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THE GOLD STAR JOURNAL



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A LETTER FROM THE EDITOR-IN-CHIEF

Dear reader,

It is with great honor that our editorial staff presents to you the 28th edition of *The Gold Star Journal*, The Citadel's most prestigious academic publication. The Journal showcases multidisciplinary nonfiction papers, photo stories, photographs, and artwork from members of the South Carolina Corps of Cadets, Veteran Day Student program, and The Citadel Graduate College. The 28th edition of the Journal carries the legacy of previous publications, combining classical academic excellence and prestige with modernity.

Following the 27th Edition of *The Gold Star Journal*, the Editorial Staff saw five seniors graduate and move on to their post-graduate pursuits. I wish to extend my utmost gratitude to our returning staff members; Andrew Palmer, Kanjanika Kincaid, and Noah Miller, as they provided the foundation for the editorial staff to continue. Special recognition must be given to Assistant Editor-in-Chief Andrew Palmer and Internal Communications Editor John Cappello, as both served as my rock in developing the 28th Edition of *The Gold Star Journal*, balancing a myriad of responsibilities with Corps of Cadets and ROTC commitments while providing support and guidance throughout the process.

This operation could not be successful without the dedication of our faculty advisor, Dr. Suzanne Mabrouk. A Professor of Chemistry, Dr. Mabrouk has served as the backbone of each editorial staff since the journal's inception in 1996. We further recognize Alex Fox who spearheaded the InDesign education for staff members throughout the fall semester. We thank our donors: the Office of the Provost, LTC and Mrs Albert G. Bauer II '72, Dr. and Mrs. James F. Boyd, '71, Mr. John S. Clark, '18, LTC and Mrs. Paul S. Hodges, '63, Friends of the Daniel Library, Dr. Suzanne T. Mabrouk and Mr. Stephen S. Jones, Mr. and Mrs. Grant N. Miller, '18, and Mr. and Mrs. Daniel J. Vallini, '95. It is only through their generosity that our work is possible.

When I joined the editorial staff in the Fall of 2022, I could never have imagined the relationships I would gain in the process. While the Journal is without a doubt a time-consuming commitment, there is no organization I would rather be a part of on this campus, and I thank my fellow editors for making this such a rewarding and enjoyable experience. Congratulations to our authors, photographers, artists, and editorial staff for their hard work and dedication in creating this year's issue. The best is yet to come.



STAR JOURNAL

THE MILITARY COLLEGE OF SOUTH CAROLINA

Yours,



Gage Timberlake
Editor-in-Chief
The Gold Star Journal



Andrew Palmer



John Cappello



Victoria Snook



From left to right: Kanjanika Kincaid, Lucy McArthur, Tyler Jacobs, David Ropp, Noah Miller, Doreen Ontiveros, Olivia Liquori, Jehanne Marie Arnal

A LETTER FROM Dr. Selden



The mission of The Citadel is to educate and develop principled leaders for all walks of life in an intellectually challenging environment. Gold Stars provide a visual symbol of the academic excellence referenced in our mission. *The Gold Star Journal* is the place we publish peer-reviewed academic papers and creative works for all to read and enjoy.

Yet, *The Gold Star Journal* is far more than its final product. It is a developmental learning experience for its editors, spanning the entire academic year. The Journal begins with recruiting a talented group of cadets and students. This team creates a vision for this year's journal. They diligently solicit, review, and curate papers and artistic contributions, design and publish the Journal, and host The Gold Star Journal Academic Conference during Student Excellence week. *The Gold Star Journal* and Academic Conference are marquee academic endeavors at The Citadel, reflecting the strategic intent of our Citadel 2026 plan – specifically, Strategic Initiative 2: Enhancing the learning environment through academic programs of distinction and student success services.

Guidance from our seasoned faculty advisor, Dr. Suzanne Mabrouk, is indispensable. Her wisdom and support guide our editors as they navigate the challenges, decisions, and deadlines inherent in producing a journal worthy of the Gold Star accolade.

The Gold Star Journal is a testament to the remarkable achievements Citadel cadets and students are capable of when they come together to learn, create, and lead with integrity.

We are proud to share this year's Journal with cadets, students, faculty, staff, alumni and the communities of the Lowcountry. I invite each of you to enjoy the articles and creative works our students have produced.



Dr. Selden
The Provost of The Citadel

IN HONOR OF

Mrs. Redmond

This Journal is dedicated to Mrs. Susan Redmond, otherwise known as “The angel of The Corps.” Her honorary service to countless generations of cadets began in 1985 when she started working as a data processing specialist in Bond Hall.

Now, some 38 years later, she works in the disciplinary sector of the Commandant’s office where she has poured into thousands of cadets’ lives in a myriad of ways.

It is thanks to people like Mrs. Redmond, who has fostered and helped develop the creativity of thousands of cadets, that we are able to produce *The Gold Star Journal*. Although this bastion of the Corps both embodies and inspires the core values of honor, duty, and respect in all cadets, Mrs. Redmond has spent the greater part of her life living and thus inspiring cadets with her greatest piece of advice: “Always treat others with kindness.”

Mrs. Redmond’s values have carried through the years, and her devotion and kindness to the cadets of The Citadel has left a long-lasting mark on grandfathers, fathers, and now the sons and daughters who find themselves at the desk of her office. “Not too

many people can say that they enjoy their job, but I can gladly say that I do. Every single day I come to work; I look forward to it.” The legacy that Mrs. Redmond continues to selflessly leave to cadets at The Citadel is exactly what makes our great school so extraordinary: “Sometimes I’ll have grads from the 80’s show up and ask if I am still around. I tell them ‘Yeah, I’m still working dummy.’”



Mrs. Redmond
Staff of The Citadel 1985-2024



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Since the 9/11 attacks, definitions and causes of terrorism have become a center of debate. The advent of the Global War on Terror prompted many nations to examine what they could do to prevent terrorist cells from rising in their country and political scientists worked to identify trends. This study takes a statistical approach to many of the key factors identified and analyses the significance these factors have on the impact of terrorism within a state.

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This research paper explores the efficacy of psilocybin-assisted therapy as an alternative treatment for Post-Traumatic Stress Disorder (PTSD) in veterans. It examines the therapeutic benefits, dosages, and ethical considerations surrounding microdosing psilocybin. It also underscores its promising efficacy in symptom improvement and emphasizes the need for further research. By addressing treatment limitations through insights from studies, clinical trials, and historical use, this paper showcases microdosing psilocybin as a transformative therapy for veterans with PTSD amidst an urgent mental health crisis.

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This document details the disappearance of the United States submarine USS Scorpion and the many theories that have arisen from her loss. With no eyewitnesses and a nearly 54-year gap in time finding facts and evidence will be hard to find. I hope to express my beliefs through this paper and detail to you why my theory is the closest to fact.

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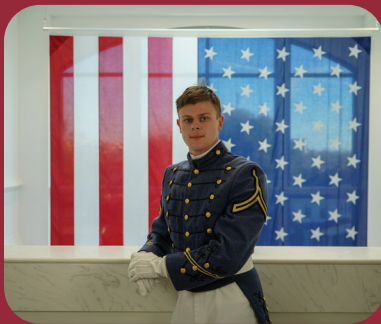
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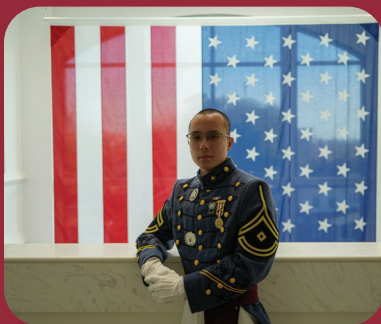
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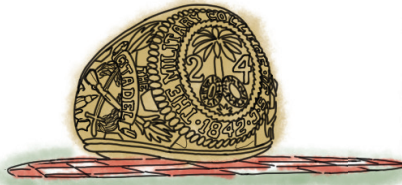
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Tomorrow's War



1. INTRODUCTION

“Quantum computing” is a phrase that’s thrown around a lot in the modern world, but not many people know what it actually means. In simple terms, quantum computers complete processes and calculations much faster than regular computers because they are able to process multiple inputs at once, compared to a regular computer that can only process one at a time. Though the topic was originally pitched over 40 years ago in 1980, progress has been extremely slow due to the complicated nature of quantum computing.

In this paper, the connection between quantum computing and cyber security will be explored, with insight into the effects of quantum computing on our future and possible solutions to the problems that it poses. Quantum computing poses a threat to everything understood about cyber security, as it enables tasks that could take a regular computer thousands of years to be completed at a rapid rate. This means that our encryption algorithms with which we protect sensitive information could be

compromised. The suggestion made by this report is to accelerate the testing of multiple types of encryptions that could be resistant to quantum computing in an effort to protect our future. Section 2. Background of Quantum Computing gives an overview of basic quantum computing and its relevance, its connection to cryptography, and an overview of solutions to the problem. Section 3. Solutions for the Rise of Quantum Computing explores more into these solutions. Section 4. Discussion on Pros and Cons elaborates more on the good and bad potential of quantum computing, and if one of these outweighs the other. Section 5. Lattice Based Cryptography gives an overview of lattice based cryptography, code based cryptography, and hash based cryptography.

2. BACKGROUND OF QUANTUM COMPUTING

Quantum computing is a quickly evolving area in computer science that uses the ideas of quantum mechanics to perform computations that are impossible for traditional computers. Quantum computing is expected to overhaul many

3. SOLUTIONS FOR THE RISE OF QUANTUM COMPUTING

This will most definitely lead to a worldwide need for cryptography that is safe from quantum computing. This is known as post-quantum cryptography. Post-quantum cryptography is an area of cryptography that will hopefully create new cryptography algorithms that are more secure against quantum attacks. These algorithms are theoretically less susceptible to algorithms like Shor's algorithm and other quantum algorithms that may be used to overcome normalized cryptographic techniques.

Multiple post-quantum cryptographic algorithms have been proposed. These include but are not limited to: lattice based cryptography, code based cryptography, and hash based cryptography. These algorithms use different mathematics that are thought to be harder for quantum computers to solve. They are also designed to be more efficient and scalable to many devices. This means that they can protect a large range of networks. These are so important because of the devastating potential that quantum computing poses. "The development of quantum computing as a response to digital cryptography also produces new problems, including posing a threat to established encryption technologies. If criminals gain access to quantum computers, the home banking of respectable citizens may no longer be secure, not to mention that nation-states



Daniel Drohan
Clear Up Left

could be used to factor large numbers in mere hours, making it highly possible for a quantum computer to crack RSA encryptions and access information that previously would have been inaccessible.

would be able to decipher the encrypted messages of their citizens.” [2]

Post-quantum cryptography is still a pretty new field. This means that many challenges and obstacles still remain. For example, it is fairly hard to prove the security of certain cryptography algorithms against quantum attacks because we do not really have quantum computers powerful enough to do traditional testing like this. However, it is not clear how long it might take for quantum computers to become powerful enough to break traditional cryptographic techniques. With that said, there are a few different ways that we could theoretically protect networks and databases against quantum computing. As previously stated, there include but are not limited to: lattice based cryptography, code based cryptography, and hash based cryptography.

4. DISCUSSION ON PROS AND CONS

Many people do not fully grasp the potential impact of quantum computing in our current way of life. This groundbreaking technology will revolutionize everything. Some of these effects will be bad, but some of them will be good. So what are these effects?

4.1 Cons

Given that the focus of this paper is cryptography, mostly only negative impacts have been cited so far. These include things like encryption breaking and ethical concerns. “The potential for harm is enormous. If these encryption methods are broken, people will not

be able to trust the data they transmit or receive over the internet, even if it is encrypted. Adversaries will be able to create bogus certificates, calling into question the validity of any digital identity online” [4]. Quantum computing also has the potential to cause mass job displacement. Many jobs will be automated and tasks that are currently completed by humans could be made completely obsolete. And what of the ethical concerns when quantum computing is used to create new surveillance technologies and weapons?

4.2 Pros

Quantum computing also has the potential to do a lot of good. From a cyber security stance, this includes the fact that quantum computing has the potential to help us create stronger encryption keys than ever before. Besides this, it can assist in the medical field by very effectively simulating chemical reactions and the behavior of molecules, vastly improve weather forecasting, and increase efficiency in supply chain technology. “Quantum computers will have an advantage over classical computers in tackling problems involving the quantum mechanical effect. For example, they would be excellent for solving problems in the fields of material design, drug development and physical chemistry, which are most difficult to solve by traditional computers” [5].

4.3. Outcome

With every major technological advancement in history we see potential for good and bad. The most important question that can be asked is which of these will outweigh the other. On one hand,

quantum computing may cause lots of destruction in the field of cyber security, whereas on the other hand it could open up many doors and opportunities for the field to be revolutionized and improved. In the end, the impact of quantum computing is difficult to predict because it is impossible to tell how it will be developed and utilized. If passed into the wrong hands, it could be a means to an end. If used responsibly, a much more favorable outcome is likely to be achieved.

5. LATTICE BASED CRYPTOGRAPHY

Lattice based cryptography is one of the methods of cryptography that is believed to be a good suit to our future needs in relation to quantum computing. This is due to the fact that lattice based cryptography is built on the foundation of mathematical problems that are theorized to be very hard for quantum computers and regular computers alike to solve. To be more specific, it uses problems of finding the

shortest vector in dimensional lattices. Since there are no good algorithms that are able to efficiently solve these problems, even quantum computers will have a hard time getting past them. This is why lattice based cryptography seems very promising as a post quantum cryptographic solution. If implemented well, this could be the new standard for cryptography starting very soon.

5.1 Code Based Cryptography

Code based cryptography is when an encryption key is created from a block of code that was engineered to correct errors. In other words, it relies on the difficulty of reverse engineering code to help protect data. This should theoretically be hard for even quantum computers with advanced machine learning to do. “Machines play an essential role in the process in the form of tools to unpack, disassemble, emulate, and perform binary similarity. However, humans are still responsible for “understanding” the code, which is the main goal in problems such as malware

Joseph Rae
The Army Goes Rolling Along



A Statistical Analysis of Terrorism



INTRODUCTION

Ever since Vera Zasulich proclaimed, “I am a terrorist, not a killer!” in her trial on January 24th, 1878, the world has been rapt with the idea of a terrorist (Ganitis, 2019). Political theorist David Rapoport noted that the world has gone through four distinct waves of terrorism. Early terrorists like Vera Zasulich helped form the anarchist wave, defined by political unrest and global socialist movements which ended in the 1910s. The second wave or the “Anticolonial wave” was born from the ashes of World War 1 and saw the first signs of tension between Western powers and the now reformed Middle Eastern nations. The third wave shared aspects with the first, being called the “New Left” wave due to its connection with the Soviet Union and the anti-capitalistic domestic movements that arose in the US during the Vietnam War. The fourth and current wave is religious, emerging in the 1970s with the growth of the Muslim Brotherhood and the subsequent spread of radical Islamic terror groups. While Rapoport’s wave theory does an excellent job of defining global trends that inspire

terrorist movements, the actual factors that allow for an organization to arise in a state are extremely contested (Rapoport, 2022).

The attacks of September 11th, 2001, forced the United States out of its short-lived era of global peace that came with the collapse of the Soviet Union. A large-scale attack on the home front suddenly legitimized the radical Islamic movements across the world and rewrote the topic of security studies. Terror groups and their development became a central research topic in thinktanks and universities across the West leading to many definitions of what constitutes terrorism and how it develops in a nation. To truly understand the global threat of terrorism, we must consider the variables that affect the rise of global terror.

Political factors are not the only indicators of possible terror emergence and spread, with economic power and inequality also playing an extremely important role. In the period immediately following the 9/11 attacks, many researchers pointed to poverty and lack of

economic production as the main factors in the rise of terror organizations. Most studies of internal conflicts show that low economic conditions increase the likelihood of civil wars, which creates the political instability needed for terrorist organizations to develop (Abadie, 2006). The idea of inequality contributing to terrorism is often tied to the economics of a nation. Nations with moderate to lower GDPs are more likely to have high inequality in all aspects of society. In a 2016 study for CESifo, Tim Krieger and Daniel Meierrieks used the relative deprivation theory to show the relationship between a nation’s income inequality and the feelings of discontent that arise from low economic groups. These feelings of discontent can grow when there are no economic protections put into place and can manifest into aggression and terrorist movements (Krieger, 2016).

There is evidence to suggest that political, social, and economic factors can be used to identify if a state is likely to have the growth and spread of terrorist organizations within its region, but the exact aspects of these factors are still disputed. Based on previous studies regarding the growth of international and domestic terror, it is reasonable to assume that there will be a correlation between the

political, social, and economic climates of a nation and the impact of terrorism.

This paper will use statistical analysis to identify the degree to which these political, social, and economic factors can be used to predict the impact of terrorism and the growth and spread of terrorist organizations within its borders.

RESEARCH AND VARIABLES

There are five key independent variables that relate to the presence of terrorism in a country all of which come from the SPSS World Data Set. The first we will use assess the degree to which the nation’s government follows the democratic process. In a 2005 edition of Democracy and Security, Alex Schmid draws on his long history of terrorism studies to identify several root causes of terrorism. The article, “Root Causes of Terrorism: Some Conceptual Notes, a Set of Indicators, and a Model,” notes common trends seen in the development of terrorist organizations throughout history and creates two categories, root causes and accelerators. The first root cause he identifies is a lack of democracy, which he calls “the recognized, non-violent method for changing the groups of people who hold the reins of government.” (Schmid,



Corbin Menz-Gentzow
Park

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2005). This supports our hypothesis that non-democratic states will have a higher terrorism score since “when unpopular rulers cannot be voted away in democratic procedures, advocates of political violence find a wide audience.” (Schmid, 2005). He also identifies high/ rising distributive inequality as well as the lack of good governance as root causes of terror which brings an economic factor into the understanding of terror. The focus on historical events is beneficial

groups... lack an institutional avenue to influence the government through a legislature.” (Aksoy, 2012) And argues that “democracies with proportional representation electoral systems experience less political violence, in part because such systems allow for a diverse set of organized interests to participate in the political system” (Aksoy, 2012). These findings support the belief that non-democratic states will have a higher impact on terrorism due to the lack



in giving us a framework for the root causes of terror but a data-based analysis is still needed.

Jess Pierce
Plane on Black Sand

The second independent variable we will be using measures the corruption perception index seen within a state. The 2012 article *Terrorism in Dictatorships* analyzes the relationship that different types of dictatorships have with the rise of terror groups. The study compares regimes with multiple versus no opposition groups as well as ones with and without separate legislatures and finds that there is a 60% higher probability of terror group emergence in regimes with no legislature. (Aksoy, 2012) The study confirms that “in dictatorships, terrorism is more likely when opposition

of non-violent methods for political change. The study also confirms our hypothesis that states with a high corruption perception index will have a higher terrorism score when it addresses the role that political turmoil and protests have in the emergence of terror groups. Referencing the Chilean resistance of the 1980s, which emerged as a peaceful protest against the new constitution and led to the rise of guerilla terror groups such as the FPMR and MAPU (Aksoy, 2012), the study shows how frustration with the government can cause terror groups to emerge as a form of violent political change.

Our third variable measures inequality when adjusted for education

join social movements or, in this case, terrorist organizations.

The final independent variable we will be using will allow us to see the rise of terrorism in a nation and if it is directly affected by conflict. Based on the research done by Aksoy and Schmid into the rise of violence in relation to political frustration, we can see the beginnings of terrorist cells in protests and higher rates of violence within a state.

DATA AND METHODS OF ANALYSIS

For this study, we used the World dataset which gives information collected from each country. The dependent variable is `terror_index_voh`, which is a composite measure made up of four indicators: incidents, fatalities, injuries and hostages. This variable was picked because it shows not only domestic terrorism but also international attacks and accounts for the spread of terror groups such as Boko Haram in central Africa. To assess whether or not specific factors influence the impact of terrorism we will be using four dependent variables all taken from the World dataset. The first independent variable is `dem_score14` which measures the level of a nation's democracy with low scores being less democratic and higher scores being more democratic. This is also an interval measurement and places nations on a scale from zero to ten. This variable will allow us to see whether or not terrorism is impacted by

the presence of democracy as seen in Aksoy's research.

Our second independent variable will be `peace_index_score`, which is an interval measurement of the overall peacefulness in a country. This variable will allow us to see the rise of terrorism in a nation and if it is directly affected by conflict as theorized by Schend. We will also be using `corruption_perception` which measures the corruption perception index seen within a state. This interval measurement will allow us to identify factors that can lead to frustration and push the population to pursue radical social change. Our fourth variable is an interval measurement of the GDP per capita, `gdppcapo8`. By analyzing the GDP, we will see the relationship that relative wealth has with terrorism, allowing us to test CESifo's research along with other political factors. The final dependent variable we will be using is `unineduc` which measures the education index in relation to inequality. This interval measurement can help us identify oppression and inequality within a state which is a key factor in the rational deprivation theory and can be used to see the impacts that a lack of minority views in government can have.

We will be analyzing the data through a multiple regression analysis, allowing us to see the strength of the relationship that the independent variables have on the impact of terrorism in a country. It can also help us rank the importance of each variable in accordance with the impact it has. We will create a scatterplot for each independent variable to see the internal

Model		Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-4.631	1.176		-3.938	<.001
	Democracy Score	0.392	0.139	0.354	2.819	0.006
	Overall Peacefulness of country	3.168	0.376	0.709	8.421	<.001
	Corruption perception index	-0.023	0.019	-0.187	-1.229	0.222
	GDP per capita in 2008	8.32E-05	0	0.472	3.317	0.001
	Inequality-adjusted education index	-3.424	1.114	-0.352	-3.072	0.003

had relatively weak negative correlations with no values exceeding 0.5. This shows us that while they are significant, the relationship between them and `terror_index_voh` is minimal.

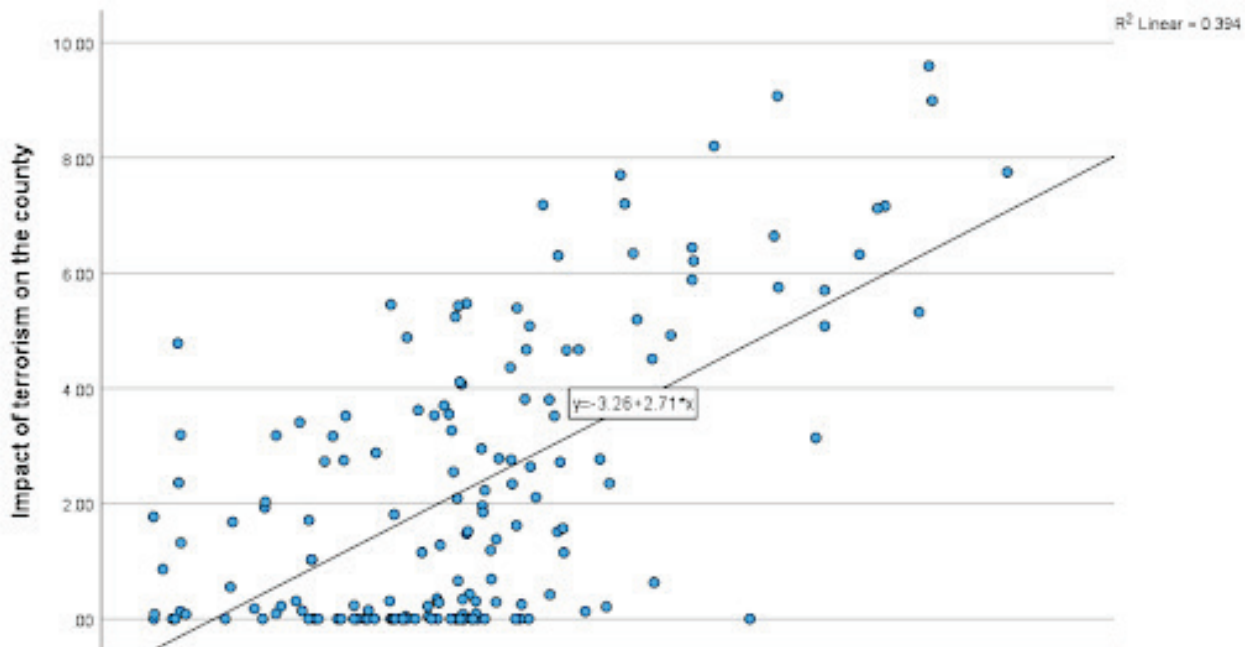
We next use scatterplots to explain the correlations between the independent variables and `terror_index_voh`. Figure 2.1 shows the positive relationship that overall peacefulness has on the impacts of terrorism on a country and the $R^2 = 0.394$ tells us that 39.4% of the variation in the impacts of terrorism on a country can be explained by the overall peacefulness. The inequality adjusted education index and democracy scores also show

Figure 3.1

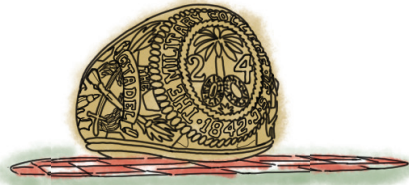
a relationship with impact on the country, but in these cases, they are negative, as we predicted. The R^2 of these scatterplots shows us that there is very little correlation between the independent and dependent variables, with only a 1-4% relationship.

Figure 3.1 shows our multiple regression analysis for all of the independent variables. We see the significance in all of the variables except for `corruption_perception`, which has a P-value of .222, telling us that it is not a determinant of the impact of terrorism on a country. The signs of the coefficient are negative for `corruption_perception` and `unineduc` telling

Figure 2.1



Psilocybin and PTSD: A Path to Recovery for Veterans



I. INTRODUCTION

Post-Traumatic Stress Disorder remains a pressing concern within the veteran community, impacting those who have served in combat zones, undergone traumatic experiences, or suffered from military sexual trauma (MST) during their military service. Deployment and exposure to life-threatening situations during missions or training accidents represent significant risk factors for military-related PTSD (Schnurr, 2023). While various treatments, such as cognitive-behavioral therapy (CBT) and medication, are available, they do not consistently provide the relief needed by all veterans.

This area of research is significant not only because it has the potential to alleviate the suffering of veterans, but also because it addresses the alarming rate of suicide among this population. In 2020, there was an average of 16.8 veterans dying from suicide a day. Of those daily suicides in 2020, 39.7% were among veterans who had utilized Veteran Health Administration services, whereas 60.3% were among other veterans who

did not. (Schnurr, 2023). This leads to a critical question: Can psilocybin-assisted therapy offer a promising alternative for veterans struggling with the debilitating effects of PTSD?

II. PREVALENCE OF PTSD IN VETERANS

The challenges of addressing PTSD among veterans who have served in combat zones are unique and complex. Military service often exposes individuals to extreme and life-threatening situations, resulting in severe trauma and a higher prevalence of PTSD (Schnurr, 2023). According to Goldstein et al. (2016), military service members frequently encounter traumatic events like combat experiences and training accidents, which elevate the risk of developing PTSD. Moreover, research emphasizes the increased rate of PTSD among veterans who have served in combat zones like Operations Iraqi Freedom (OIF) and Enduring Freedom (OEF) (Wisco et al., 2022). Veterans are also more predisposed to developing PTSD than civilians, with a 7% lifetime

comparison, medication alone leads to remission in 42 out of 100 cases.

Cognitive-behavioral therapy (CBT) remains an evidence-based intervention, but it may not be effective for all veterans, as it demands active participation in therapy, which can be challenging for individuals struggling with severe PTSD symptoms or resistance to engagement. In instances where non-pharmacological treatments alone are insufficient, medications, or a combination of medication and psychotherapy, pharmacotherapy is advised as a primary treatment strategy for PTSD. This recommendation aligns with the guidelines proposed by Forbes et al. (2007), the National Collaborating Centre for Mental Health (UK) (2005), and Ursano et al. (2004), which all highlight the significance of pharmacotherapy in managing PTSD, either as a standalone or a complementary approach. Selective Serotonin Reuptake Inhibitors (SSRIs) show an approximate 60% response rate in treating PTSD, but complete remission is achieved in only 20% to 30% of patients (Berger et al., 2009). A separate study on extended-release venlafaxine (ER) revealed a higher response rate of 78% and a remission rate of 40% in PTSD patients, as measured by a shortened version of the Clinician-Administered PTSD Scale (CAPS). However, this study noted no significant improvement in hyperarousal symptoms (Davidson, 2006).

Another significant challenge specific to veterans in PTSD treatments is the high rate of treatment dropout, further underlining the limitations

of these approaches. This issue not only hinders the recovery process but also increases the risk of persistent symptoms among veterans. Research reports substantial dropout rates among veterans undergoing treatments like PE and CPT for PTSD. For instance, Kehle-Forbes et al. (2016) found that about 38.5% of veterans dropped out of PE/CPT treatment, resulting in only a portion of individuals completing the treatment. Notably, the likelihood for early dropout is a concern, with approximately one-quarter of veterans leaving before the third session, and the majority discontinuing treatment in the initial two-thirds of the protocol. This is especially troubling given that, according to Nishith, Resick, & Griffin (2002), the therapeutic benefits of PE/CPT often do not manifest until around the sixth session. The pattern of early dropout underscores the need for more tailored and effective treatment plans for veterans, particularly since early engagement is crucial for achieving the full benefits of these evidence-based therapies. Furthermore, Kehle-Forbes et al. (2016) highlighted that not all veterans with PTSD respond favorably to existing therapeutic modalities, with some participants experiencing persistent symptoms even after undergoing treatment.

While conventional therapies like CBT and medication have been used, their effectiveness may vary due to immediate exposure to trauma, ongoing stressors, and limited access to mental health resources (Schnurr et al., 2009). In the context of veterans who have encountered severe trauma, whether

its capacity to significantly reduce symptoms of depression and anxiety. Studies focused on the veteran population are particularly promising, indicating that psilocybin could be a critical tool in addressing PTSD.

Key studies, such as the one conducted by Griffiths et al. (2016) at Johns Hopkins University, have played a pivotal role in rekindling interest in psilocybin. Griffiths and colleagues demonstrated that psilocybin, when administered alongside psychotherapy, led to substantial reductions in depression and anxiety among patients facing life-threatening cancer diagnoses. In the study, each participant received two dosing sessions: one with a low dose of psilocybin (which was either 1 or 3 mg/70 kg, acting as a placebo-like control), and another with a high dose (either 22 or 30 mg/70 kg). This study was designed as a randomized, double-blind, cross-over trial, with sessions spaced five weeks apart and included a six-month follow-up to assess the long-term effects of the treatment. This revolutionary research ignited hope for an innovative approach to addressing mental health conditions.

Similarly, in 2018, the Multidisciplinary Association for Psychedelic Studies (MAPS) facilitated a Phase 2 Clinical Trial led by Mithoefer et al., that examined the impacts of MDMA-assisted psychotherapy for individuals suffering from PTSD. Findings indicated not just significant symptom improvement but also sustained relief of PTSD-related distress. Positive outcomes were recorded at both short-term (one and two months) and long-

term (12 months) intervals following treatment.

The study led by Carhart-Harris et al. (2021) at Imperial College London offered new insights into the neurobiological impact of psilocybin on patients with treatment-resistant depression. Their research, utilizing functional MRI (fMRI), suggested that psilocybin may reduce the hyperactivity of the amygdala, which is often associated with the emotional dysregulation of depression (Carhart-Harris et al., 2021). Participants reported a significant reduction in depressive symptoms, as measured by standardized clinical scales. These effects were not only rapid but sustained, with many participants experiencing improvement for several weeks following treatment. The researchers observed that psilocybin appeared to disrupt entrenched negative thought patterns, allowing for a 'reset' of neural circuits that may be dysfunctional in depression. The implications of these findings point to the promise of psilocybin as a catalyst for change in the neural pathways associated with depressive states, highlighting the substance's therapeutic potential beyond transient symptom alleviation (Carhart-Harris et al., 2021). Collectively, these studies and the invaluable contributions of esteemed researchers have established the foundation for exploring the therapeutic potential of psilocybin.

VI. CHALLENGES AND FUTURE DIRECTIONS

The exploration of psilocybin-

assisted therapy for PTSD in veterans presents several challenges and prompts the need for future directions in research and practice. Legal and regulatory barriers are paramount, as psilocybin remains classified as a Schedule I substance under the Controlled Substances Act in many countries, indicating a high potential for abuse and no accepted medical use (Center for Drug Evaluation and Research, 2017). This classification hinders research access and funding, limiting the exploration of its therapeutic potential (Johansen & Krebs, 2015). Psilocybin and similar classic psychedelics that act as 5-HT_{2A} agonists typically have limited addictive properties, evidenced by minimal and transient self-administration in animals. Risks include the possibility of hazardous behaviors in unprepared or unsupervised users and the potential worsening of mental health conditions, especially in individuals with or susceptible to psychotic disorders. However, the

overall prevalence and risks associated with psilocybin use are relatively low compared to more commonly abused drugs. In a medical setting, risks are further mitigated through controlled dosing, careful patient selection, thorough preparation and follow-up, and supervised sessions in a healthcare facility.

Psilocybin may exacerbate certain psychiatric conditions, and its use must be carefully considered and monitored (Garcia-Romeu, Griffiths, & Johnson, 2020). The practical implementation of psilocybin therapy also presents challenges. The long duration of treatment sessions, often extending to eight hours, necessitates a substantial time commitment from both patients and clinicians. This could limit access to those who cannot afford the time or do not

Anthony Harper
Charleston Strong

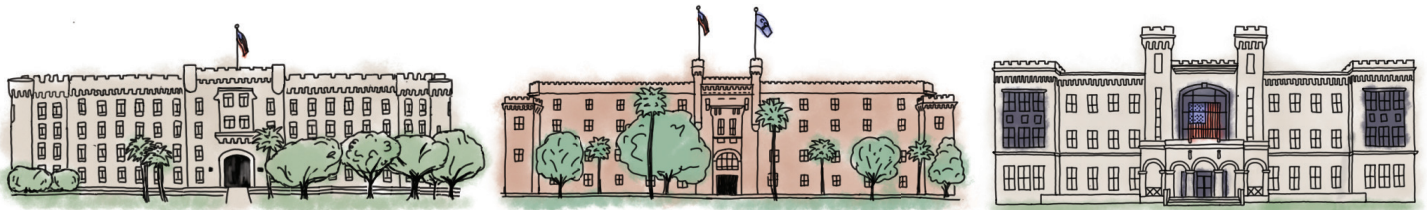


this mental health crisis but to actively engage in developing and advocating for innovative treatments. The courage displayed by our veterans calls for an equally bold commitment to their mental health care, one that may well be answered by the therapeutic potential of psilocybin.

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The USS Scorpion



INTRODUCTION

On May 22nd, 1968, a United States nuclear-powered submarine was sailing off the coast of the Azores Islands in the Atlantic Ocean when it mysteriously disappeared, leaving all of its 99 officers and crew missing with her.

Though one of the Navy’s most expensive assets of the 1960s has been sitting on the bottom of the Atlantic Ocean for more than 54 years, the true reason she is on “eternal patrol” is

still unknown. There are currently six working theories that would explain why the submarine was lost. The six working theories are: hydrogen explosion during battery charge, accidental activation of torpedo or intentional firing of a defective torpedo, explosion of torpedo inside the sub, structural damage, malfunction of the trash disposal unit, and soviet attack.

In this paper, I intend to unearth the major conspiracy theories that have evolved from the disappearance of the Scorpion submarine. I intend to explain why I believe that the Scorpion went down because of two major faults by the United States Navy.



TECHNICAL INFORMATION

Naval submarines are categorized by their propulsion system. The Scorpion is thus a nuclear-powered American submarine, she is also the 589th American submarine, therefore labeled as SSN-589. Submarines can dive up and down under the surface of the water for protection and stealth reasons.

To “sink” submarines, water is pumped into tanks all around the

[10] (Fig. 1) Launch of the USS Scorpion, SSN-589 on 19 December 1959, almost eight and a half years before her disappearance.

was an explosion outside the pressure hull.

After the explosion, the ballast tanks would have been damaged to an unknown extent. If any of these were flooded uncontrollably, it would have been nearly impossible for the crew to stabilize the boat and get it back level. Once the boat reached the critical crush depth, the walls of the pressure hull could no longer hold out against the pressure from the ocean, and water was forced into the boat to cause an implosion.

Accidental Activation of Torpedo or Intentional Firing of Defective Torpedo

The second most highly theorized explanation for the loss of the USS Scorpion is that one of the two Mark 37 torpedoes was ejected from the front tube, finding the closest target, (which at the time would have been the Scorpion) and trained on and then hit the boat.

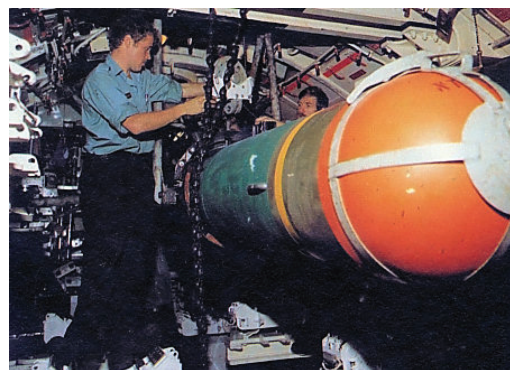
The first explanation is that while the crew was conducting routine checks of the torpedo tubes and the torpedoes inside of them, human error caused a torpedo to be fired from the tube. Without any targeting programmed into the torpedo, it would be fired from the tube blind. After making it a good distance from the sub, the rotation of the propeller would naturally cause it to make a wide arc. Once the torpedo made it far enough into its arc, the noise from the unsuspecting Scorpion would be picked up and trigger its targeting

systems, causing it to lock onto and engage the submarine.

The second more plausible theory of the two is that there was a malfunction with one of the torpedoes; at some point during the Scorpion's patrol, a defect was found by the Navy on other boats. A problem that occurred with the torpedo batteries would power them to their target and cause them to overheat. Many, if not all, of the boats in the fleet had already replaced these torpedoes with ones that had updated batteries. However, orders from command were for the Scorpion to continue with the regular patrol and that her torpedoes would be replaced in port in the United States. This could have been the cause of the Scorpion disaster, that a malfunction occurred in one of the two torpedoes, causing the crew to fire a torpedo with no targeting information.

Explosion of Torpedo Inside Submarine

Similar to the theory that was just explained, Dr. John Craven was under the impression that the



[12] (Fig.3) Canadian submarine crew loads a Mark 37 torpedo of the same kind onboard the USS Scorpion when she sank.



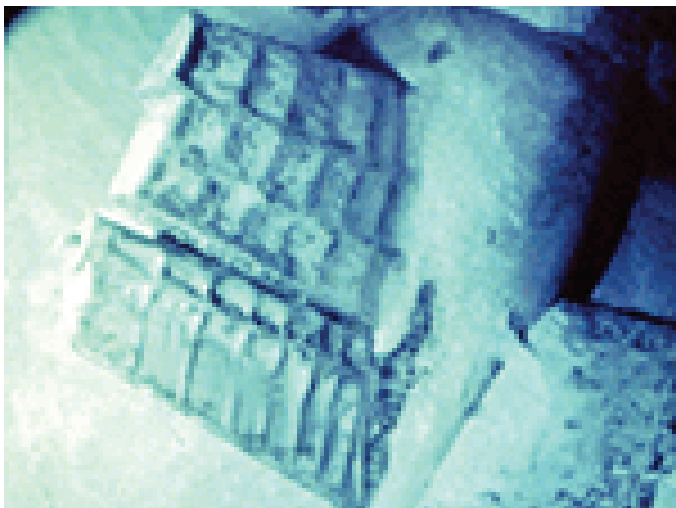
have been a few cases of United States submarines experiencing a brief loss of buoyancy due to flooding through valves in the trash disposal units. American submarines began being fitted with more advanced trash compactors following the conclusion of World War II. These new compactors were able to press weeks' worth of trash into tiny metal containers that would sink to the

ocean floor, keeping them from floating to the surface.

The Vice Admiral believed that when the submarine was dumping its trash, the seal on the valves located on the bottom of the boat, shown in Fig. 5, were penetrated with water. Once the water began to pour into the boat, it would have taken a quick response for the crew to save her. Shade believed that the crew did not move quickly enough. After just a few minutes, the boat would have reached her crush depth, causing the previously mentioned implosion and the loss of the submarine and her crew.

Soviet Attack

The last, and arguably the most serious of the theories, is that an attack could have crippled the boat. The initial mission that the submarine and her crew were sent out on was a routine patrol of Soviet waters. She was sent to spy on Soviet submarine operations in the Atlantic and other classified waters, and was then given orders to return to Norfolk after making a port call, or "pit-



[13] (Fig.4) Stern view of the Scorpion (SSN-589) showing the upper portion of the rudder (with draft markings) and the port "left side" stern plane.



stop,” at the Tallahatchie County (AVB-2) outside Claywall Harbor, Naples, Italy.

What has been brought up by many researchers and experts is that there may have been a Soviet submarine tailing the Scorpion, waiting for the right time to strike. Is it possible that the Americans missed something in their search of the wreckage, maybe something that deep sea cameras in the 1960s just could not see?

SUMMATION OF THEORIES

A mix of factors led to the loss of the submarine. The submarine was out

Sarah Norton

Alaska

on a regular patrol surveying the coast and tracking the movements of Soviet Submarines. The reason that she received her sudden orders to return to Norfolk was because the Navy had just deemed the old Mark 37 torpedoes unsafe and wanted to get them off her as soon as possible. Before making her port call at the submarine tender, Tallahatchie County (AVB-2) outside Claywall Harbor, the sub began to experience problems with her batteries while they were charging, but could not find any issue that would cause the temperature

[14] (Fig. 5) A rough blueprint of the USS Scorpion shows her cut down the middle. The large white space is the Nuclear reactor and missile spaces.



spikes that they were reading. With the crew and the captain having to balance multiple needs of his sub, he could have simply got distracted and lost his edge in the torpedo room.

Once making it back out to sea, the sub suddenly had an issue with one of her torpedoes. Instead of trying to fire the torpedo and clear it from the submarine, Francis Slattery, the commanding officer, ordered a “performing a 180° turn in an attempt to activate a torpedo’s safety systems”[7]. Even though there was no acoustic proof of any turn, once the turn was executed the likelihood of the torpedo disarming was highly unlikely. Fearing the loss of his crew, Captain Slattery ordered the torpedo to be fired out of the tube hopefully to detonate far enough away from the submarine to not cause any damage. The torpedo did not make it more than a few yards away from the vessel before breaking apart. If it had simply exploded, it would have caused a major explosion underwater that would have easily been picked up by underwater hydrophones. This breaking up of the torpedo along the sides and bottom of the hull would be heard by the crew as the metal tube of the submarine and torpedoes would be banging against each other.

At some point while the Scorpion was moving past the wreckage of the torpedo, debris would have hit the valve on the bottom of the vessel connected to the trash disposal unit. Considering that the unit had already been experiencing issues, it would have been vulnerable to more damage and would not have survived another major impact. This hit would have caused an issue in the pressure valves that hold out the

seawater and keep the pressure hull pressurized. Water would have begun pouring into the submarine through the valve, making it almost impossible to fight the flooding. The boat would have begun filling up rapidly to the point that even an emergency blowing of the ballast tanks would not equalize the pressure to bring her to the surface. After only a few brief moments, the submarine would have reached her crush depth, causing the implosion that was heard on the hydrophones and documented clearly in the wreckage images.

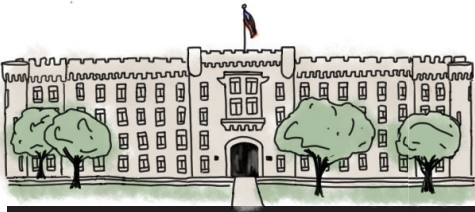


Jess Pierce
Beached Ship

CONCLUSION

What could have been done to save the ill-fated submarine and her 99 officers and crew? There were indeed many factors that led to the disappearance of the USS Scorpion, and many of them could have been prevented. Why was the submarine ordered to complete her patrol with faulty torpedoes while the rest of the fleet was having them removed? Why was the issue in the battery compartment not dealt with more thoroughly to better stabilize the

Intervertebral Disk Degeneration Tissue Engineering Strategies



INTRODUCTION

While the specific mechanism that causes lower-back pain is still unresolved, Intervertebral Disk Degeneration (IDD) is shown to be a significant pathological factor of lower-back pain [1]. Lower-back pain has been linked to significant social, psychological, and economic burdens on the United States population [2,3,4]. Many clinical treatments have been proposed and used to alleviate the symptoms of this pathology. This paper evaluates the proposed clinical treatments for biomechanical content, restoration of biomechanical properties, and longevity of each treatment. The important characteristics of the Intervertebral Disk (IVD) and IDD will be outlined to provide background information for the proposed clinical treatments to be compared. Tissue engineering strategies that slow the progression and mitigate the symptoms of IDD degeneration will be evaluated. These therapies are proposed to resolve limitations of older clinical procedures for reducing lower back pain.

The Intervertebral Disk (IVD) is a multiphasic cartilaginous tissue with

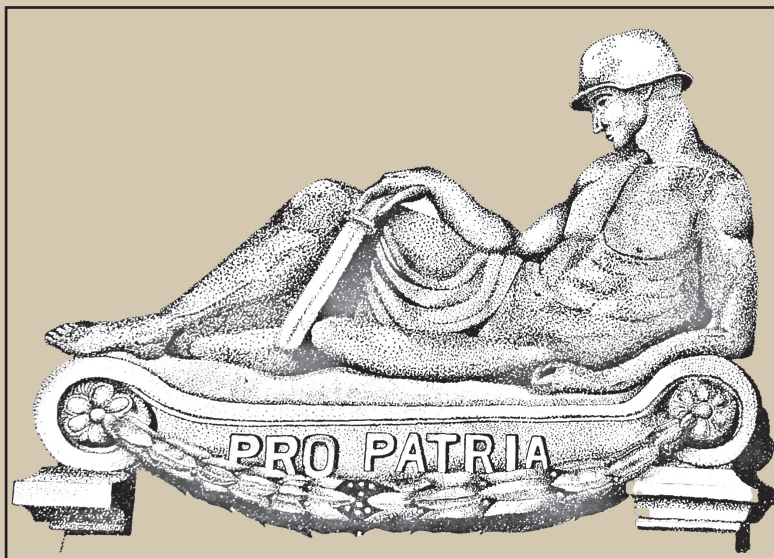
viscoelastic properties, which allows the spine's vertebral disks to sustain tensile and compressive loads [5]. The tissue is composed of three sections: the nucleus pulposus (NP), the annulus fibrosus (AF), and the cartilage end-plate (CEP). These three sections have unique biomechanical and molecular properties [6].

The NP is a highly hydrated structure with low cellular density. It is centrally located and is composed of NP cells and the extracellular matrix (ECM). The structure has a high ratio of Type II collagen to Type I collagen. This Type II collagen is critical for forming irregular networks to support aggrecans, providing viscoelastic properties and maintaining osmotic pressure [7].

The AF is a more heterogeneous structure than the NP, comprising 15–25 concentric collagen layers. These layers are composed of alternately aligned collagen fibers dispersed with proteoglycans. This structure helps contain the NP's swelling pressure and sustain the shear and tensile loading of the nucleus pulposus [8]. The AF's outer layers are mainly comprised of Type I

collagen, whereas the inner layers of the AF are primarily composed of Type II and aggrecan, similar to the NP [9].

The cartilage end-plate (CEP) is located at the caudal and cranial edges of the IVD. The structure comprises a narrow layer of hyaline cartilage, primarily Type II collagen and aggrecan. [10] The CEP is responsible for diffusing nutrients from the capillaries and the removal of metabolites [11].



Osbourne Owens
Pro Patria

Intervertebral disk degeneration's (IDD) studied mechanisms can occur at different sections of the IVD. Abnormal mechanical stress, obesity, nutritional disorders, and genetic factors can all contribute to the degeneration of the IVD. At the AF, a substantial increase of inflammatory cytokines, specifically $IL-1\beta$, $IL-6$, $TNF-\alpha$, and $IL-8$, has been observed during the degeneration of the IVD. These cytokines expressed in the IVD cells can change the environment of the extracellular matrix from anabolic to catabolic, causing the matrix to degenerate, leading to IDD [8]. In other studies, an ingrowth of vascularized granulation tissue was seen extending from the AF into the NP [12]. Additionally, as an IVD degrades, a decrease in NP cells and proteoglycan content has been observed. Concurrent with this decrease,

the NP was observed to become more fibrous [13].

In addition to the biomechanical changes of the IVD, the nutritional content entering a degenerating IVD has been

observed to decrease as the disk degenerates. This phenomenon is due to the occlusion of marrow spaces and the calcification of the CEP, which inhibit the diffusion of solute across

the end plates [11]. The lack of these nutrients decreases the disk's ability to regenerate NP and other cells, ultimately promoting degeneration.

TISSUE ENGINEERING STRATEGIES

I. Bioprinted Tissue Analogues

Recent research has been experimenting with bio-inks involved in tissue implant composites. Researchers have implemented two primary methods: decellularized Extracellular Matrix (dECM) particulate encapsulation and solubilized dECM. These dECM particulates are enclosed by a cross-linked hydrogel network, whereas the solubilized dECMs are gelled by a network of collagen fibers. Researchers have attempted to mitigate the loss of

collagen fiber and glycosaminoglycan content during decellularization. Immunohistochemical tests and electron microscopy have been used to study the effect of decellularization of the collagen matrix. These tests have confirmed that decellularization techniques have not affected the Type II collagen epitope and ultrastructure. The glycosaminoglycan content has not had this unaltered morphology. Research has shown that glycosaminoglycan content loss can be minimized by reducing detergent exposure time through high concentrations and ethanol prewashes to facilitate the uptake of detergents. Nevertheless, the best decellularization protocol still results in a loss of 70% of glycosaminoglycan [14].

Older procedures for bioprinting scaffolds were limited by their resolution during extrusions, with a maximum collagen fibril resolution between 1-300 μm . These scaffolds could not create the collagen fibrils on the scale of collagen naturally found in human IVDs, which ranges between 100-150 nm in the NP and 100-200 in the AF. Light-assisted printing techniques have been proposed to achieve this higher resolution, achieving resolutions as high as 100 nm. These light-assisted techniques have drawbacks. For curing of the scaffolding, a chemical modification is required of the dECM [14]. This chemical modification significantly hampers the mechanical properties of the dECM. With current procedures, the highest Young's modulus achieved has been 20 kPa, where human IVDs can sustain 1-10 MPa [15]. For

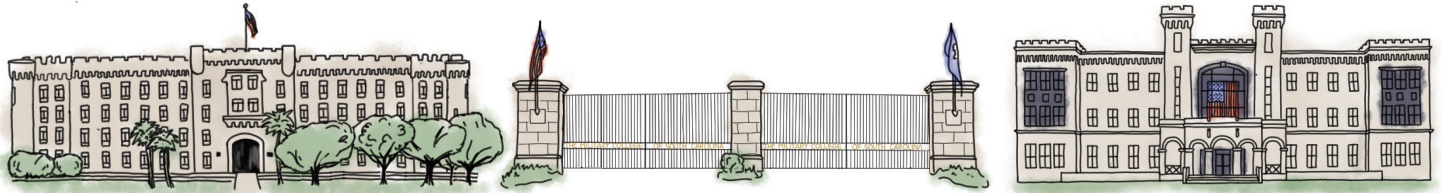
bioprinting to advance, this limiting complication must be addressed.

II. Mesenchymal Stem Cell (MSC) Techniques

Stem Cell treatments have been experimented with since their success with leukemia and lymphoma. Mesenchymal stem cells, in particular, have gained recent attention and are believed to be a good candidate for future stem cell therapies. Xenogenic in vivo testing has shown that MSC treatments have increased disk height and hydration [16]. Furthermore, increased glycosaminoglycan content and synthesis have been observed in the xenogenic IVDS [17]. Therefore, selecting the best type of MSC for injection and scaffolding has emerged as a developing field of research. Most MSCs have a drawback that has limited their applicability to IVD degeneration. When MSCs are chondrogenically cultured, they primarily express Type I Collagen rather than the Type II collagen of a native ECM [18].

Wharton's Jelly stem cells (WJSC) present a method to circumvent these undesirable biochemical competitions. Research has shown that WJCS collagen composition and glycosaminoglycan content were significantly higher than BM-MSCs. WJSC cultured on nano-scaffolds also had increased expression of the protein coding gene SOX9, Type II collagen, and cartilage oligomeric matrix protein [18]. During the culturing process, growth differentiation factors 5 and 6 have been shown to enhance matrix synthesis, in turn creating an ECM more similar to the NP of a native IVD [19]. The

A Losing Game



Scott Stevens, known by many as a family man and a model citizen, was living a double life. As a Chief Operating Officer of Berkman’s company, he had a six-figure salary, three cars, two country club memberships, and various vacations to Mexico (Rosengen 2016). What people did not know about him was his weekly casino visits and gradual addiction to the sights and sounds of gambling. By the time anyone had found out, it was too late.

Gambling can come in many different forms such as casino games, lottery tickets, and even Bingo. It can very easily become addictive; once the addiction starts, it becomes less about enjoyment and more about stimulation. Casinos, lotteries, and gambling websites understand the simple signs behind their patrons’ addictions and therefore are able to exploit them through different targeting techniques. Due to the disastrous effects of gambling on one’s mental well-being and ability to control their life, society should recognize these following constructs that lead to addictive gambling.

Arcades. While they may seem innocent, they are one of the many

conduits that teach children how to gamble. Category D machines, such as crane games or coin pushers, are based on casino games but are not classified as gambling games; thus, children are legally allowed to play them. According to Jacob Smith, a contributor to casino.org, “the current view is that the prizes available are too inexpensive for the game to be considered gambling” (Smith 2023). Even though the prizes may not be classified as having enough monetary value, “research shows that it is often the act of playing – not the value of the prize – that leads to gambling addiction” (Smith 2023). Although arcades have actual video games and sports games, such as basketball, they also have games that closely resemble casino games: the Amusement Roulette, the Wizard of Oz Coin Dozer, and the Bass Wheel (“Legalized Games of Chance Control Commission” 2020). Through the various seemingly harmless games, arcades are giving children and young adults a taste of what gambling actually is.

Parents. The detrimental effects of gambling can manifest at any point in the player’s life, but the risk is much higher at a younger age. For the most

perfect way to escape from their grim reality. Indian Journal of Psychiatry publishers, Lakshmi Vijayakumar and Vinayak Vijayakumar, stated that “addictive behaviors such as substance abuse and online gaming and gambling grew markedly during this period” (L. Vijayakumar and V. Vijayakumar 2023). To regain some control and temporary happiness, people resorted to relaxing activities like gambling. Given the easy convenience of being able to gamble anywhere and the unlimited amount of time people had available, gambling addiction grew immensely. It can only take one spin or one hand of cards for addiction to begin.

A drug. Although the idea of gambling and drugs are completely different forms of interest, the effects of both of the addictions are similar. Despite the lack of chemicals to give the brain a high, the rush of dopamine still flows all the same. “Like drug addicts, [players] develop a tolerance, and when they cannot gamble, they show signs of withdrawal such as panic attacks, anxiety, insomnia, headaches, and heart palpitations,” Rosengren explains (Rosengren 2016). Like other addicts, gamblers also experience the withdrawal of needing to feed their addiction. When in withdrawal, the parts of the brain that signal warnings are less active, and the temptation becomes unbridled. The author of *Compulsive Gambling: What’s It All About?* comments, “when you’re dealing with an addict active in their addiction, they’ve lost all judgment” (Rosengren 2016). When players are in the zone, they are in a state of euphoria and never want to leave. The zone

becomes an escape from the harsh reality of life, which becomes more captivating than winning. Gambling is now a key ingredient in a player’s recipe book as a way to reduce stress.

Casinos. They capitalize off of the players continuing interest to invest in a failing plan known as the sunk-cost fallacy. Psychologist’s Arkes and Blumer explain that “the sunk-cost effect refers to the tendency ‘to continue an endeavor once an investment in money, effort, or time has been made’” (Dijkstra and Hong 2019). Common examples of how the sunk-cost fallacy is practiced are by watching a dull movie or eating more food at a restaurant despite being full. It is common that since the customer has already paid and watched that far into the movie, they must finish the movie. Likewise, if they had ordered too much at a restaurant, instead of letting their money go to waste, they continue munching away even though it may not be appetizing anymore. The sunk-cost fallacy stems from the negative feeling of not getting a return on investment. In casinos, players believe they must win back what they lost. This goes against economic theory that states, “decisions should only be guided by future gains and losses, as prior costs do not affect the objective outcomes of current decisions,” (Dijkstra and Hong 2019). However, addicted players are fueled by anger which means that rather than a fear of losing more, they have a burning desire to reclaim what they lost.

Slot machines. They are another menace wreaking havoc in the casino industry where players mindlessly pull

count out their bet, which also lets their wager sink in a little more to realize how much they are actually betting. With chips, however, the player just has to throw their blue chip onto the table. It is just “a single, lonely chip sitting there in the middle of a green felt sea” (Richardson 2014). The trick is this: a one dollar chip is the same size as a one thousand dollar chip. While with cash, it would be the difference between a single bill versus ten one hundred dollar bills.

Sights. Casinos burst alive with bright colors, flashing lights, and blaring sounds; two things that they do not have are clocks and windows. Such as the use of chips, the lack of clocks and windows provide a disconnect between the player and the outside world. Casinos trick their players into feeling like it is “an appropriate hour to be awake” (John 2019). If the player looks up to a clock or out the window and notices a huge time difference, they will be more likely to stop and leave as opposed to keep playing. Casinos are also designed as a labyrinth in order to keep players trapped. The exits are at the very front, while all of the amenities, bathrooms, and restaurants are deep into the abyss of bright lights and constant sounds. Casinos lay out their floor as such because “curving paths and strategically placed gaming sections are



Jasmine Franklin
Time Stands Still

intended to catch your attention as you wander” (John 2019). Once the attention of the player is caught, they are allured to the attraction as opposed to going to their intended destination. There are so many opportunities for the player to win, and it is tempting to not indulge.

Sounds. The clinking of coins is not the only sound at the casinos. The melodies created by the machines are intended to make the casino more lively. The casinos want to continue to deceive their players by making them believe that people are constantly winning. If you spend twenty dollars and win five back, you still lose, but the machine will “treat you like a winner, with flashing lights and congratulatory videos and the requisite clinking of virtual coins” (Rosengren 2019). The sight of seeing someone else win gives the other gamblers encouragement to continue. The win registered through the brain is a false win, thus strengthening the psychological strategy that casinos implement into their business.

Alcohol. It is served at casinos to benefit the casinos, not the players. In addition to alcohol being able to take the sting out of the players’ losses, it encourages them to take bigger risks and higher wagers. John describes, “booze

lowers inhibitions and clouds judgment” (John 2019). Poker and Blackjack require the player to think and have a strategy. Due to alcohol’s impairing effects, it makes those games much harder to play. Pain points, which are signs that a player is experiencing mental pain or distress, then begin to surface. Casinos sees this as a warning sign that the player might cease their play for the day and leave. When hosts detect a player ready to give up, they will intervene and will “offer a voucher for some free credits, a drink, or perhaps a meal in the restaurant” (Rosengren 2016). The intervention allows the gambler to take a break and recollect themselves before going back to gambling. The same logic applies to players who have already suffered a huge loss of money. The casino lures them with perks that include “complimentary drinks and meals, limo service, freebies from the casino gift shop, golf excursions...” (Rosengren 2016). The player does not know, but their complimentary drink was paid for by their losses. Casinos only offer complimentary items if they know that they can exploit the player to wager more money than the cost of the item.

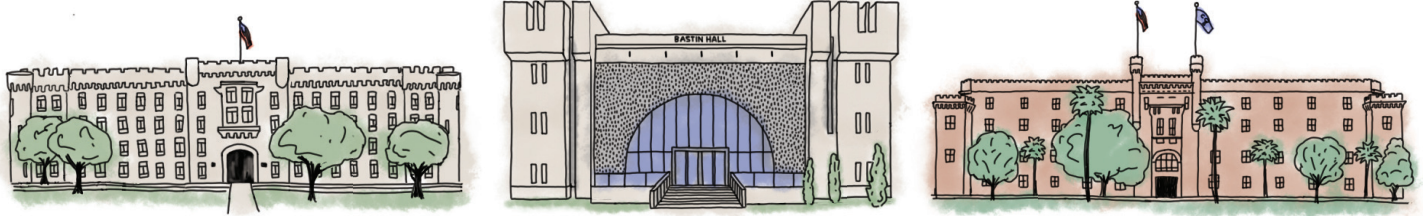
Scott Stevens, down on his luck, went to the Mountaineer Casino to try to save him from the financial hole that gambling had put him in. Up until this point, he had embezzled almost four million dollars, drained his 401(k) of \$150,000, maxed out his credit card, and lost a \$110,000 personal loan. Tragically, the repercussions of his addictions led him to take his own life. The story of Scott Stevens demonstrates how gamblers are affected by the devastating aftermath of their addiction. Once the concept of

gambling is introduced to a child through arcades, their parents, or electronics, the possibility of addiction begins. Once hooked, casinos take advantage and slowly siphon the money out of their patrons until they are bone-dry. Stevens succumbed to the temptation of gambling, where he not only lost his money, but he also lost his own life. In the end, the house always wins.

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Synthetic Aperture Radar in Geospatial Engineering & Military Intelligence



INTRODUCTION

The applications of synthetic aperture radar technology are vast and provide insight into problems that would require on-the-ground tests or unnecessary manpower. The United States military developed this technology for use in aerial and spatial reconnaissance. It has since been adapted for use in numerous civilian applications. This document gives an overview of what this technology is, and how it has been adapted to various platforms in the military and domestic sectors. Radar systems have the unique ability to describe an object and even weather patterns. With the use of a synthetic aperture, one can also determine the change in an object's position, vibrations, density, structure, moisture content, and create a two-dimensional or three-dimensional reconstruction of the target. This novel technology makes synthetic aperture radar applicable to more fields than conventional radar and has become a very useful tool for engineers,

cartographers, intelligence analysts, and safety professionals.

I. WHAT IS SYNTHETIC APERTURE RADAR?

Synthetic aperture radar (SAR) is defined as a method of active data collection in which a sensor projects a beam of energy onto the Earth that is reflected at the sensor after interacting with the scene and is then interpreted [6]. The beam of energy interacts with structures, moisture, and other surface characteristics to create an image of a scene. The sensor uses a "synthetic aperture" to simulate a large antenna. The transmitter would be required to have an impractically large antenna to produce an image with a high spatial resolution [6]. The term "aperture" describes collecting multiple data sets at once and compiling the images to achieve the same effect as if using a much larger antenna, just as a camera's aperture is controlled to focus the camera on a depth of field and the exposure of the image. Using a SAR system, thousands of very small, detailed images can be collected instantly and then compiled

or underground manmade structures such as a missile silo or underground aircraft hangar.

III. CIRCULAR SYNTHETIC APERTURE RADAR USING SRUAUS

Circular Synthetic Aperture Radar (CSAR) refers to a SAR system that uses a 360-degree sensor to cover the totality of an area. Recently, a new method of SAR imaging was developed that uses a small rotor unmanned aerial vehicle (SRUAV) --similar to a domestic quadcopter-- to take a 360-degree panoramic image of a scene and uses “adaptive sub-aperture image” techniques to enhance the level of detail in the final image. This technique requires the use of a back-projection algorithm that interprets the boundary points and the received data to create an image that is then superimposed. It is then verified by the SAR echo data which yields a result that has a lower rate of entropy, or disorder, by 11.12% when compared to if an image was produced by a full aperture with a back-projection algorithm at 66.77% increase in entropy [1]. This method of CSAR is verified by the field-echo data instead of being verified by the inertial navigation system or global positioning system imaging data[1]. This technique produces a much clearer image. This particular method of CSAR



Jess Pierce
F15 and Bonfire

using an SRUAV also has benefits in several diverse applications. The mode of delivery being an SRUAV has the distinct advantage of being much cheaper and therefore accessible to military applications but also in civilian sectors. Because the SRUAV is considerably closer to the ground, it can produce a much more precise image than a satellite or even a conventional UAV with sensing equipment. Moreover, it does so with ease of accessibility and stealth. For example, a SRUAV mode of delivery would be optimal if a team of soldiers were operating out of a forward operating base in an austere environment that requires reconnaissance of a ridgeline near their position to detect caves or concealed positions. This method of SAR is particularly useful because it is cheap, accessible, difficult to detect, and remotely operated and interpreted in real-time to provide essential information about the surrounding area. This makes this new method of SAR a great choice for assessing an area where other resources may not be available.

IV. GROUND—BASED SYNTHETIC APERTURE RADAR TO MONITOR PIPELINES

In the aforementioned sections, SAR has been discussed as being conducted from an aerial perspective or from a satellite in low-earth orbit;

however, SAR technology can be adapted to a ground-based system of data analysis to monitor certain systems like an underground pipeline. Pipelines are susceptible to damage by erosion and corrosion which can result in failure at high pressure [2]. Radar can penetrate the ground to monitor an underground system of pipes. It does this by using the echos of the radar projection which can be used for a vibrational analysis of the system. With a synthetic aperture, this data would then have a cross-range resolution, meaning that it interacts with the pipeline at right angles. This feature gives the radar the ability to distinguish objects that are present at the same range, which can be an indicator of damage to the pipe [2]. The radar can determine the pipe's vibration parameters and the angle at which it obstructs the signal, which can be compared to normal vibrations produced by the pipe. The proposed method of monitoring would be constant and allow for analysis at multiple sections of the pipeline to detect damage. This method is advantageous compared to other methods of monitoring because it is an early indicator and non-invasive.



This proposal suggests that a ground-based synthetic aperture radar system could be mounted onto a mechanical rail that can be moved along the pipeline to assess damage across multiple sections [2]. This system would reduce costs, improve safety, and offer early detection, thus making it an effective mode of monitoring pipeline health. Its uses may even expand to monitoring structural health for a diverse group of structures such as bridges and buildings.

V. UTILIZATION OF SYNTHETIC APERTURE RADAR TO AUTOMATE CARTOGRAPHIC TASKS

A new method of locating and monitoring sea ice has been developed using SAR. It is predicted to have various advantages that the conventional method, dual-polarization (DP), does not offer. The process of DP is fairly straightforward: a pulse in a vertical and horizontal direction is transmitted and received, which is largely a manual task [3]. The new proposed method is called compact polarization (CP) and utilizes a neural network to automate the process and provide greater detail in

the images. Compact polarization is the method in which a single polarization is projected and subsequently two orthogonal, orthogonal in this context refers to interacting at a 90-degree angle polarizations [7]. Polarization refers to the locus, as in the targeted area of the radar field in the plane perpendicular to the direction of transmission [9]. A neural network is a computer program modeled after the human brain, a form of artificial intelligence (AI). This method creates nodes based on the radar signature to create a series of images and places them into the neural network to create an automated system. Such an application maps floating sea ice in the Arctic regions. This has vast applications with the recent technological developments in naval architecture that allow new trade routes via cargo ships, particularly in the North Sea between Russia and Northern Europe. This can reduce costs and make ship navigation much more efficient, increasing safety, reducing environmental risk, and decreasing shipping times.

VI. THE DEVELOPMENT OF SYNTHETIC APERTURE RADAR SYSTEMS TO MONITOR SHIPYARDS

Remote sensing has limitations when scanning metal objects because metal objects are typically electromagnetically conductive which significantly impacts penetration depth of the projected energy. This limits the kind of information that a SAR system can detect, which makes imaging of shipyards and naval infrastructure to include

vessels less accurate. A new method utilizing multi-modal saliency, a term describing visual prominence to human eyes, has been developed that creates a more accurate total image of a shoreline or shipyard. Four saliency maps are created and then compared to each other to create an image that is more accurate than any of its individual parts [4]. These four saliency maps are as follows: an ocean-buffer saliency map (OSBM), a local stability saliency map (LSSM), a superpixel saliency map (SPSM), and an intensity saliency map (ISM). The OSBM is utilized to outline the coastline in turn reducing noise in the image. Likewise, the LSSM is used to ensure pixel spatial distribution. The SPSM picks out critical terrain features in the region. The ISM highlights target pixels with intensity distribution [4]. When these four saliency maps are combined, a more accurate image can be synthesized as opposed to more conventional methods of SAR. This increases the practicality of SAR in the context of monitoring avenues of naval transit. This method increases safety, enhances efficiency, and increases security in ports. It can be applied to commercial applications as well as military applications in terms of maritime security. In the Sea of Aden and the Horn of Africa, piracy is a major problem that impacts commercial shipping and safety. While currently, several countries have committed warships to interdict vessels used for piracy, illegal fishing, and pollution, this creates a strain on the naval assets committed to this task. With this new method of SAR, the ports of East Africa could be more easily secured via

accurate monitoring to prevent piracy before it occurs on open seas.

VII. DISCUSSION OF METHODS OF APPLICATION OF SYNTHETIC APERTURE RADAR TECHNOLOGY

Synthetic Aperture Radar technology is extremely vast in its applications and could be used in rather unconventional methods to increase efficiency, reduce costs, increase safety, provide strategic support in conflict, provide information useful for land surveys, create cartographic data for navigation, and analyze structural integrity in buildings, bridges, dams, and other structures. This makes SAR a versatile tool to combat a variety of problems. This particular technology is primarily only used by militaries and defense contractors but has recently been utilized by navigators, environmentalists, and geologists. There has not been a high frequency of use in the fields of civil engineering or by smaller municipalities in the context of land surveys where it may be beneficial. This is also true for law enforcement where it may be useful for detecting illegal activities such as illegal fishing, logging, or dumping. While SAR is extremely vast in its potential, it currently remains in limited use due to cost limitations and lack of individuals skilled in analyzing sensor images.

V. CONCLUSION

In conclusion, synthetic aperture radar technology is applicable to a variety of fields and can give extremely

insightful data in the form of images, data points, and vibrations. This makes it an effective tool for cartography, geospatial intelligence, surveying, monitoring, and even structural analysis. Because of these applications, the use of synthetic aperture radar technology can increase productivity, increase safety, reduce cost, and provide a mode of non-invasive analysis of structures, underground caves, and collect cartographic information.

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A Note on the Type

The Gold Star Journal is set in Playfair Display, a typeface designed in the late 18th century, influenced by John Baskerville and Scotch Roman designs. Our headers use Ethereal, a typeface in the Modern Elegant Serif Family, with our title page subheadings featuring the classic font, Georgia.

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Anthony Harper

Nature's Fireworks