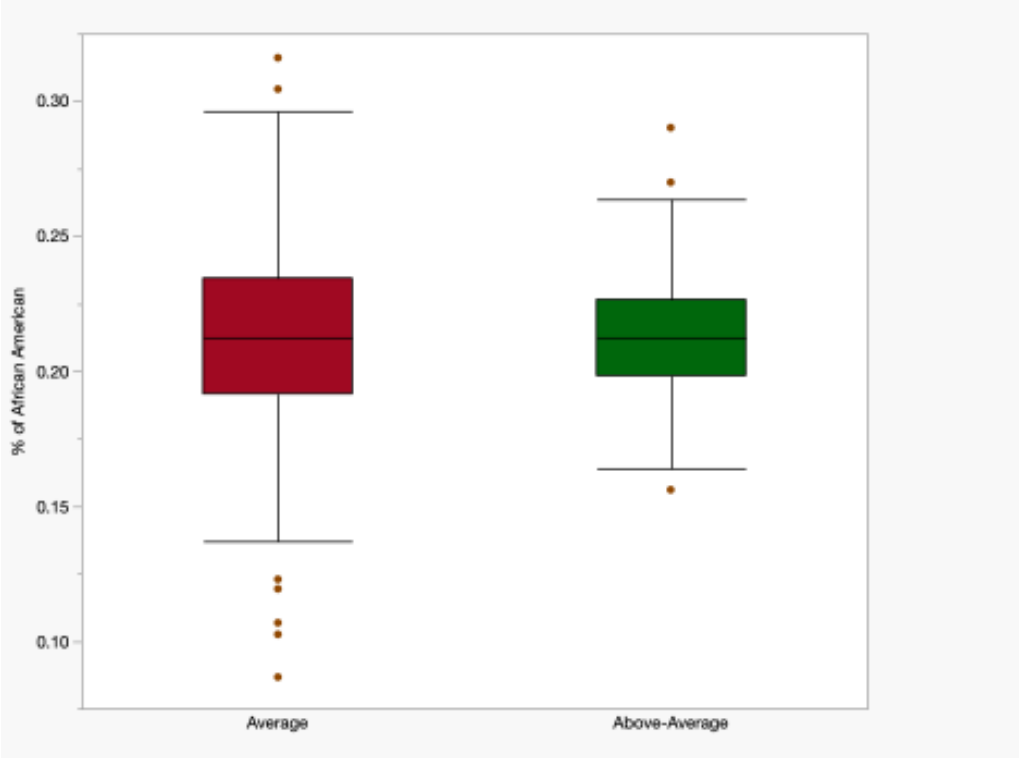

Figure 8. Analysis of MA Scores Evaluation and African American Crew Proportion from 2017–2022

The findings from our analysis suggest no substantial difference in the proportion of African American crew members between ships based on their MA performance levels. The % African American metric does not appear to be a significant factor in the performance outcomes as measured by the MA scores within our sample.

G. ASSESSMENT OF THE PROPORTION OF CREW MEMBERS WITH HIGHER DEGREES (%HIGHEREDDEG)

Through correlational analysis, we find a significant relationship between the proportion of American Indian members in a ship, %American Indian metric, and the ship's Battle E Winner status. With 418 observations in our sample, we find a small negative

correlation between these two variables, with r(416) = -0.090, p = 0.0664, which shows a marginally significant correlation. This indicates that ships with a larger percentage of American Indian members tend to have a slightly lower chance of winning the Battle E award, although the relationship is marginally significant.

It is crucial to note that the overall representation of American Indian members in both winning and non-winning ships is relatively low, comprising only 1.71% and 1.92% respectively. This narrow range indicates that the findings are based on a small proportion of American Indian representation within the crews. Consequently, the results might present a different picture under conditions of greater representation.

Figure 9 illustrates the comparison of %American Indian between ships that won the Battle E and those that did not win the Battle E. We use a between-subjects t-test to compare the average proportion of American Indian crew members on ships that were awarded the Battle E distinction (M = 1.71%, SD = 0.71%) with the average proportion of American Indian members on ships that were not awarded (M = 1.92%, SD = 0.80%). The analysis reveals a significant difference in the %American Indian between groups, t(84.23) = -2.01, p = .048.

Our analysis has shown that there is a meaningful difference between the proportion of American Indian members on ships that received the Battle E award and those that did not, with the award-winning ships having a slightly lower percentage of American Indian members on average. This difference is statistically significant, suggesting that there might be other factors at play that contribute to whether a ship wins the Battle E distinction.

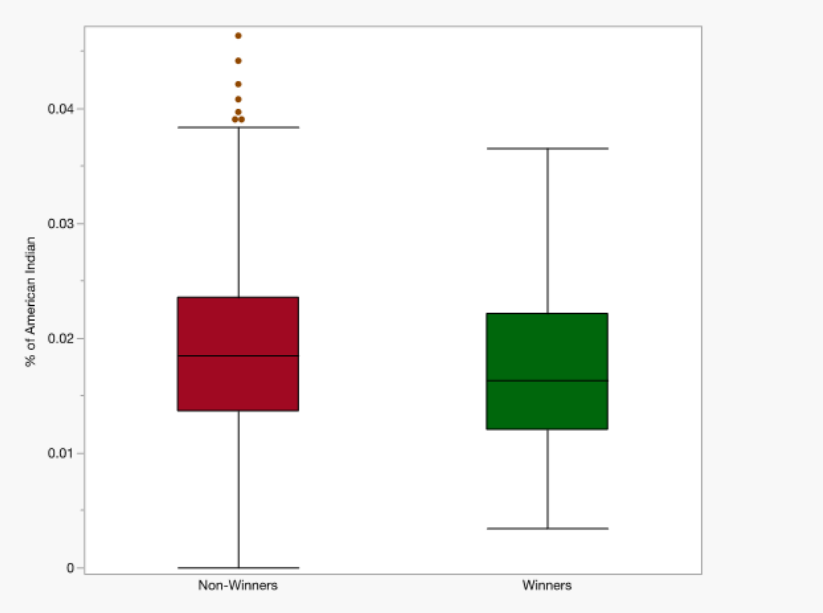

Figure 9. Analysis of Battle E Winner and American Indian Crew Proportion from 2017–2022

Through correlational analysis, we examine the relationship between the proportion of American Indian crew members on ships, represented by the %AmIn metric, and the ships' MA scores. With 263 observations in our sample, we uncover a small positive correlation between these two variables, with $r(261) = 0.042$, $p = 0.500$, indicating that the correlation is not statistically significant. This suggests that the proportion of American Indian crew members is not strongly related to the MA scores of the ships.

Figure 10 illustrates the comparison of %AmIn between ships with above-average and average MA scores. Employing a between-subjects t-test, we compare the average percentage of American Indian crew members on ships recognized with above-average MA scores ($M = 1.81\%$, $SD = 0.85\%$) to those with average scores ($M = 1.86\%$, $SD = 0.68\%$). The analysis results do not demonstrate a significant difference in the %AmIn between the two groups, with a t-value of $t(261) = -0.45$ and a p-value of 0.653.

The findings from our analysis suggest no substantial difference in the proportion of American Indian crew members between ships based on their MA performance levels. The %AmIn metric is not a significant factor in the performance outcomes as measured by the MA scores within our sample.

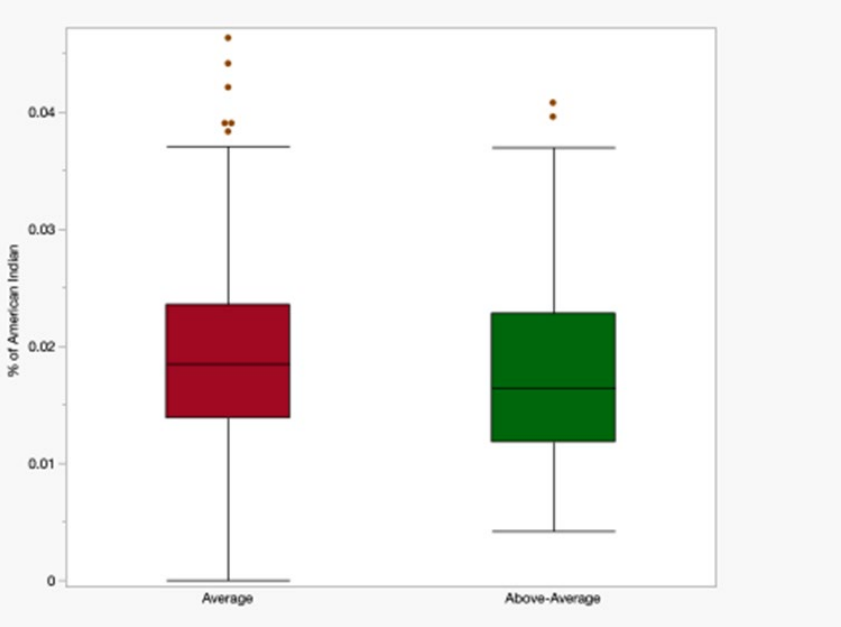

Figure 10. Analysis of MA Score Evaluation and American Indian Crew Proportion from 2017–2022

H. ASSESSMENT OF THE PROPORTION OF ASIAN CREW MEMBERS (%AS)

Through correlational analysis, we find a significant relationship between the proportion of Asian crew members in a ship, denoted as the Asian metric, and the ship's Battle E Winner status. With 418 observations in our sample, we find a small negative correlation between these two variables, with $r(416) = -0.085$, $p = 0.0820$, which shows a marginally significant correlation. This indicates that ships with a larger percentage of Asian crew members tend to have a slightly lower chance of winning the Battle E award, although the relationship is marginally significant, it is not particularly strong.

Figure 11 illustrates the comparison of %Asian between ships that won the Battle E and those that did not win the Battle E. We use a between-subjects t-test to compare the average proportion of Asian crew members on ships that were awarded the Battle E distinction ($M = 6.69\%$, $SD = 2.04\%$) with the average proportion of Asian members on ships that were not awarded ($M = 7.26\%$, $SD = 2.38\%$). The analysis reveals a marginal statistically significant difference in the %Asian between groups, $t(86.25) = -1.95$, $p = .055$.

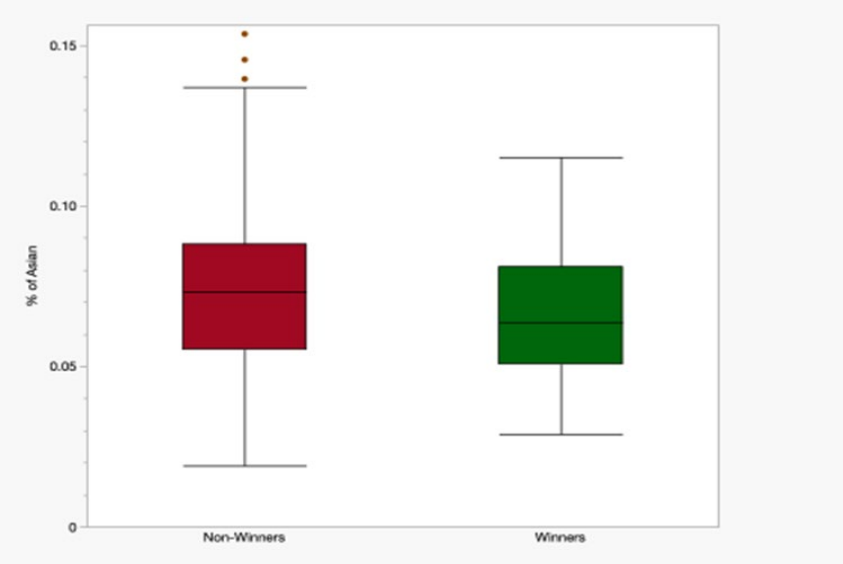

Figure 11. Analysis of Battle E Winner and Asian Crew Proportion from 2017–2022

Our analysis has shown a meaningful difference between the proportion of Asian members on ships that received the Battle E award and those that did not, with the award-winning ships having a slightly lower percentage of Asian members on average. This difference, while marginally significant, suggests that other factors might contribute to whether a ship wins the Battle E distinction.

Through correlational analysis, we examine the relationship between the proportion of Asian crew members on ships, represented by the %Asian metric, and the ships' MA scores. With 263 observations in our sample, we uncover a small positive correlation between these two variables, with $r(261) = 0.013$, $p = 0.840$, indicating that the correlation is not statistically significant. This suggests that the proportion of Asian crew members is not strongly related to the MA scores of the ships.

Figure 12 illustrates the comparison of %Asian between ships with above-average and average MA scores. Employing a between-subjects t-test, we compare the average percentage of Asian crew members on ships recognized with above-average MA scores ($M = 7.21\%$, $SD = 2.32\%$) to those with average scores ($M = 7.34\%$, $SD = 2.39\%$). The analysis results do not demonstrate a significant difference in the %Asian between the two groups, with a t-value of $t(147.80) = -0.416$ and a p-value of 0.678.

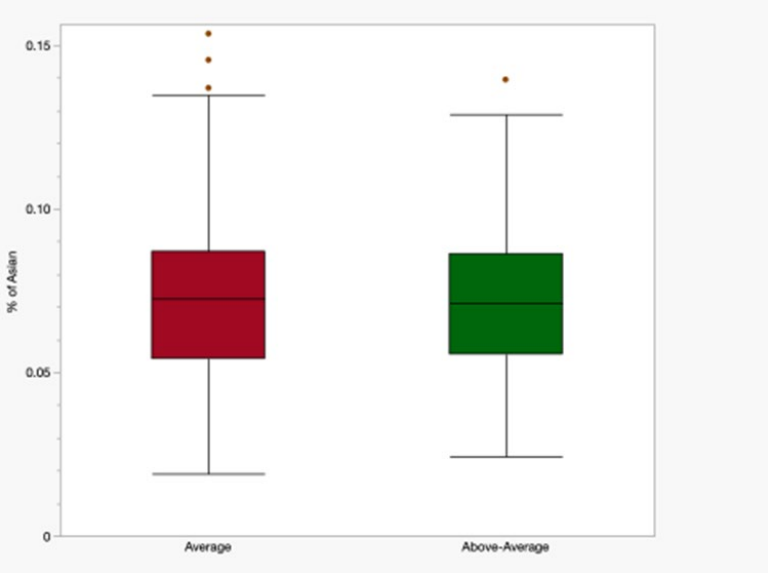

Figure 12. Analysis of MA Scores Evaluation and Asian Crew Proportion from 2017–2022

The findings from our analysis suggest no substantial difference in the proportion of Asian crew members between ships based on their MA performance levels. The %Asian metric does not appear to be a significant factor in the performance outcomes as measured by the MA scores within our sample.

I. ASSESSMENT OF THE PROPORTION OF CREW MEMBERS HIGHER DEGREES (%HIGHEREDDEG)

Through correlational analysis, we find no significant relationship between the proportion of crew members with higher education degrees in a ship, denoted as the %higheredDeg metric, and the ship's Battle E Winner status. With 418 observations in our sample, we find a negligible negative correlation between these two variables, with $r(416) = -0.001$, $p = 0.986$, indicating no significant relationship. This suggests that the percentage of crew members holding higher education degrees does not influence a ship's likelihood of winning the Battle E award.

Figure 13 illustrates the comparison of %higheredDeg between ships that won the Battle E and those that did not win the Battle E. We use a between-subjects t-test to compare the average proportion of higher education degree holders on ships that were

awarded the Battle E distinction (M = 13.28%, SD = 1.89%) with the average proportion of degree holders on ships that were not awarded (M = 13.29%, SD = 1.96%). The analysis reveals no significant difference in the %higheredDeg between groups, t(−0.02) = −0.018, p = 0.986.

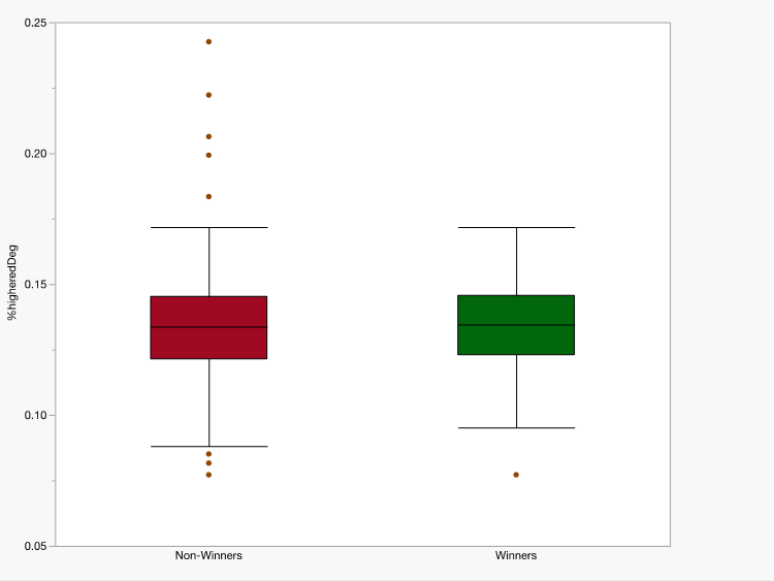

Figure 13. Analysis of Battle E Winner and Crew Members with Higher Degrees from 2017–2022

Our analysis has shown no significant difference between the proportion of higher education degree holders on ships that received the Battle E award and those that did not. This lack of difference suggests that the educational level of the crew, as measured by %higheredDeg, is not a determining factor in whether a ship wins the Battle E distinction.

Through correlational analysis, we examine the relationship between the proportion of crew members with higher education degrees on ships, represented by the %higheredDeg metric, and the ships' MA scores. With a sample size sufficient for correlation analysis, we find a small positive correlation between these two variables, with r = 0.075, p = 0.226, indicating that the correlation is not statistically significant. This suggests that the proportion of crew members with higher education degrees is not strongly related to the MA scores of the ships.

Figure 14 illustrates the comparison of %higheredDeg between ships with above-average and average MA scores. Employing a between-subjects t-test, we compare the average percentage of crew members with higher education degrees on ships recognized with above-average MA scores (M = 13.77%, SD = 1.73%) to those with average scores (M = 13.34%, SD = 1.83%). The analysis results reveal a marginal significance in the %higheredDeg between the two groups, with a t-value of t = 1.861 and a p-value of 0.064.

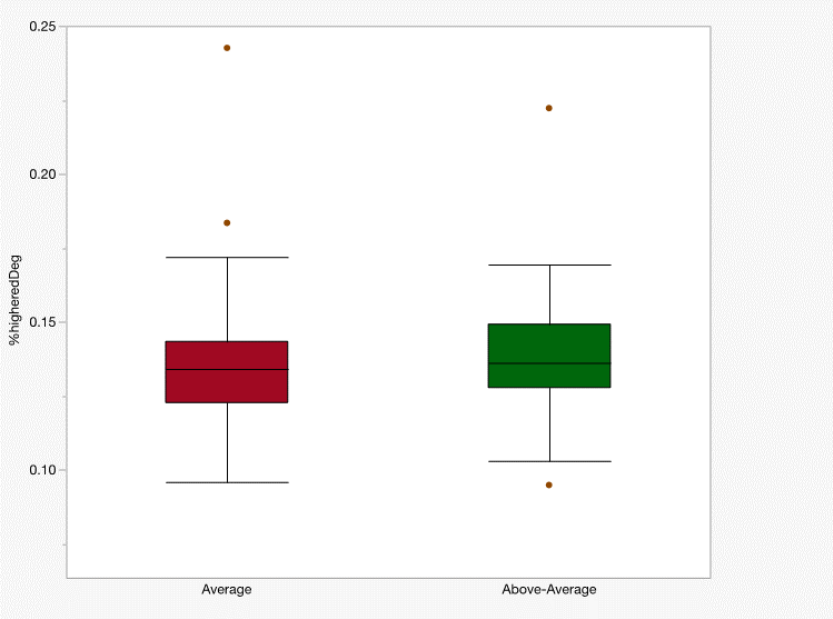

Figure 14. Analysis of MA Scores Evaluation Crew Members with Higher Degrees from 2017–2022

The findings from our analysis suggest a marginally significant difference in the proportion of crew members with higher education degrees between ships based on their MA performance levels. The %higheredDeg metric appears to be somewhat relevant in the performance outcomes as measured by the MA scores within our sample, indicating that higher education levels might have a slight impact on MA performance.

J. ASSESSMENT OF THE PROPORTION OF CREW MEMBERS WITHIN AFQT CATEGORY 1 (AFQTCAT1%1)

Through correlational analysis, we find no significant relationship between the proportion of crew members in the AFQTCat1 category in a ship, denoted as the AFQTCat1% metric, and the ship's Battle E Winner status. With 418 observations in our sample, we find a small negative correlation between these two variables, with $r(416) = -0.0047$, $p = 0.924$, indicating no significant relationship. This suggests that the percentage of crew members in the AFQTCat1 category does not have a notable impact on a ship's likelihood of winning the Battle E award.

Figure 15 illustrates the comparison of AFQTCat1% between ships that won the Battle E and those that did not win the Battle E. We use a between-subjects t-test to compare the average proportion of AFQTCat1% on ships that were awarded the Battle E distinction ($M = 5.63\%$, $SD = 1.47\%$) with the average proportion of AFQTCat1% on ships that were not awarded ($M = 5.65\%$, $SD = 1.52\%$). The analysis reveals no significant difference in AFQTCat1% between groups, $t(-0.10) = -0.098$, $p = 0.922$.

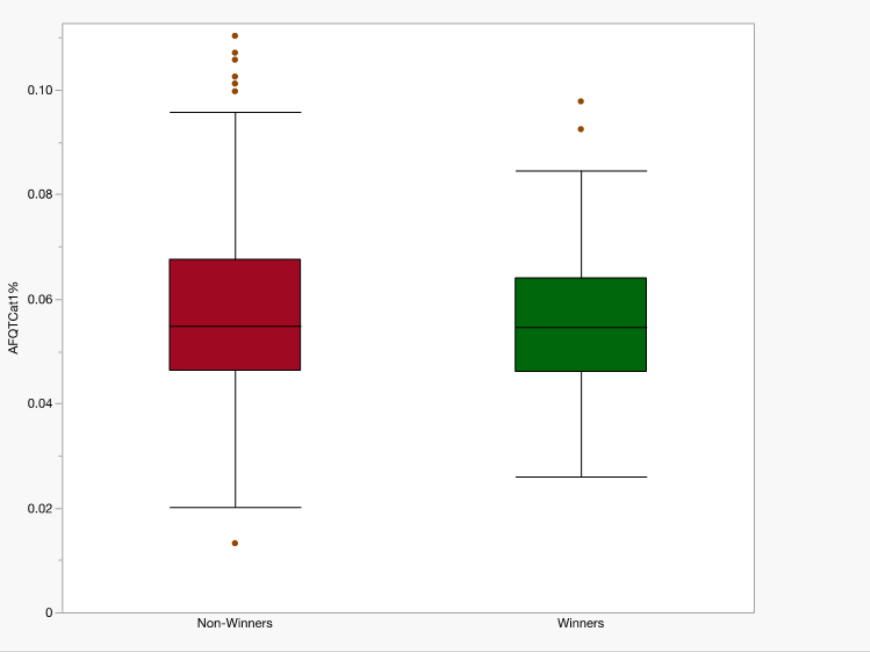

Figure 15. Analysis of Battle E Winner and Crew Members within AFQT Category1 from 2017–2022

Our analysis has shown that there is no significant difference between the proportion of AFQTCat1% category members on ships that received the Battle E award and those that did not. This lack of difference indicates that the presence of crew members in the AFQTCat1 category is not a determining factor in whether a ship wins the Battle E distinction.

A Through correlational analysis, we examine the relationship between the proportion of crew members in the AFQTCat1 category on ships, represented by the AFQTCat1% metric, and the ships' MA scores. We find a slight positive correlation between these two variables, with r = 0.081, p = 0.191, indicating that the correlation is marginally significant. This suggests that the proportion of crew members in the AFQTCat1 category might have a small influence on the MA scores of the ships, although the relationship is not strongly pronounced.

Figure 16 illustrates the comparison of AFQTCat1% between ships with above-average and average MA scores. Employing a between-subjects t-test, we compare the average percentage of crew members in the AFQTCat1 category on ships recognized with above-average MA scores (M = 5.74%, SD = 1.38%) to those with average scores (M = 5.43%, SD = 1.47%). The analysis results reveal a marginal significance in the AFQTCat1% between the two groups, with a t-value of t = 1.682 and a p-value of 0.094.

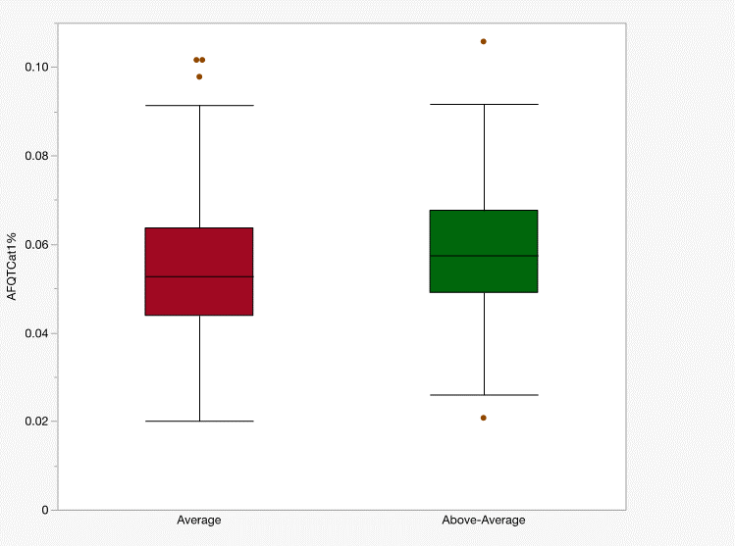

Figure 16. Analysis of MA Scores Evaluation Crew Members within AFQT Category 1 from 2017–2022

The findings from our analysis suggest a marginally significant difference in the proportion of crew members in the AFQTCat1 category between ships based on their MA performance levels. The AFQTCat1% metric is relevant in the performance outcomes as measured by the MA scores within our sample, indicating that the presence of crew members in this category might slightly impact MA performance.

K. ASSESSMENT OF THE PROPORTION OF CREW MEMBERS WITHIN AFQT CATEGORY (AFQTCAT1%5)

Through correlational analysis, we find a small negative correlation between the proportion of crew members in the AFQTCat5 category in a ship, denoted as the AFQTCat5% metric, and the ship's Battle E Winner status. With 418 observations in our sample, we find this correlation, $r(416) = -0.079$, $p = 0.107$, which is not statistically significant. This indicates that the percentage of crew members in the AFQTCat5 category does not significantly influence a ship's likelihood of winning the Battle E award.

It is essential to note that the range of proportions we are examining here is quite small, with less than 1% difference. This narrow range underscores that our findings are based on minimal variations in the representation of AFQTCat5 category members within the crew.

Figure 17 illustrates the comparison of AFQTCat5% between ships that won Battle E and those that did not win Battle E. We use a between-subjects t-test to compare the average proportion of AFQTCat5% on ships that were awarded the Battle E distinction ($M = 0.000\%$, $SD = 0.000\%$) with the average proportion of AFQTCat5% on ships that were not awarded ($M = 0.015\%$, $SD = 0.071\%$). The analysis indicates a significant difference in AFQTCat5% between groups, $t(-3.99) = -3.991$, $p < 0.001$.

Our analysis has shown a significant difference between the proportion of AFQTCat5% category members on ships that received the Battle E award and those that did not, with the award-winning ships having a notably lower percentage of AFQTCat5% members. This significant difference suggests that while the correlation with Battle E status is not strong, the presence of crew members in the AFQTCat5 category may play a role in whether a ship wins the Battle E distinction.

Figure 17. Analysis of Battle E Winner and Crew Members within AFQT Category5 from 2017–2022

Through correlational analysis, we examine the relationship between the proportion of crew members in the AFQTCat5 category on ships, represented by the AFQTCat5% metric, and the ships' MA scores. We find a slight negative correlation between these two variables, with r = -0.038 and p = 0.544, indicating that the correlation is not statistically significant. This suggests that the proportion of crew members in the AFQTCat5 category does not have a notable impact on the MA scores of the ships.

Figure 18 illustrates the comparison of AFQTCat5% between ships with above-average and average MA scores. Employing a between-subjects t-test, we compare the average percentage of crew members in the AFQTCat5 category on ships recognized with above-average MA scores (M = 0.016%, SD = 0.066%) to those with average scores (M = 0.010%, SD = 0.052%). The analysis results do not demonstrate a significant difference in the AFQTCat5% between the two groups, with a t-value of t = 0.809 and a p-value of 0.420.

The findings from our analysis suggest no substantial difference in the proportion of crew members in the AFQTCat5 category between ships based on their MA performance levels. The AFQTCat5% metric does not appear to be a significant factor in the performance outcomes as measured by the MA scores within our sample.

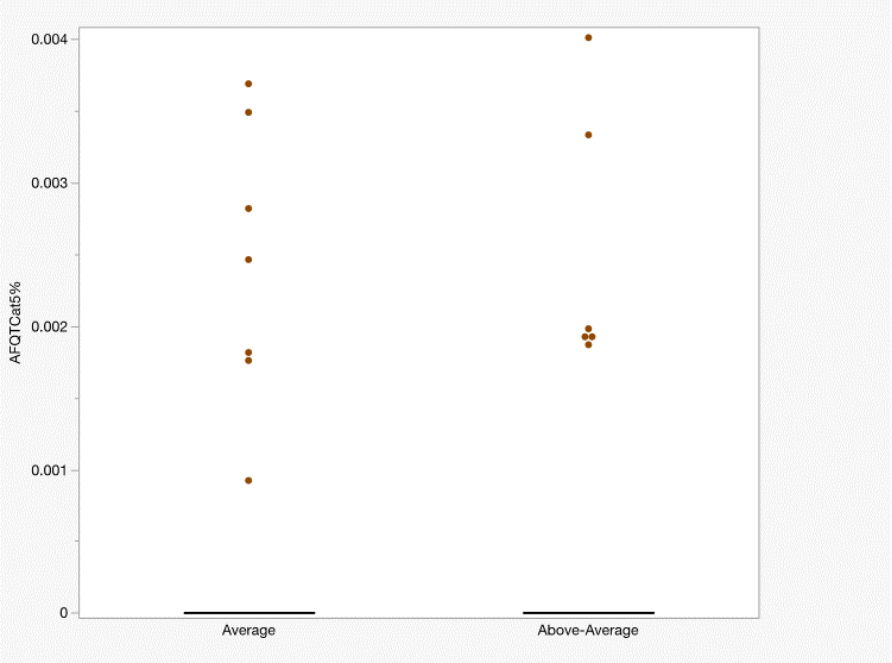

Figure 18. Analysis of MA Scores Evaluation Crew Members within AFQT Category 5 from 2017–2022

V. SUMMARY, FINDINGS ANALYSIS, RECOMMENDATIONS AND CONCLUSION

A. SUMMARY

This thesis embarked on a rigorous exploration of the interplay between diversity attributes and performance metrics within the fleet of U.S. Navy DDGs. By meticulously correlating a spectrum of crew diversity variables with the attainment of the Battle Effectiveness (Battle E) award and Mission Area Scores, the study sought to deepen our comprehension of the influence of diversity on naval operational performance. Central to this inquiry was the determination of whether there exists an empirical link between the diversity within a DDG's crew and the ship's performance, and to discern how different diversity dimensions distinguish between above average-performing and average-performing units. This research was designed to provide a structured analysis of these relationships, contributing to the broader conversation on diversity's operational impact in military settings.

B. QUANTITATIVE DATA ANALYSIS

Research Question 1: Is there a relationship between unit diversity and performance in the DDG class?

Our analysis of the empirical relationship between unit diversity and performance in DDG warships highlighted the following significant correlations:

- **Battle E Awards Correlation:** The study identified a negative correlation between the percentage of female crew members and the likelihood of receiving the Battle E award ($r=-0.121$, $p=0.013$). DDGs not awarded the Battle E had an average female representation of 19.27%, compared to 17.60% for award recipients, with a statistically significant t-test result ($p=0.039$). Conversely, a positive correlation was found with African American crew members ($r=0.095$, $p=0.052$), suggesting mixed relationships between demographic composition and awards for operational excellence.

- **Correlations with Other Demographics:** We also noted slight correlations for Asian American (r=-0.085, p=0.055) and American Indian crew members (r=-0.090, p=0.048). The Asian representation on non-Battle E ships averaged 7.26%, compared to 6.69% on Battle E recipients, indicating marginally significant differences (p=0.055). African American representation showed a marginally significant difference, being higher on Battle E recipients (22.04%) compared to non-recipients (21.16%) (p=0.052).
- **Interpretation of Research Question 1 Correlations:** These correlations, while statistically significant or marginally so, highlight the complex interplay between various demographic factors and their influence on a ship's performance as recognized through awards like the Battle E. The varying degrees of correlation across different demographics underscore the multifaceted nature of diversity's impact on operational effectiveness in the context of DDG warships.

Research Question 2: How do dimensions of diversity relate to performance in both above-performing and average-performing units?

In assessing the diversity dimensions between average and above-average performing units based on Mission Area (MA) score evaluations, our study yielded the following insights:

- **Marginal Significance in Education and AFQT1 Scores:** Our statistical analysis revealed marginally significant values in certain demographics, particularly in the realm of education and AFQT1 scores, with p-values recorded at 0.064 and 0.094, respectively. These findings suggest that educational background and cognitive classifications may have a nuanced influence on performance, albeit not conclusively decisive.
- **Analysis of Gender and Ethnicity Variance:** The study found no statistically significant difference in the mean percentage of female crew members between high (18.60%) and average (19.53%) performers (t(257)=-1.469, p=0.144). Similarly, the analysis showed nonsignificant differences in racial demographics among the units. This was observed for African American (t(261)=0.015, p=0.988),

Asian (t(147.80)=-0.416, p=0.678), and American Indian (t(261)=-0.45, p=0.653) crew members.

- **Implications of Research Question 2 Findings:** These results suggest that while there are marginal differences in certain demographics, such as education and AFQT1 scores, they do not necessarily translate into significant variations in performance as measured by MA scores. This indicates that factors beyond the scope of gender and racial demographics, possibly including educational attainment and cognitive abilities, might play subtle roles in influencing unit performance.

B. Implications for Further Research

The study's findings do not establish a definitive, uniform relationship between diversity and operational performance within DDG fleets. While certain demographic correlations were noted, particularly in the context of Battle E awards, these were not consistently observed across various performance metrics. These outcomes suggest that the role of diversity in influencing operational performance is intricate, potentially interwoven with other unit factors. Future studies should therefore investigate how diversity interacts with elements like leadership effectiveness, training quality, and resource management to fully grasp performance variations in naval units. This comprehensive approach is essential to understand the multifaceted drivers of success, recognizing that diversity is a complex component within a broader operational context.

C. LIMITATIONS

1. Limitations from Research Design

Our study encountered a major limitation due to the lack of detailed data on changes in crucial leadership and watch team roles aboard the ships. The transitions in key positions, notably the Commanding Officer and Executive Officer, are critical in influencing ship performance. However, our method of collecting periodic snapshots of crew compositions on a quarterly basis fell short in capturing these vital changes. Consequently, our data did not adequately reflect the dynamic nature and significant impact of these leadership transitions on ship performance.

To effectively address the limitation of insufficient detail on key personnel changes, future research should take a comprehensive approach, incorporating the integration of in-depth personnel records. Such studies should meticulously track every significant transition in leadership and critical watch team positions, focusing not only on the timing of these transitions but also on the backgrounds, qualifications, and expertise of the individuals involved. This approach necessitates close collaboration with Navy human resources and personnel management systems for data access and analysis. Incorporating this level of detail will enable future research to provide more insightful analyses of the impact that changes in leadership and team composition have on ship performance. This holistic method is poised to yield a more thorough and complete understanding of the complex dynamics involved, thereby significantly enhancing the depth and relevance of research findings in contexts where key positions on warships play a crucial role.

Additionally, our study was limited by not possessing insights into every DDG's historical operational schedule or detailed phase period timelines in relation to when specific performance evaluations were conducted. This gap hindered our ability to assess how various operational cycle stages, like being in port during a maintenance phase or deployed in advanced phase may have specifically influenced a DDG's performance. The different operational phases, such as maintenance, sustainment, and basic all play a crucial role in determining a ship's readiness and efficiency, thereby providing an impact on its performance.

To effectively address this limitation, future studies should adopt a targeted approach that involves the incorporation of comprehensive deployment and operational data. This requires forming strategic partnerships with Immediate Superiors in Command (ISICs) and Type Commanders (TYCOMs) who maintain extensive records that provide key insights into the operational history and records of Navy DDGs. Through these partnerships, researchers can gain access to both current and historical operational data, significantly enhancing the depth and accuracy of their analysis. This approach will enable a more thorough understanding of the intricate ways in which different operational phases impact ship performance.

2. Limitations from Data Constraints

The periodicity of Afloat Training Group (ATG) Evaluations introduces inherent challenges. The constant turnover of ship crews means that during Certification events, ships will possess different levels of crew manning, varied qualifications, and a unique amalgamation of Navy Enlisted Classification codes and watch team experiences. The number of observations for DDGs also varies, with some ships having as few as two in a year, while others may have 14 or more. The COMNAVSURFPAC/ COMNAVSURFLANTINST 3502.7C provides guidelines on Certification Periodicities. However, the directives, such as "All mission area certifications are valid for a period of 36 months...," imply a fixed timeframe for certification validity but do not account for real-world variables that might affect ship performance (COMNAVSURFPAC/ COMNAVSURFLANTINST 3502.7C, DON, 2022).

Furthermore, the available data doesn't detail the exact phase a DDG is in at the time of certification, be it sustainment or advanced, or whether the ship was in port or at sea during the evaluation. The specialized training given by external warfare experts, which subsequently aligns with ATG evaluations, is another area where existing data might not fully capture its impact on overall performance metrics. While the Navy has instated measures like the "Mission Area Watch Team Continuity Requirements," the study faces constraints from the provided data in truly gauging the impact of such measures and other variables on ship performance (COMNAVSURFPAC/ COMNAVSURFLANTINST 3502.7C, DON, 2022).

As mentioned with limitations in our research design, limitations in data also derive from the lack of detailed data on the specific phase of a DDG during certification evaluations. Critical details such as whether the ship is in a sustainment or advanced phase, or its status as being in port or at sea during evaluations, are not captured in the current data. This gap hinders the ability to fully comprehend contextual mission factors affecting ship and crew performance. The impact of specialized training conducted by external warfare experts, aligned with ATG evaluations, is not fully reflected in the available performance data, potentially misrepresenting its effect on available performance metrics.

To address these data limitations and enhance future research, it is recommended that the Navy develop a more comprehensive performance database for all warships, expanding beyond the current scope of ATG mission area evaluations. This database should include quantifiable records of performance, enriched with variables that could significantly impact ship performance. Such variables might include the duration of time a watch team has operated together, specifics of operational deployment time as a watch team, detailed DDG manning percentages, and a breakdown of shortages by ranks and ship departments at the time of evaluation. Additionally, this approach would allow for a deeper analysis of how crew composition, deployment status, and details related to a watch team interplay in shaping a ship's operational effectiveness and performance. It is essential for this proposed database to capture dynamic operational elements, such as the phase of the ship during evaluations (whether in sustainment or advanced phases) and whether the ship was in port or at sea when a quantifiable performance measuring evaluation was conducted. By integrating these combined details, the Navy could better assess the effectiveness of measures like the 'Mission Area Watch Team Continuity Requirements' and understand the true impact of specialized training and other crucial variables on ship performance. This enhanced data infrastructure would significantly contribute to a more accurate and comprehensive understanding of performance determinants in the Navy's operational context."

D. INTERPRETATION OF RESULTS

Despite initial assumptions that crew diversity variables might observably influence operational performance, our analysis underscores the complexity involved in evaluating Navy unit performance. While some correlations were noted, particularly in the context of the Battle E award, their marginal or significant nature was coupled with relatively small effect sizes. For example, the negative correlation between the percentage of female crew members and the likelihood of receiving the Battle E award ($r=-0.121$, $p=0.013$) was statistically significant but indicated only a modest impact. Additionally, American Indian crew members showed a marginally significant correlation with the Battle E award at, $r(416) = -0.095$, $p = 0.052$. In the case of mission area (MA) score evaluations, certain demographics like Higher Education and AFQT1 were marginally significant, with

p-values of 0.064 and 0.094, respectively. This suggests that while diversity factors may play a role, they are not the predominant in determining ship performance.

These observations align with broader organizational research, which posits that multiple factors contribute to effectiveness. The marginal and small significant effects we observed underscore this complexity. Studies by Ali et al. (2011) and Pitts (2005) illustrate that the impact of diversity varies based on the organizational context. In structured and hierarchical military organizations like U.S. Navy DDGs, the potential for diversity to positively influence performance may not be as pronounced as in more fluid service organizations. This could explain why diversity was not a predominant factor in determining the likelihood of receiving the Battle E award, even though some correlations were observed. Additionally, the lack of strong correlations with Mission Area (MA) scores further suggests that DDGs' performance is influenced by a constellation of factors, with diversity being just one aspect.

Pitts's (2005) findings in the education sector reveal a non-uniform relationship between racial diversity and organizational performance, resonating with our observations in the DDGs where slight variations in crew diversity did not consistently translate into improved operational performance. Similarly, Ely's (2004) research in retail banking suggests that while diversity alone did not lead to performance issues, the quality of team processes played a more critical role. In the DDG context, this implies that the determinant of high performance could be how well the team operates within the structured environment of a military vessel, rather than merely the presence of diversity. The complexity and potential conflict due to social categorization could also be relevant, where effective team processes could mitigate potential adverse effects on performance indicators such as the Battle E or MA score.

Overall, the literature implies that the effect of diversity is multifaceted and context dependent. In the case of U.S. Navy DDGs, slight variances in gender and ethnic composition appear to be less influential than other factors not examined within this study, such as various leadership roles within the ship, organizational climate, crew training and rotation, and specific operational tasks and schedules. These elements could provide a more

robust explanation of the determinants of high performance in this specialized and highly regulated environment.

E. CONCLUSION

In our study examining the impact of crew diversity on the performance of U.S. Navy DDGs, particularly in relation to the Battle E award, we discovered significant patterns. Notably, ships with a lower percentage of female, Asian American, and Native American crew members were more likely to receive the Battle E award. In contrast, a higher percentage of African American crew members correlated with receiving this award. However, at the Mission Area score level, our findings did not demonstrate significant correlations for these demographic groups and others, as presented in Table 6. This research sheds light on the complex dynamics of diversity within military operations and the importance of context-specific diversity management. It highlights that effective diversity integration and management are vital for maximizing operational excellence within the unique environment of the Navy. By drawing parallels with broader diversity studies in various sectors, this study emphasizes the distinct challenges in implementing diversity initiatives in the Navy. It points to the need for more nuanced, contextually appropriate diversity metrics. The thesis reaffirms the strategic value of diversity in the Navy, advocating for its recognition as more than a compliance requirement. Properly leveraged, diversity can greatly enhance the operational capacity and global effectiveness of the fleet. This realization calls for ongoing, informed efforts across all command levels to fully harness the potential of a diverse workforce, thereby enhancing unit cohesion, morale, and establishing the Navy as an inclusive and powerful global force.

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