Baseline Differences between Successful and Unsuccessful Candidates during Special Forces Qualification Course for a Canadian Military Special Operations Unit

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Abstract

The assessment, selection and training of Special Operations Forces (SOF) personnel is no small task. Significant resources are allocated into the system for developing future Operators. The high attrition rate represents a potential inefficiency and an opportunity for critical examination of existing approaches. Little research is available to determine whether 'combine like' metrics collected at baseline have any predictive value for successful completion of the Special Forces Qualification Course (SFQC). The current study examined a battery of performance metrics, lifestyle and demographic information collected at the beginning of a qualification course for a Special Operations Unit within Canada. The present analysis explored whether those who successfully completed the qualification course differed within the baseline metrics collected from those who were unsuccessful. In this single year of data, there were no significant differences between the successful and unsuccessful groups of candidates on the course. It also appears that the population selected were exceptionally homogenous within the metrics collected. The present study will provide valuable insight for the Chain of Command regarding of the composition and abilities of those entering their unit.

Keywords: Talent Identification, Special Operation Forces, Combine testing

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List of Abbreviations

SOF	Special Operation Forces
NATO	North Atlantic Treaty Organization
SOE	Special Operations Executive
OSS	Office of Strategic Services
SF	Special Forces
SFAS	Special Forces Assessment and Selection
SFQC	Special Forces Qualification Course
KSAO	Knowledge, Skills, Abilities and Other Characteristics
BUD-s	Basic Underwater Demolitions Seals
SEAL	Sea Air Land
IMTP	Isometric Mid Thigh Pull
CMJ	Counter Movement Jump
FP	Force Plates
RM	Repetition Max
NT	Neurotracker
N	Newton's
AB	Assault Bike
BF	Body Fat
ID	Identification
CAF	Canadian Armed Forces

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Note to the Reader

As a result of National interest and Operational Security, information regarding specifics of organizational structure, capabilities and identifiers has been omitted. Please contact the author for clarification or further information.

Background

The study of Special Operations Forces (SOF), given its inherent nature, is shrouded in secrecy and buried in redacted literature. Effective examination of these elite military units is made further difficult due to a lack of consistent basic definitions as to what constitutes their key functions, such as through their purposes, missions, and components. This lack of clarity presents myriad challenges when studying SOF in a meaningful way.

To demonstrate the lack of an agreed upon universal definition of SOF, consider the following commonly used definitions. To begin, Navy Seal Vice Admiral William H. McRaven defined SOF vaguely yet practically in the influential book *Spec Ops: Case Studies in Special Operations Warfare: Theory and Practice* as, "forces specially trained and equipped, and supported for a specific target whose destruction, elimination, or rescue, is a political or military imperative" (McRaven 1996). The North Atlantic Treaty Organization (NATO), which represents allied Nations, adopts a broader approach defining them as, "forces that provide a flexible, versatile and unique capability, whether employed alone or complementing other forces or agencies, to attain military-strategic or operational objectives. Special Operations, in contrast to conventional Operations, are generally small, precise, adaptable and innovative, they may be conducted in a clandestine, covert or discreet manner" (NATO, March 1997). As an allied member, one can infer the Government of Canada's definition to be similar to NATO's, which refers to SOF as, "Military activities conducted by specially designated, organized and equipped forces, using operational techniques and modes of employment not standard to conventional forces. These activities are conducted across the spectrum of military operations independently or in coordination with operations of conventional forces. SOF units are strategic assets that lack

the size and equipment for direct involvement in major battles. They are built around carefully selected and highly trained people and rely on the use of intelligence, stealth, surprise and operational flexibility to achieve their objectives" (Fulton 2001).

It is clear through these accepted, albeit differing definitions of SOF units that a key function is the capacity to rapidly evolve to meet international needs, technological advancements, and shifts in the nature of warfare – which may explain their vague and ever-changing definitions. The dynamic formation of these units makes it all but certain that the definition of SOF will frequently require re-evaluation based on their key functions at each phase of their rapid evolution.

In Canada, SOF are described as being "built around carefully selected and highly trained people" (Fulton 2001), which emphasizes the importance placed on the process by which personnel are trained and selected into these units, with an emphasis on the cognitive and personality descriptions of individual personnel. The pathway through which candidates enter SOF units has been a subject of significant interest over the past century. The first organizations to see the need for a separate and extensive multi-phase selection program were the American Office of Strategic Services (OSS) and its British Counterpart, the Special Operations Executive (SOE) (Balasevicius 2007, Banks 1986). These organizations were birthed out of necessity during World War 2 and represent the foundation of modern SOF. Banks describes this first undertaking as "tapping into the patriotism and dedication of some of the best psychologists in the United States, the OSS established the first psychological assessment center in America" (Banks 1986). While the effectiveness of the assessments conducted by the OSS during this time have come into the question, the work established by the psychiatrists and psychologists

throughout the development of the OSS represents groundbreaking advancements in the assessment of personnel.

Following initial selection, training, and implementation of SOF in WW2, the OSS and SOE were disbanded. While SOF units continued to exist in various capacities, it was not until the 1980s when the American Special Forces (SF) developed the Special Forces Assessment and Selection courses (SFAS) with the goal of better managing attrition and resource costs associated with the selection and assessment of its personnel. The selection phase represents the first version of the modern SOF selection process (Balasevicus, 2007). In 1987 the first selection phase was officially completed. Today, SOF units operate a similar format of this original approach. The selection phase includes two phases: (1) Pre-Screening and (2) Testing/Assessment. Following selection phase, successful candidates enter the Special Forces Qualification Course (SFQC).

Within the revised format, unsuitable applicants are removed through pre-screening, while successful candidates are assigned for temporary duty to the Special Forces. By embedding successful applicants within the unit, SOF units benefit from a reduction in the resources previously 'wasted' on unfit candidates. For a unit to possess a strategic and scientifically validated selection phase and qualification course, they must be fundamentally and principally built upon a systematic job analysis. Major Gary Ivey writes in *Special Operations Forces Selection: Job Analysis and Multi-Form Assessment, a report for NATO,* that it is critical to identify "bona-fide knowledge, skills, abilities and other characteristics (KSAOs) that predict successful performance within the job." (Ivey 2012). Once a KSAO has been successfully identified, the unit, personnel selection officers, and subject matter experts determine the appropriate requirements and the appropriate process for identifying candidates who possess the

necessary KSAOs. One such example of a job analysis conducted on U.S. Army SF Soldiers produced a list of 11 specific job roles and 26 associated job performance categories (Sharp 2012). The wide variety of specific roles and associated performance categories demonstrates the difficulties SOF units and their personnel face when tasked with developing an effective selection process that aptly assesses and selects candidates who will have success within qualification course and throughout their career.

Each phase of the selection and assessment process has distinct purposes and outcomes. For instance, pre-screening typically includes medical assessment, collecting biological data, general information briefing, personal interviews, and work sample testing, as well as physical, psychological, and cognitive ability testing (Balasevicius, 2007). In pre-screening applicants, recruitment personnel can also de-select individuals possessing undesirable traits/skills in a resource efficient manner. These tests are typically highly standardized and easily repeatable, so that they can be conducted at various assessment centers with interchangeably trained personnel.

Following pre-screening, successful candidates enter the testing or selection phase. Selection typically includes job related tasks where candidates are assessed on the relevant KSAOs identified in the job analysis. Given its secretive nature, selection can be described limitedly as, “candidates are expected to travel significant distances, over periods of days or weeks with little sleep and few days off” (Balasevicius, 2007).

Finally, individuals who successfully complete selection phase typically move into some version of a qualification course, which can last many months, or even years (Vlahov, 2019). During this phase, candidates are expected to learn and demonstrate all of the necessary skill sets required for SOF personnel. These skill sets are taught and tested under extreme stress and pressure. Upon completion of qualification course, newly ‘badged’ Operators must be able to

execute the following skills at an elite level; Counterterrorism, counter proliferation of weapons of mass destruction, special reconnaissance, direction action, non-combat evacuation, defense diplomacy, military assistance, irregular and special warfare. (Balsevicus 2007)

Executing an effective SFAS and SFQC is extremely resource intensive. Balsevicus (2007) notes that it costs "approximately $800,000.00 USD to train a SEAL during the first year alone." Over the past 13 years, the resource requirements to produce a single SOF soldier have no doubt significantly increased, to match both inflation and demand. Further, the attrition rates during selection into SOF units are extremely high; examples include: 42% for the Rangers (Kidd 2003), approximately 70% for the Green Berets (SFAS) (Simpson 1983), and a typical graduation rate of just 25% during the Basic Underwater Demolition Seal (BUD-S) for the Sea Air Land (Seal) Forces. (Doolittle, 2004). Considering the resource investment, high stakes, and potential for international consequences, it is critical that these organizations select, qualify, and retain individuals who are able to successfully execute missions in an effective and ethical manner. Ultimately, one can envision the difficulties these organizations face in producing and retaining the required number of candidates at the end of this process. In countries such as Australia, which share a similar population, demographic, and political orientation as Canada, the SOF system is challenged to fill their minimal required manning of 3,000 Operators (Balasevicius, 2007). The high-level process of talent identification and selection implies that the margin for error between a highly effective SOF unit and unsustainable operations is razor thin amongst similar structures.

Despite having similar structures, individual SOF units need to develop their own selection pathways based on their own KSAOs, in order to fulfill their country's unique

challenges and mandates. SOF Candidates who successfully become Operators must possess the right balance of physical, psychological, social, and physiological characteristics.

Rationale

This project focuses on a Special Operations unit which may possess a similar structure to other NATO allies. For example, the Norwegian MJK conduct their selection phase and qualification course in three phases: Phase 1: Pre-screening; Phase 2: Selection - Lasting 4-5 weeks with the purpose of screening out candidates who are note suitable for the unit's requirements; and, Phase 3: qualification course - Lasting approximately 1 year where candidates are exposed to tests in order to be qualified for further training by passing each test (Vlahov, 2019). Similar to the other SOF units referenced, the Canadian SOF unit's ability to select and retain the best individuals available is critical to the unit's success, longevity, and fulfillment of international obligations.

There have been significant efforts to examine the Pre-Screening and Selection phases of the selection pathway. However, once a soldier has successfully passed the selection phase and been accepted into the qualification course, the baseline data collection has ended. Qualification course represents a drastic increase in resources invested into the individual candidates and therefore, these individuals should possess the necessary skills for success on qualification course. This sentiment is echoed in Sharp et al's (2012) *Physical/Physiological Selection of Special Forces Soldiers* which noted that "optimally, SF candidates would be selected on a high probability for success in training" (NATO, 1997). The NATO contributors contend that the congruency between the requirements to successfully complete the training course and

requirements necessary to complete Pre-Screening and Selection are not observed. Selection is designed to assess the KSAOs required to meet the job analysis and therefore, the nature of selection is typically short in duration and created to expose candidates to a maximum legal amount of stress and pressure.

Unlike selection, the qualification course functions to assess the candidate's ability to learn and demonstrate the pertinent KSAOs day-in and day-out over an extended period of time. If 'selection' chooses the KSAOs required to be a successful SOF Operator, then, barring injury, a low attrition rate during qualification course should be observed, yet many qualification course's attrition rates are equal to or in excess of 50%. Sharp et al. argues that as a result of the massive resources invested during qualification course and the differences in the requirements for success between selection and training, it is critical that individuals entering SFQC are examined with the same rigor as candidates entering selection phase. Collecting Candidate information across the physical, psychological, and demographic spectrum at the commencement of the qualification course will allow the exploration of factors associated with success.

In this regard, this project takes an exploratory approach in order to examine relationships between participant's successful completion of the qualification course and a wide array of physical, psychological and demographic variables collected at baseline.

Methods

The sample for this project included 33 candidates for the Special Forces Qualification Course. Participants ages ranged from 22 to 39 years old with a mean age of 28.5. All tests were conducted by qualified members of the support staff working within this unit. Participation in all testing activities were voluntary, no incentives were provided for participation. Prior to

beginning the course, all participants underwent a series of tests design to measure parameters considered important for success in this occupation. These tests are described below.

Testing Protocols

Mid-Thigh Isometric Pull. Hawkins Dynamics Dual Force Plates were utilized for all force plate testing. A Strength and Conditioning Specialist led all members in the baseline testing pool through a standardized warm-up protocol. They were also provided familiarization training, at which point candidates were properly fitted for self-selected bar height between the top of the femur and the top of the patella. 1 to 2 familiarization efforts were provided to ensure technique, safety and optimization. Instructions were provided to ensure maximal effort on command "Go", each effort last 05 seconds. A 1 – 2-minute recovery period was provided and a second trial was conducted.

Counter Movement Jump. Candidates were led through a standardized warm-up protocol by a Strength and Conditioning Specialist. Instructions were provided to ensure proper technique and all participants were provided an opportunity to practice execution of the counter movement jump and receive feedback. Candidates were instructed to place their hands on their waist and remain this way throughout execution of the test. Self-selection of the most appropriate jump technique and depth was acceptable. Candidates executed 3 trials with 30 seconds recovery between trials.

1 RM Pull Up. Candidates began by weighing and recording their weight in Kg on a standard scale. A standardized warm-up led by a Strength and Conditioning Specialist. Instructions were

given to begin from a position of upper limb lock out, without the use of momentum candidates were required to pull themselves to a position where, in a neutral position, their chin raised over the bar. A strength and conditioning specialist was present to ensure proper technique and grant success on each trial. The Pull Up was executed utilizing a neutral grip position to mitigate shoulder injury risk. A belt and chain apparatus was utilized in order to add load to the movement. In consultation, load was progressively added after each successfully executed each trial, candidates were able to continue to increase load in order to achieve their 1 repetition maximum. After two unsuccessful attempts the test was concluded, the last previous successful attempt was recorded as candidates 1 repetition maximum. Relative strength was calculated utilizing the candidate's weight and recorded result.

Maximum Wattage. All energy system trials were conducted on a CrossFit competition grade assault bike, bikes were maintained and tested for coherence prior to testing. Candidates completed a standardized warm up protocol led by a Strength and Conditioning Specialists. Instructions were provided to complete a short duration, maximal effort on the Assault Bike and to achieve the highest wattage possible. The maximal wattage achieved was recorded by a dedicated spotter. Once wattage began to decline the trial was ended. Candidates were given 3 opportunities to attempt the test with a maximum of 5 minutes between trials.

Anaerobic Threshold. A standardized warm up protocol led by a Strength and Conditioning Specialist. This test consisted of a 2:00 minute maximal effort on the Assault Bike. The instructions were provided to exert maximal effort in order to achieve the highest distance,

average wattage and calorie count possible within the 2:00 minute trial. A dedicated spotter was assigned to each candidate during all trials.

Aerobic Threshold. Candidates completed a standardized warm up protocol led by a Strength and Conditioning Specialist. The aerobic threshold test consisted of a 10:00 minute maximal effort on the Assault Bike. Candidates were instructed to achieve the highest distance, average wattage and calorie count possible within the 10:00 minute trial. A dedicated spotter was assigned to each candidate during the trial.

Anthropometric Analysis. The In-Body 580 was utilized to measure the body composition of candidates. The test was conducted by ISAK certified personnel and overseen by a Registered Dietitian. Candidates were scheduled into early morning time slots and instructed to arrive at the assessment in a fasted state.

Neurotracker Baseline. Neurotracker is a 3 dimensional perceptual-cognitive object tracking software program. Candidates complete 3, 6 minute sessions consisting of 20 individual trials. The prescribed setting was set to 4 ball tracking, there were a minimum of 12 minutes between each session. Baseline score was established and recorded after completion of the third session.

Lifestyle and Demographic Questionnaire. The lifestyle and demographic questionnaire consisted of a number of questions that were proposed by the Human Performance cell, the

questions that are presented were the questions that had been approved by the military chain of command and the medical chain of command. Questions were presented in numerical, categorical or as scales. The purpose of the questionnaire was to commence the development of a working database of the backgrounds of candidates entering onto the SFQC. Questions were related to military exposure and experience, demographic information such as age and family structure and self-reported lifestyle habits such sleep, nutrition, stress and training habits.

Procedure

Testing was conducted over a 5-day period. More specifically, Mid-Thigh Isometric Pull, Countermovement Jump, Alactic and Anaerobic tests were conducted on day 1, Aerobic testing and 1 RM Pull Up Up were conducted on day 3. In-Body Anthropometric assessments were conducted in a fasted state upon waking. Neurotracker, Threat Attention Bias, C3Logix were spread equidistance throughout the 5-day span to minimize cognitive fatigue. The lifestyle and demographic questionnaire was delivered on day 1 and collected on day 5.

Statistical Analysis

Exploratory analyses were performed to determine whether there were any meaningful differences in measures at baseline between participants who ended up being successful on the Special Forces Qualification Course (i.e., the ‘successful’ group, n = 16) and those who were not (the ‘unsuccessful’ group, n = 17). Reasons for being removed from the training course included

injury, inability to demonstrate requisite skills, safety violations and voluntary removal. Given the preliminary nature of this research and the rarity of individuals in this sample, descriptive statistics (mean, standard deviation) were calculated for all variables. Differences between successful and unsuccessful cohorts explored using t-tests (for continuous variables) or Chi-square (for ordinal or categorical variables). In a series of pre-analysis procedures for the continuous outcomes, the Shapiro-Wilk's W test was used to assess the distribution assumption of normality and assumptions of homogeneity were determined using Levene's test. Both of these assumptions were met for the performance metrics. All statistical procedures were conducted using SPSS v.25 for Windows (SPSS Inc., Chicago, IL., USA)

Results

Table 1 provides the mean, standard deviation, t-values and significance for the performance metrics, separated into cohorts according to successful vs unsuccessful completion of qualification course. According to the t-tests, the mean difference between the two groups for all performance tests were non-significant (all $p > .05$). Interestingly, the means and standard deviations on many of the variables indicates a high degree of homogeneity amongst the group. However, even for variables where there was higher variability amongst the groups (e.g., the measures of power output such as IMPT Peak Force and TwoMin AB Avg Watt), differences between groups were not statistically significant. One out of the twelve questions selected on the lifestyle and demographic survey (Current Chewing Tobacco Consumption) achieved significance within the Chi-Square test ($p>.05$), these findings suggests a low level of predictability amongst any of these factors.

Table 1. Descriptive statistics relating to performance metrics collected at baseline during SFQC and TT for successful vs. unsuccessful candidates.

		N	Mean	Std. Deviation	t	Sig. (2-tailed)
Age	Successful	16	27.8	3.1	-1.05	.302
	Unsuccessful	17	29.1	4.2		
Peak_AB_Watt	Successful	14	1545.6	230.6	-.178	.860
	Unsuccessful	14	1558.8	154.4		
RM_Pull_Up	Successful	14	283.3	27.7	-.187	.853
	Unsuccessful	14	285.7	38.1		
IMPT_Peak_Force	Successful	12	3424.0	272.1	-1.493	.149
	Unsuccessful	13	3705.3	597.4		
NT_Baseline	Successful	13	1.52	.39	.419	.679
	Unsuccessful	14	1.47	.20		
TwoMin_AB_Avg_Watt	Successful	12	524.4	80.2	1.442	.163
	Unsuccessful	13	484.3	58.0		
TenMin_AB_Avg_Watt	Successful	14	369.3	63.5	.407	.687
	Unsuccessful	14	360.0	44.4		
RM_Pull_Up_Relative	Successful	14	1.5	.12	1.657	.110
	Unsuccessful	14	1.4	.13		
Height	Successful	16	181.6	6.5	-1.114	.274
	Unsuccessful	17	184.3	7.5		
Mass	Successful	16	193.1	17.3	-1.181	.247
	Unsuccessful	17	200.6	19.1		
Prct_BF	Successful	16	13.9	5.0	-.701	.489
	Unsuccessful	17	14.9	3.4		

Table 2 presents the descriptive statistics for from the scaled questions on lifestyle and demographic survey. Again, despite considerable range in the types of variables collected and their hypothesized links to success in the course, there were no significant differences between the groups. Moreover, the groups seemed to be even more homogeneous on these variables than the performance metrics presented in Table 1.

Table 2. Descriptive results taken from the completion of the lifestyle and demographic questionnaire administered at the commencement of SFQC

		N	Mean	Std. Deviation	Std. Error Mean
Yrs_In	Successful	14	7.3571	2.59013	.69224
	Unsuccessful	14	7.7143	3.85164	1.02940
Nmb_Deploy	Successful	16	.6875	.70415	.17604
	Unsuccessful	17	.9412	1.08804	.26389
	Unsuccessful	17	1.7059	.46967	.11391
Life_Stress	Successful	16	3.1875	1.47054	.36764
	Unsuccessful	17	3.5294	2.15400	.52242
Slp_Quality	Successful	14	6.8571	1.40642	.37588
	Unsuccessful	16	7.0000	1.50555	.37639
Slp_Hours	Successful	16	7.2813	.44605	.11151
	Unsuccessful	16	6.7813	.70637	.17659
Nurition_Habits	Successful	15	6.8333	1.43510	.37054
	Unsuccessful	15	6.9333	1.16292	.30026

Table 3. Descriptive results taken from the completion of the lifestyle and demographic questionnaire administered at the commencement of SFQC and Pearson's Chi-Square Test for successful vs. unsuccessful candidates.

		Married	Divorced	Other	Asymptotic Significance (2-sided)
Parents_Mar_Stat	Successful	8	8	0	
	Unsuccessful	11	5	1	.343
	Total	19	13	1	
		Yes	**No**		
Siblings	Successful	14	2		

	Unsuccessful	16	1		.509
	Total	30	3		
		Single	**Partnership**		
Relationship_Stat	Successful	13	3		
	Unsuccessful	13	4		.737
	Total	26	7		
		Yes	**No**		
Children	Successful	4	12		
	Unsuccessful	5	12		.776
	Total	9	24		
		Yes	**No**	**Ex**	
Smoker	Successful	1	15	0	
	Unsuccessful	2	11	4	.085
	Total	3	26	4	
		Yes	**No**	**Ex**	
Chewing_Tobacco	Successful	11	4	1	
	Unsuccessful	4	12	1	*.027**
	Total	15	16	2	
		Yes	**No**		
Drink_Alch	Successful	13	3		
	Unsuccessful	15	2		.576
	Total	28	5		
		Yes	**No**	**Unsure**	
Excess_Fatigue	Successful	6	7	3	
	Unsuccessful	6	4	7	.303
	Total	12	11	10	

Table 3 presents the descriptive statistics for from the ordinal questions on lifestyle and demographic survey. 1 of the 14 questions asked on the lifestyle and demographic questionnaire was significant, this further highlights the challenges regarding predictability of SFQC.

Discussion

The aim of this preliminary study was to explore the potential relationship between Human Performance and Lifestyle/Demographic metrics collected on participants prior to the qualification course and subsequent successful completion of the course. The initial analysis suggests no relationship between any individual metric collected as predictors of success on qualification course.

The present results support the conclusion that the identification and selection of talent at the elite level is a dynamic and complex process, unlikely to be simplified into specific and individual surrogate metrics. As noted in the introduction, there has been relatively little published research on SOF to compare our results to but similar results have been noted in related domains. For instance, previous research on talent identification within the NFL, NBA, AFL and NHL drafts (Gogos 2020, Kutzmits 2008, Vescovi 2006, Robbins 2010), has noted the ability to identify and select talent through cross sectional testing metrics is, at best, an imperfect science and, at worst, an abysmal failure. The preliminary results of the current study suggest the identification and selection of elite performers within the military arena is similar. To this point, a recent publication from Till and Baker (2020) highlights the challenges when utilizing cross-sectional methodology in order to measure future success from a performance at a "one-off" specific time point. In sport it is becoming increasingly clear that talent is a "dynamic, emergent, non-optimal and non-linear" (Till & Baker, 2020), Special Operations appears to be no different, as a result future research should adopt a longitudinal, multi-dimensional and ecological approach to the collection and analysis of data. Further to this point, it would be wise for future efforts to establish a clearly defined definition of what 'talent' means within the Special Operations community. In a complex environment with a multitude of established KSAOs, the

notion of excelling within a Special Operations career appears to lack clear boundaries, this is observed in the frequent use of abstract terminology used to describe members such as "Candidate lacks SA (situation awareness)" or "The candidate is good to go".

In addition, future research should be directed to determine the efficacy and efficiency of the selection phase, which is designed to identify and select for the characteristics necessary for success on qualification course. If selection phase adequately acts as an effective filter for graduating candidates into Operators, it is not clear why the attrition rate through the qualification course remains above 50%. It may be more appropriate to position the selection phase not as a predictor of success on qualification course but as a necessary (but not sufficient) first step through the training and stress inoculation required to complete the education process while becoming a Special Forces Operator.

Beyond the complexity in the identification of future talent there are several plausible explanations for the absence of relationships between the pre-course metrics and course completion. First, it is possible that the metrics collected within the dataset do not sufficiently represent the skills and performance indicators required for success on course. Future assessments should involve an in depth needs analysis for completion on qualification course and evaluate the metrics collected in order to critically assess the future integration of new skill-based metrics. Second, all of the participants who completed the pre SFQC testing battery had previously completed selection phase, as a result the cohort beginning qualification course is largely homogenous as represented by the narrow standard deviations among many of the variables in this preliminary study. Had the Human Performance metrics been collected prior to selection phase the author imagines there may have been greater heterogeneity in the variance within the various testing metrics. Third, as a result of the constrained sample size it is very

likely that the cohort was simply too small to identify differences between groups within this population. Small differences between groups may be the reality of this type of research (similar to high performance sport research). Within the SOF community, sample size will always be a challenge; the examination of elite individuals is by definition rare. As these metrics are collected year after year it will be important that new results are continuously re-evaluated so that any relationships can reveal themselves over time as the sample increases.

Although, at first glance, it appears these metrics do not provide insight into characteristics associated with successful completion of qualification course. However, we would advise continued examination in this area due to the preliminary nature of the current analyses coupled with issues associated with small samples, rare populations, etc. It is important the practitioners responsible for the accumulation of this data not only continue the collection of these variables, but expand their evaluation. The original intent of baseline collection, storage and analysis of these metrics was to guide future programs and interventions in order to support and develop Operators throughout their life cycle. The lasting benefit of this source of data will likely be the sustained longitudinal collection and analysis of these metrics in order to inform the embedded staff on the inter and intra variability and progression of the Operators within this unit. As Operators are repeatedly re-evaluated on these metrics throughout their career the unit may be able to begin to model the typical progression through the Operator lifecycle, identify periods of significant ascension or decline and target particular interventions in order to sustain a long and successful career.

Implications

As this research is intended to inform and empower the specific unit, there are several implications worth considering moving forward. First, the challenges of talent Identification and the initial results of this study caution against assuming high predictability when identifying future talent and success. Second, understanding that success on qualification course requires a multitude of potentially related and unrelated factors as well as a vast array of complex skill sets it may be a reality that despite every effort to support and control factors throughout qualification course a high attrition rate is unavoidable and future efforts must be directed towards increasing candidate pool. Third, in order to maximally impact future programs and appropriately inform unit decision-making, it is critical the chain of command considers providing the resources and support necessary to adopt a longitudinal, ecological approach to data collection and analysis where multiple key performance indicators are considered and analyzed beyond the current silo approach. Finally, a systematic effort should be orchestrated to further establish a working definition of talent within the Canadian Special Operations community; providing clarity within this environment will aid in efficiently and accurately selecting and retaining the unit's members.

Limitations

As noted earlier, one limitation to this examination was the small sample size, clearly 33 participants were not an ideal N to establish relations. This period of data collection represents the first time that a comprehensive baseline testing effort has occurred within this unit, hence, with support from Chain of Command and multiple repeat years will eventually provide a rich

dataset for future analysis. The reality is, small numbers are the cornerstone of a Special Operations Unit and sample size will always be a challenge. New and innovative ways to analyze exceptional outlier groups are necessary and welcome. As previously mentioned, the cross sectional nature of this examination is not ideal when assessing future talent, however, in units such as this, the talent pathway is unique, closer to talent transfer than the normative North American sport pathway. For instance, individuals who enter this unit are typically older in age than sport models such as LTAD (Balya, Way, Higgs, 2013) and must have served a minimum of 2 years in the Canadian Armed Forces (CAF) prior to attempting selection phase. This makes any longitudinal research *a priori* difficult, however, an examination of normative data within the CAF on available metrics may provide insight into existing differences between CAF members in general and SOF Operators in particular. Ongoing data collection and analysis on both future qualification courses and Operators as they progress through their career are planned and will enable cohort to cohort and Operator to Operator longitudinal examinations.

The author acknowledges the potential for unintended bias due to his professional role with the organization. His role as performance lead for this unit could impact access, outcomes and conclusions. As previously mentioned, this project was not designed for this analysis, instead this data was collected to establish baseline thresholds and inform future programming. The design and collection of the original data was decided upon and conducted within the parameters set forth by the Chain of Command and Human Performance cell. Within this specific instance the data was repurposed as a secondary analysis to explore the potential relationship between the metric collected and success on SFQC, this analysis occurred a full calendar year after its original collection. Because of the structure and oversight the Author has no indication that bias

impacted the results and he has made very attempt to remain critical in the analysis, interpretation and declaration of limitations.

Conclusion

The results of this study provide useful preliminary insight into members of a Special Operations unit. Continual year after year data collection will help illuminate the true relationship between the metrics examined and success throughout the qualification course. Additionally, members responsible for the design and collection of future testing are advised to critically evaluate their methodologies and metric selection in order to achieve a longitudinal, multi-dimensional and ecologically valid insight into this complex process.

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Appendix

Further Information on Test Protocols

Assault Bike: Calories were treated as an arbitrary unit. To ensure reliability 3 newly professionally assembled assault bikes were utilized. 3 controlled rotation pet minute (RPM) pacing trials were conducted at 2 minutes, 5 minutes and 10 minutes to ensure agreement of Calorie totals. All assault bikes were in agreement within 2 Calories for all 3 trials on all 3 ABs. 1 AB was selected for the participant trials, the seat height and positioning was self-selected by the participants.

The AB was selected for several logistical and rational reasons. To effectively conduct the time trials an exercise modality had to meet the criteria to minimize potential for harm and the level of skill required. Candidates entered this course with a large variance in running capabilities and the potential for injury on a high value asset was too great to justify the completion of a preferred running base test. In conjunction with this explanation, previous research has shown that aside from the Step Mill and Treadmill modalities the assault bike produced the highest physiological response at different reported RPEs (HR, VO2, Oxygen Pulse) (Jensen, 2018). As a result of these factors the administrators believed that the AB would be the most appropriate modality for assessing physiological capabilities of the participants regardless of skill level.

Isometric Mid-Thigh Pull: The IMTP has become recognized as the safe and effective alternative for physical performance professionals to assess full body force production capabilities. Research has shown that the IMTP is a reliable and safe method for evaluating peak force across varying populations (Moeskops, 2018, Lachlan, 2017). Previous research has also demonstrated a strong relationship between IMTP peak force and various dynamic strength exercises (Haff 2005, McGuigan 2006, Winchester 2008, 2010). Due to participants varied level of dynamic strength technique capabilities, safety and logistical ease of execution, the IMTP was selected

over other traditional modalities of force production assessment such as the Back Squat or Deadlift exercises.

Counter Movement Jump: The CMJ is an assessment of an individual's vertical power producing capability. This is an important assessment for evaluating the force producing and absorption capabilities of the participants. The qualities expressed during the CMJ are required for a variety of potential tasks presented to Special Operations (running, jumping, landing, clearing obstacles). The CMJ has previously been demonstrated as a reliable test for explosive power (Markovic, 2004) and an acceptable means for monitoring effects of training (Claudino, 2016). Further, Lombard et al, found that measuring CMJ using Force Plates possessed "sufficient precision to detect trivial to medium changes in neuromuscular function" (Lombard, 2017)

Neurotracker: The Neurotracker has been studied extensively with various conclusions regarding its efficacy as a training modality. Previous research has demonstrated that NeuroTracker training was associated with significant improvements in the adaptive dual n-back task (Oshin, 2017), improved concentration in Archery Athletes (Komarudin, 2020) and improved auditory reaction time in Collegiate Varsity swimmers (Snowden-Richardson, 2019) . Other studies have shown no significant transfer effect to executive functioning tests (Moen, 2018). The author of this article is very cautious when placing weight on the value of training with the Neurotracker system with the goal of far transfer. To the authors knowledge there have been no studies examining the Neuotracker as a baseline assessment or exploring it as a function of assessing the possible presence of underlying traits such as concentration, task switching and working

memory. As an exploratory exercise the Neurotracker was collected to begin examining these factors at baseline.

1 RM Pull Up: The Pull Up test has been repeatedly shown to be an effective assessment tool for upper body strength. Gabbett et all demonstrated that Semiprofessional Rugby League Players who were selected had a greater maximal pull up than those who were not (Gabbett, 2013). In research by Peyer et all NCAA division 1 hockey players who were high performers (coach identified) had significantly higher pull up scores than their lower performing counterparts (Peyer, 2011). Orr et al have previously demonstrated that chin ups were significantly and positively associated with selection success in Police Specialist Selection (Orr, 2018). The administrators of this test selected a maximal strength assessment as opposed to a repetition method because maximal repetition was previously collected during the initial assessment phase prior to selection and utilized as a “gateway” for entering selection.