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Optimization of Business Processes through Digitization and Automation

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NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

DATA DIGITIZATION TO IMPROVE NSW TRAINING OUTCOMES

by

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ABSTRACT

Reporting and clerical functions at Naval Special Warfare (NSW) Echelon IV commands are ripe for digitization, automation and optimization. While cost is a concern for prioritizing a more automated data system, there are potentially large benefits including the use of these data for prediction modelling. This study utilizes two unique digitalized NSW datasets to showcase how to use "big data" in the context of SEAL training and how it can be used to predict medical and performance fails during BUDS and passing various types of training evolutions (e.g., two mile swim, four mile run, etc.). Our main findings indicate higher probabilities for a medical fail to occur amongst males, Whites, and SEALS (both enlisted and officers). For performance fails, the results show higher probabilities for fails to occur amongst females, Blacks, Hispanics, and enlisted SEALs. As for passing evolutions, we find that individuals who are taller, older, lighter (in terms of weight), males, married, White, officers, and college educated are more likely to pass their evolutions. This study is just one example of how long-term efficiencies could be gained from greater automation of data through the use of simple software. Some data (such as those shown in this study) could provide long-term benefit if captured in a more persistent manner. We highly advocate the implementation of a more automated data/software collection system and the use of "big data" for NSW studies going forward in the near future.

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TABLE OF CONTENTS

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LIST OF TABLES

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I. INTRODUCTION

Reporting and clerical functions at Naval Special Warfare (NSW) Echelon IV commands are ripe for digitization, automation and optimization. While cost is a concern for prioritizing a more automated data system, there are potentially large benefits including the use of these data for prediction modelling. This study shows a framework for how to use "big data" in the context of SEAL training and how it can be used to predict medical and performance fails during BUDS and passing various types of training evolutions (e.g., two mile swim, four mile run, etc.). In addition, we highlight how long-term efficiencies could be gained from greater automation of data within the NSW system.

Naval Special Warfare Command requires its SEAL and SWCC operators to be mentally and physically capable to perform and succeed in every mission that is given to them. The trust and reputation in their ability to succeed is built on a historical foundation of carefully selected individuals with the right character and strength to meet the unwavering standard of a Navy SEAL. To maintain trust in the NSW community and preservation of its standards for entry into its ranks, every opportunity must be made to optimize its assessment and selection process.

Every individual who is accepted into the BUD/S program is unique. To be clear, there is no obvious way to determine if someone will pass or fail the training pipeline. Certain so-called mental "x-factors" that encompass a person's internal desire to succeed are immeasurable and will always produce outliers in a dataset. However, data collected on candidates prior to and during training can help produce statistical performance trendlines that encompass an ideal candidate.

This study utilizes two unique digitalized NSW datasets used in a prediction model framework. The first dataset is categorized from BUDS transcripts and includes detailed demographic information for individuals going through the BUDS program for Naval Special Warfare Command. In addition, it provides the specific reason(s) for why individuals failed out of the training cycle. The second dataset focuses on performance metrics for training under Naval Special Warfare Command. It includes demographic information as well as whether the individual(s) passed different types of evolutions (e.g., two mile swim, four mile run, etc.) during their training.

For our prediction model, we use Ordinary Least Squares (OLS) in our regression analysis. The first regression model uses the BUDS transcript data to predict being washed out of BUDS. The second model uses the Student Performance dataset to predict whether an individual passes their evolution. Our main findings indicate higher probabilities for a medical fail to occur amongst males, Whites, and SEALS (both enlisted and officers). For performance fails, the results show higher probabilities for fails to occur amongst females, Blacks, Hispanics, and enlisted SEALs. As for passing evolutions, we find that individuals who are taller, older, lighter (in terms of weight), males, married, White, officers, and college educated are more likely to pass their evolutions.

This study highlights how long-term efficiencies could be gained from greater automation of data through the use of simple software. Some data (such as those shown in this study) could provide long-term benefit if captured in a more persistent manner. As a final recommendation, we highly advocate the implementation of a more automated data/software collection system and the use of "big data" for NSW studies going forward in the near future.

The paper proceeds as follows. Section 2 provides institutional details for Naval Special Warfare training. Section 3 describes the datasets. Section 4 details the methodology used in our final analysis. Section 5 presents the results. Section 6 concludes the study.

II. INSTITUTIONAL DETAILS

A. NAVAL SPECIAL WARFARE TRAINING BACKGROUND

Navy SEAL training is dangerous, but for good reason. It is a dynamic training environment that is influenced by multiple human and environmental factors. Leveraging risk upfront is necessary to ensure a candidate is prepared and able to succeed as a future SEAL. Lowering standards to reduce risk is an unacceptable compromise. Although risk cannot be removed, it can be managed and mitigated to help ensure confidence in the training, instructors, and established standards. NSW's commitment to improving the assessment and selection process can be demonstrated by the recent development of the Naval Special Warfare Assessment Command (NSWAC) in August 2022.

According to Rear Adm. H.W. Howard, III, commander, U.S. Naval Special Warfare Command, the purpose of the new command is to "build the sustainable architecture for diversified outreach, more rigorous pre-assessments for character, cognitive and leadership attributes across the Assessment and Selection pathway and implement the innovative initiatives that strengthen continuous assessment across the continuum of a Naval Special Warfare" (Perlman 2022). In its current form, Navy SEAL assessment, selection, and training is split into six stages.

STAGE 1: Naval Special Warfare Preparatory Course

After completing bootcamp as an enlisted sailor or commissioning as an officer, the first training stage is Naval Special Warfare Preparatory Course (NSWPREP). NSWPREP is a five-week long course focused getting candidates physically prepared to begin Basic Underwater Demolition/SEAL (BUD/S) training. It also incorporates professional development, mental training, and other various academic topics of importance. Recently relocated to Coronado, CA, NSWPREP provides candidates the ability to train in the same environment as BUD/S. BUD/S training has taken place in Coronado, CA since 1971. Before moving to stage 2, NSWPREP candidates must pass all testing requirements.

STAGE 2: Naval Special Warfare Orientation

Naval Special Warfare Orientation (NSWO) is a two-week training period designed to accustom students to the basic evolutions and tests that will be conducted in BUD/S. Areas of focus include running in the sand, open ocean swimming, obstacle course, and technical pool skills. Depending on a student's overall performance, to include run, swim, and obstacle course test scores, instructors will determine if a student moves to the first phase of BUD/S or is removed from the program.

STAGE 3: First Phase

First Phase marks the beginning of BUD/S training. It is seven weeks long and designed to measure your physical ability, water competency, mental toughness, and capability to work as a team while under stress. Each week is comprised of multiple physical evolutions (Log PT, surf passage, ruck runs, etc.) and tests to measure and prepare you for the fourth week of training: Hell Week. Lasting five-and-a-half days, Hell Week tests each student's physical and mental fortitude. It is a major milestone in the training pipeline, responsible for the most attrition compared to any other evolution. Following Hell Week, the remaining members of the class will recover then conduct a final set of physical tests before moving on to Second Phase.

STAGE 4: Second Phase

Like First Phase, Second Phase is seven weeks long. The primary focus of second phase is to teach students basic combat diving skills. The first portion of training is learning about open-circuit diving and displaying your ability to remain comfortable and in control underwater. The remaining time in Second Phase is spent utilizing closed circuit dive rigs. Students will spend multiple weeks learning and practicing underwater navigation and various other critical skillsets. After completing series of culminating dive tests, students will move back to the land for Third Phase.

STAGE 5: Third Phase

The Third and final phase of BUD/S concentrates on the fundamentals of land warfare. Over the span of seven weeks, students will learn land navigation, marksmanship, demolitions, patrolling, and small unit tactics. Each component of training has its own testing requirements, designed to reflect your ability to learn, retain, and execute a complex skill. Physical standards are still maintained and tested throughout the phase in addition to all the other requirements. Upon completion of Third Phase, students have the necessary foundational tactics and skills required in the next stage of training.

STAGE 6: SEAL Qualification Training

SEAL Qualification Training (SQT) is the final stage before joining a SEAL Team. SQT is 26-week course designed to build a student's tactical knowledge to a more advanced level required for a SEAL platoon. In SQT, students learn to operate in multiple environments to include the water, desert, and mountains. At the conclusion of SQT, students will undergo advanced static and freefall operations as well as Survival, Escape, Evasion, and Resistance (SERE) training. Upon receiving a Trident, a student will be assigned to a SEAL Team and prepare for the Inter Deployment Training Cycle (IDTC) (Naval Special Warfare 2022).

B. INTER DEPLOYMENT TRAINING CYCLE (IDTC)

The 18-month IDTC combined with a six-month overseas deployment completes a 24-month cycle which is the standard rotation of the SEAL Teams. This allows one SEAL Team per coast to deploy while the additional three teams man, train and equip for the next deployment. While this is the model of SEAL Team rotational deployment and training, frequent disruptions to the schedule may occur.

Traditionally, the first six months of IDTC are reserved for professional development. Commonly called PRODEV, this phase is reserved for enhancing individual qualifications for the enlisted SEALs and developing the platoon administration for the officers. During this phase most SEAL operators will attend qualification schools such as sniper, breaching, communications, range supervisor, advanced combat swimmer or Joint Terminal Attack Controller (JTAC), among others. These schools are run by a variety of commands and services and are often not NSW specific. This phase concludes with all SEALs returning to the platoon they will call their own for the next 18-months. Many times, the end of PRODEV marks the first time the SEAL platoon has all its members under one roof.

The second phase of IDTC is Unit Level Training (ULT). This phase is the most demanding phase in IDTC due to the frequent travel and continuous assessment from the instructor staff at the NSW Training Detachment (TRADET). The training cells are broken into the following categories: Assaults, Maritime/Mobility and Land Warfare. The duration of each block of training varies, some blocks are ten days while others can be up to 4 weeks. Often there is a quick turn-around between training blocks resulting in scant recovery time. The high training tempo during ULT combined with the increased physical training typically leads to the highest number of injuries when compared with other IDTC phases.

The final phase of IDTC is Task Group Integration Training (TGIT). The focus of this phase is to integrate with other support elements and train for the specific area of operation (AO) and mission set based on the upcoming deployment. This phase cumulates with a final battle problem where the team and platoon finish all final training requirements and become mission capable. Once IDTC is complete the priority shifts to logistical efforts to support the deployment.

C. HISTORICAL TRAINING ISSUES, MEDICAL STUDIES AND MITIGATION RESPONSES

The study of adverse medical conditions related to BUD/S training is nothing new. In a 1991 study of SEAL trainees published in the Clinical Journal of Sports Medicine, Dr. Jerry Linenger and his team concluded, "strenuous physical training results in a high incidence of medical conditions and musculoskeletal injury in trainees" (Linenger et al. 1993). This study found that combined medical conditions and musculoskeletal injuries occurred at a rate of 61.4 cases per 100 trainee-months at risk. More recent medical studies of BUD/s students have attempted to identify psychological and physiological predictors of resilience. A 2020 study by Andrew Ledford and his team concluded, "both psychological and physiological resilience can be important predictors of persistence individually, but combining the measures provides a more holistic view to predict the success of an individual in this intensive training program” (Ledford et al. 2020).

The recent death of SEAL candidate Seaman Kyle Mullen during BUD/S in February 2022 has reignited the public discussion of safety during training (Mongilio 2022). Currently, Naval Special Warfare Basic Training NSW BTC command employs a multitude of safety measures to reduce risk. A few examples are heat index tables denoted by a flag color, water/air temperature tables for surf immersion, instructor safety training, and operational risk management (ORM) papers. ORMs are risk templates designed to be applied to any training evolution. ORMs outline each individual risk and possible outcome associated with that risk, then apply a mitigating action to reduce the overall risk. The main goal of an ORM is to outline risk, not necessarily prevent it.

NSW BTC currently uses environmental data to assess risk but does not apply historical records to refine their risk assessment. Using past environmental parameters overlayed with individual/class performance/mishaps within a day/evolution trend analysis could potentially help expose potential patterns in historical data. This could allow instructors the ability to see a real time assessment of risk and make better-informed decisions within the training environment.

III. DATA

We use individual level information from Naval Special Warfare Command as our primary data source for analysis. Two separate datasets were utilized in the final analysis. The first dataset is categorized from BUDS transcripts and includes detailed demographic information for individuals going through the BUDS program for Naval Special Warfare. In addition, it provides the specific reason(s) for why individuals failed out of the training cycle. The BUDS transcript dataset includes a total of 44,896 observations.[1] The second dataset focuses on performance metrics for training under Naval Special Warfare Command. It includes demographic information as well as whether the individual(s) passed different types of evolutions (e.g., two mile swim, four mile run, etc.) during their training. The dataset includes a total of 106,972 observations.[2]

The BUDS transcript data is particularly useful for seeing why people washed out of the program. It also provides a nice breakdown for the type of individuals that go through the BUDS program. Table 1 shows summary statistics for the BUDS transcript dataset. Out of the 44,896 observations, the vast majority (81.5%) were categorized as White. Hispanics were the next largest group (8.2%) followed up by "Other Race" (4.8%), Multiple Races (2.6%), Asian (1.6%), and Black (1.3%). Females comprised only 0.2% of the observations. The average age was 25.7 with a minimum of 18 years of age and a maximum of 42 years of age. The SEAL enlisted category included 73.3% of the observations. Next was SWCC at 15.7%, SEAL officer at 10.3%, and foreign nationals at only 0.7%.

[1] We drop any observation with age listed as less than 18.
[2] We drop any observation less than 18 years of age, weight less than 100 pounds, and height less than 50 inches.

Table 1. BUDS Transcript Summary Statistics

	Mean	Standard Deviation	Min	Max
Demographics				
Black	0.0134756	0.1153009	0	1
Asian	0.0163934	0.1269845	0	1
White	0.8145492	0.3886672	0	1
Hispanic	0.0819895	0.2743518	0	1
Multiple Races	0.0258152	0.1585855	0	1
Other Race	0.0477771	0.2132966	0	1
Male	0.9984854	0.038889	0	1
Age	25.74497	3.564323	18	42
SEAL Enlisted	0.7333615	0.4422067	0	1
SEAL Officer	0.1025258	0.303342	0	1
SWCC	0.1566732	0.3634964	0	1
Foreign National	0.0074394	0.0859316	0	1
Reason				
Administration	0.0159257	0.1251895	0	1
Lack of Motivation	0.0318291	0.1755469	0	1
Medical	0.0720554	0.2585825	0	1
Null	0.5729909	0.4946491	0	1
Not Meeting Standard	0.0088649	0.0937366	0	1
Not Mentally Strong	0.0056575	0.0750042	0	1
Performance	0.0738596	0.2615452	0	1
Quit	0.0043434	0.0657617	0	1
Rolled In	0.0841055	0.277549	0	1
Weak	0.0107359	0.1030577	0	1
Other Reason	0.119632	0.3245344	0	1

Notes: N = 44,896

A number of reasons for why individuals washed out of the program are given at the bottom of Table 1. Unfortunately, a majority of the observations (57.3%) do not give a reason in the raw data. In the upcoming Result section, we focus on two specific metrics (medical and performance). Medical washouts comprise 7.2% of the observations. Performance washouts comprise 7.4% of the observations.

Table 2 shows the summary statistics for the Student Performance dataset. Males are categorized as 99.985% of the total. Single people are represented as 85.7% of the total, Married individuals are 13.7%, and Divorced or Unknown are only 0.6% of the total. In terms of race, Whites comprise 83.8% of the observations. Next up are Hispanics (7.8%), Other Race (5.9%), Asian (1.5%), and finally Blacks (1.0%). The average age is 27.3 with a minimum age of 18 and a maximum age of 38. The average height is 70.3 inches and the average weight is 178.2 pounds.

Table 2. Student Performance Summary Statistics

	Mean	Standard Deviation	Min	Max
Demographics				
Male	0.99985	0.0122291	0	1
Single	0.857383	0.3496832	0	1
Married	0.136662	0.3434917	0	1
Divorced or Unknown	0.005955	0.0769378	0	1
Black	0.0099	0.0990044	0	1
Asian	0.014817	0.1208203	0	1
White	0.838397	0.368088	0	1
Hispanic	0.077852	0.26794	0	1
Other_Race	0.059034	0.2356897	0	1
Age	27.25602	3.386537	18	38
Height	70.26129	3.460624	50	173
Weight	178.2326	18.85638	118	260
SEAL	0.991278	0.0929834	0	1
SWCC	0.008722	0.0929834	0	1
Enlisted	0.88139	0.3233311	0	1
Officer	0.118611	0.3233311	0	1
High School	0.116414	0.3207218	0	1
Some College	0.018781	0.1357501	0	1
College	0.445229	0.4969934	0	1
Beyond College	0.012798	0.1124014	0	1
Education Unknown	0.406779	0.4912353	0	1
Type of Evolution				
Two Mile Swim	0.315802	0.4648368	0	1
Four Mile Run	0.26793	0.442883	0	1
O-Course	0.366404	0.481824	0	1
Other Evolutions	0.049864	0.2176639	0	1
Outcome Variable				
Pass Evolution	0.891252	0.3113243	0	1

Notes: N = 106,972

Further breakdowns in Table 2 show SEALS are 99.1% of the total and enlisted personnel are 88.1% of the total. In terms of education, 40.7% of the observations list education as unknown. College is listed for 44.5% of the observations. Next up is High School (11.6%), Some College (1.9%), and finally Beyond College (1.3%). We categorize the type of evolution into four categories. O-Course (or obstacle course) is listed as the evolution for 36.6% of the observations. Next up is Two Mile Swim (31.6%), Four Mile Run (26.8%), and Other Evolutions (5.0%). Pass Evolution is our main outcome variable and shows 89.1% of the observations passing their evolution.

IV. METHODOLOGY

For our prediction model, we use Ordinary Least Squares (OLS) in our regression analysis. The first regression model uses the BUDS transcript data to predict being washed out of BUDS. We focus on medical fails and performance fails. This model is shown below:

$$Fail_i = \alpha + X_i'\theta + \epsilon_i \quad (1)$$

Where $Fail_i$ takes a value of one if individual i fails BUDS and zero otherwise. Two outcome variables (medical fail and performance fail) are used in two separate regressions. The vector X_i' is a set of individual predictor variables including Male, Black, Asian, Hispanic, Other Race, Age, SEAL Enlisted, SEAL Officer, and Foreign National. Baseline variables omitted from the regressions are White and SWCC. Finally, ϵ_i is an idiosyncratic error term. In addition, we use the Student Performance dataset to predict whether an individual passes their evolution. This model is shown below:

$$Pass\ Evolution_i = \alpha + X_i'\theta + \epsilon_i \quad (2)$$

Where $Pass\ Evolution_i$ takes a value of one if individual i passes the evolution and zero otherwise. Five different outcome variables are used in the analysis including Two Mile Swim, Four Mile Run, O-Course, Other Evolutions, and All Evolutions. The vector X_i' is a set of individual predictor variables including Male, Married, Divorced or Unknown, Black, Asian, Hispanic, Other Race, Age, Height, Weight, SEAL, Officer, Some College, College, Beyond College, and Education Unknown. Baseline variables omitted from the regressions are Single, White, and High School. Finally, ϵ_i is an idiosyncratic error term.

V. RESULTS

Table 3 shows the main results from equation (1). The first column shows the predictor variables for a medical fail. The results show higher probabilities for a medical fail to occur amongst males, Whites, and SEALS (both enlisted and officers). Males were 6.5 percentage points more likely to have a medical fail in comparison to females. Blacks and Asians were around 3 percentage points less likely to have a medical fail in comparison to Whites. Age does not appear to play a factor in predicting a medical fail and was not statistically significant at any of the standard levels. Enlisted SEALS as well as Officer SEALs were more likely to have a medical fail in comparison to SWCCs.

Table 3. Predictors for Type of Failure

	(1) Medical Fail	(2) Performance Fail
Male	0.0648771**	-.1217908***
	(0.0314162)	(0.0318122)
Black	-0.0259101**	0.0243046**
	(0.0106039)	(0.0107375)
Asian	-0.0278318***	0.0071805
	(0.0100342)	(0.0101607)
Hispanic	-0.0084081*	0.0106022**
	(0.0044823)	(0.0045388)
Other Race	-0.0043044	-0.0022622
	(0.0047118)	(0.0047712)
Age	-0.0000811	0.0003108
	(0.0003527)	(0.0003571)
SEAL Enlisted	0.0309068***	0.0121212***
	(0.0034476)	(0.003491)
SEAL Officer	0.0124821**	-0.0041618
	(0.0050362)	(0.0050997)
Foreign National	0.1283549***	-0.0251083
	(0.0152029)	(0.0153945)
Observations	44,896	44,896

Notes: Baseline variables that are omitted from the regressions are White and SWCC.
***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Standard errors are in parentheses.
Outcome variable in column (1) is Medical Fail (Yes =1 ; No = 0).
Outcome variable in column (2) is Performance Fail (Yes =1 ; No = 0).

Column 2 in Table 3 shows the predictor variable results for a performance fail. The results show higher probabilities for a performance fail to occur amongst females, Blacks, Hispanics, and enlisted SEALs. Females were 12 percentage points more likely to have a performance fail in comparison to males. Blacks and Hispanics were 2.4 and 1.1 percentage points more likely, respectively, to have a performance fail in comparison to Whites. Both of the Black and Hispanic coefficients were statistically significant at the 5% level. Enlisted SEALs were 1.2 percentage points more likely to have a performance fail in comparison to SWCCs. Of note, the Enlisted SEAL coefficient was statistically significant at the 1% level. All of the coefficients for the other variables (Asian, Other Race, Age, SEAL Officer, and Foreign National) were not statistically significant at any of the conventional levels.

Table 4 shows the performance metric results from equation (2). Column 1 displays the results for passing the evolution for two mile swim. Column 2, 3, and 4 presents the results for the four mile run, O-course, and other evolutions, respectively. Column 5 shows the overall results for all of the evolutions.

Table 4. Predictors for Pass Evolution

	(1) Two Mile Swim	(2) Four Mile Run	(3) O-Course	(4) Other Evolutions	(5) All Evolutions
Male	-0.1530445	0.0660754	0.4127685***	0.9619524***	0.2031785***
	(0.1883476)	(0.1282059)	(0.1268424)	(0.242382)	(0.0786843)
Married	0.0163788***	0.0158815***	0.0206406***	0.0195315*	0.0180781***
	(0.005319)	(0.005518)	(0.0046672)	(0.0102208)	(0.0028736)
Divorced or Unknown	0.0076778	-0.0114881	-0.0234844	0.0454881	-0.0067448
	(0.0238211)	(0.0250207)	(0.0212649)	(0.0467442)	(0.0130027)
Black	-0.110924***	-0.0159441	-0.0553165***	0.0380486	-0.0597884***
	(0.0178964)	(0.0185817)	(0.0154804)	(0.0373388)	(0.0096527)
Asian	-0.0022811	-0.0107658	-0.0215588	0.0063573	-0.0114408
	(0.015037)	(0.0155431)	(0.0131485)	(0.0320798)	(0.0081399)
Hispanic	-0.0264975***	0.0031963	-0.0048444	0.0439191***	-0.0074469**
	(0.0067228)	(0.006911)	(0.0059498)	(0.0128209)	(0.0036326)
Other Race	-0.0323296***	0.0163787**	-0.0034681	0.0572229***	-0.0040894
	(0.0075838)	(0.0076591)	(0.0066111)	(0.0146712)	(0.0040587)
Age	0.0014452**	-0.0042036***	0.006116***	-0.0037436***	0.0012877***
	(0.0005739)	(0.0005923)	(0.0005064)	(0.00114)	(0.0003104)
Height	-0.0004293	0.0033134***	0.0028235***	0.0027993***	0.0018968***
	(0.000604)	(0.0006308)	(0.0005512)	(0.0009655)	(0.0003281)
Weight	0.0007233***	-0.0011784***	-0.0012349***	-0.0006936***	-0.0005666***
	(0.0001146)	(0.0001186)	(0.0001016)	(0.000204)	(0.0000619)
SEAL	Omitted due to	Omitted due to	-0.0663598***	-0.0477217***	-0.0831229***
	multi-collinearity	multi-collinearity	(0.0173068)	(0.0104785)	(0.0102252)
Officer	0.0285216***	0.0481796***	0.0876497***	-0.0010572	0.0543357***
	(0.0057332)	(0.005984)	(0.0051122)	(0.0110649)	(0.0031213)
Some College	-0.0347249**	0.0317214**	-0.0166057	0.0429533*	-0.0038926
	(0.0139204)	(0.0142856)	(0.012405)	(0.0232935)	(0.0074716)
College	-0.0013075	0.0573534***	-0.0109143**	0.0237094*	0.0132636***
	(0.0060903)	(0.0062809)	(0.0053595)	(0.0129736)	(0.0032998)
Beyond College	-0.0331641**	0.0796987***	-0.0090073	0.0795809***	0.0129095
	(0.0163429)	(0.0167504)	(0.0150859)	(0.0297761)	(0.0089289)
Education Unknown	-0.0149114**	0.0381599***	-0.0099019	-0.0047991	0.0025678
	(0.0058515)	(0.0060362)	(0.0051157)	(0.0125567)	(0.0031646)
Observations	33,782	28,661	39,195	5,334	106,972

Notes: Baseline variables that are omitted from the regressions are Single, White, and High School.
***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Standard errors in parentheses.
Outcome variable is Pass Evolution (Yes = 1 ; No = 0).

The Male coefficient in Table 4 is positive in four out of the five regressions and statistically significant at the 1% level in three of the five regressions. The Married coefficient is positive and statistically significant in all five regressions. Blacks appear to be the least likely to pass evolutions in comparison to the other races. The Black coefficient is negative in four out of the five regressions and statistically significant in three out of the five regressions. Height is another strong predictor for passing evolutions as shown Table 4. The Height coefficient is positive and statistically significant at the 1% level in four out of the five regressions. The coefficient for Officer is positive and statistically significant in four out of the five regressions.

Column 5 in Table 4 shows the key takeaways from the statistical analysis for the performance metric data. The key takeaways are that individuals who are taller, older, lighter (in terms of weight), males, married, White, officers, and college educated are more likely to pass their evolutions. All of the coefficients for these variables were statistically significant at the 1% level indicating very precise estimates from the regression analysis. The total number of observations for all evolutions was 106,972.

VI. CONCLUSION

This study utilizes two unique digitalized NSW datasets to showcase how to use "big data" in the context of SEAL training and how it can be used to predict medical and performance fails during BUDS and passing various types of training evolutions. The first dataset we utilize is categorized from BUDS transcripts and includes detailed demographic information for individuals going through the BUDS program for Naval Special Warfare Command. In addition, it provides the specific reason(s) for why individuals failed out of the training cycle. The second dataset focuses on performance metrics for training under Naval Special Warfare Command. It includes demographic information as well as whether the individual(s) passed different types of evolutions (e.g., two mile swim, four mile run, etc.) during their training.

For our prediction model, we use Ordinary Least Squares (OLS) in our regression analysis. The first regression model uses the BUDS transcript data to predict being washed out of BUDS. The second model uses the Student Performance dataset to predict whether an individual passes their evolution.

Our main findings indicate higher probabilities for a medical fail to occur amongst males, Whites, and SEALS (both enlisted and officers). For performance fails, the results show higher probabilities for fails to occur amongst females, Blacks, Hispanics, and enlisted SEALs. As for passing evolutions, we find that individuals who are taller, older, lighter (in terms of weight), males, married, White, officers, and college educated are more likely to pass their evolutions.

This study is just one example of how long-term efficiencies could be gained from greater automation of data through the use of simple software. Some data (such as those shown in this study) could provide long-term benefit if captured in a more persistent manner. We highly advocate the implementation of a more automated data/software collection system and the use of "big data" for NSW studies going forward in the near future.

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