



Diverse predictors of early attrition in an elite Marine training school

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ABSTRACT

Reconnaissance Marine training is deliberately difficult, to assure that graduates have the capabilities required to function successfully in the high-risk military occupational specialty. The majority of training attrition is due to voluntary withdrawal and previous research has identified certain predictive factors such as demographics, mental status, and physical performance. While some characteristics of training attrition have been identified, there is still a lack of understanding related to an individual's profile that is more apt to complete Recon training. Retrospective survey data was analyzed from 3,438 trainees within the Reconnaissance Training Company. Surveys were related to trainees' military recruitment history and other military experience, prior life experience, athletic experience, self-identified personality characteristics and motivations, and reasons for voluntary withdrawal if applicable, as well as physical performance metrics. Various demographic factors, self-reported hobbies, motivations, aquatic experience, and physical performance were associated with success in Recon Marine training courses. Subjects who voluntarily withdrew from training most commonly cited mental stress and aquatic rigor as the reason and less commonly cited reasons were physical and family reasons. These results could potentially increase training success, but more research is needed to understand the relationships between the observed trainee characteristics and success in elite warfighter training.

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What is the public significance of this article?—This study provides observational evidence showing that prior life experiences and predispositions are related to success in training and occupational selection. Findings can be used in support of adapting changes to selection criteria by taking a whole-person approach depending on military occupational specialty to improve training success and possibly retention.

Introduction

Training to become a Reconnaissance (Recon) Marine is deliberately difficult, to cultivate and assure that each graduate has the capabilities required to function successfully in the high-risk military occupational specialty (Saxon et al., 2020). These capabilities include physical, aquatic, and mental resilience. In Recon training, the majority of training attrition is due to voluntary withdrawal, referred to as a Drop on Request (DOR). Similar to other special operations training programs, most attrition occurs within the first month of training and averages between 25% and 40% of entering service

members (Farina et al., 2019; Saxon et al., 2020). While some characteristics of success and failure in training have been identified, there is still a lack of understanding related to the profile of an individual that is more apt to complete training and excel (Council on Foreign Relations, 2020; Department of Defense, O. of the D. A. S. of D. for M. C. and F. P., 2018).

Our previous research has shown that certain personality traits and daily ratings of physical and mental status can predict DOR's in the Basic Reconnaissance Primer Course (BRPC, now referred to as Reconnaissance Training and Assessment Program, RTAP – see *Appendix B*) (Saxon et al., 2020). This is in line with literature analyzing personality traits in military populations revealing that those with lower negative affect, trait anxiety, neuroticism, depression, hostility, and stress are more productive, more successful, and more likely to complete mission requirements, and that high performers tend to display higher levels of conscientiousness and extraversion (Detrick & Chibnall, 2006; L. T. Fatkin et al., 1997; Linda T Fatkin & Patton, 2008). Research has also

shown that selection and retention in challenging military programs is related to resilience, social support, self-efficacy, grit, and mattering (Eskreis-Winkler et al., 2014; Farina et al., 2019; Gruber et al., 2009; Kelly et al., 2014; Maddi et al., 2012).

A recent study by Farina and others found that physical performance measures were most predictive of training success, including road march times, land navigation coordinates found, run times, fitness test scores, obstacle course scores, and pull-ups. Notably, this study found that physiological markers such as basal cortisol were weakly predictive of success and weakly correlated with measures of physical and mental performance (Farina et al., 2019). However, our previous work did not find a significant difference between those who DOR and those who did not on the number of sit-ups performed or the 3-mile hike time, but it did find a significant difference between the groups on the number of pull-ups, and a trend toward significance between groups on the time on the 3-mile run (Saxon et al., 2020). A different study found that baseline and aerobic fitness predicted dropout during a short-term winter survival military training (Vaara et al., 2020).

In nonmilitary populations, demographic characteristics, such as age, gender, race, education, and work experience, have not necessarily been shown to be predictors of intentions for turnover (Harrington et al., 2001). However, some data suggests military attrition is related to military experience, marital status, and self-reported unit support during deployment (Vasterling et al., 2015). For example, one study of Special Forces Qualifying Course (SFQC) found that physical performance measures were most predictive of success, followed by demographic predictors such as officer or 18x enlisted status, having less than a year of service, at least a bachelor's degree, no children, and a single marital status that were also predictive of success. Not surprisingly Ranger school graduates were also more likely to be selected ($p < .05$) (Farina et al., 2019).

A previous study of Marine Corps Basic Reconnaissance Course (BRC) training data found that Physical Fitness Test (PFT) scores, cognitive ability measured by General Technical (GT) scores, and having some college education were predictive of success at BRC (Nowicki, 2017). Yet there is little contemporary knowledge on how prior life experiences, hobbies, and habits influence training school success and failure. For instance, very little is understood related to the effects on training of frequent video game play, that up to 40% of service members participate in after enlistment (Orvis et al., 2009, 2010). Irvine (2014) in the UK has shown that administering personality and vocational

interest assessments, compared to the ability test only, improved accuracy of predicting membership of different branches – especially for Royal Marines (combat) and Women's Royal Naval Service (mainly logistic and keyboard-related functions).

In order to obtain a more complete understanding and to define a profile of a trainee likely to be successful entering Reconnaissance training, we analyzed data related to prior life experience, self-identified personality characteristics and motivations, athletic experience, military recruitment history and other military experience, as well as physical performance metrics obtained within the Reconnaissance Training Company training itself. We sought to identify predictors of failure and success.

Methods

Participants

Since 2014, Marines and Sailors entering training are asked to complete a survey (Appendix A). Additionally, if trainees initiated a DOR, they were also asked to complete a second survey that asked why they withdrew. We consolidated and digitized paper records for analysis from four consecutive fiscal years (FY'16 – FY'19) of RTC surveys. During the study timeframe there were 3,438 trainees that entered the RTC training pipeline. Complete survey data was available for 2005 trainees (mean age $21.3 \pm 3.3SD$ [age reported $n = 1469$]) and Physical Fitness Test data were complete for 1,557 trainees. There was one change of command during the study timeframe and graduation rates did not differ between commands.

Structure of reconnaissance training

Initial training to become a Reconnaissance Marine, Marine Occupational Specialty (MOS) 0321, takes place at Reconnaissance Training Company (RTC), School of Infantry-West, Camp Pendleton, Ca. Since 2014, the training has been divided into two segments. The first segment is an initial 5-week Reconnaissance Training and Assessment Program, (RTAP). Upon successful completion of RTAP, trainees enter a 12-week Basic Reconnaissance Course (BRC). Over the years, and by intent, the majority of training events that result in trainee attrition, are introduced in RTAP, in order to consolidate attrition to the initial training interval. This approach is designed to assure best trainee safety and quality of training (Maj Zuber, personal communication, October 11th, 2017). Marines and Sailors arrive at Reconnaissance Training Company from two

pathways: 1) Recruiting station contracts (HZ, entry-level), and 2) Lateral movers (other Marine MOS, active officers, Navy enlisted). This research was conducted under Marine Corp HRPO and USC IRB (#HS-17-00729).

Measures

The archival student records consisted of entry-surveys administered during student check-in, exit-surveys upon graduation or upon being disenrolled from training, Marine Corps Training Information Management System (MCTIMs) data, and physical fitness data from graded events. The key outcome variables that were targeted were whether the subject graduated or dropped from the initial RTAP, and we also report graduation rates for Basic Reconnaissance Course (BRC).

Physical fitness tests (PFT)

All Marines undergoing Reconnaissance training are administered a PFT as an initial RTAP course requirement. It consists of pull-ups, crunches, and a 3-mile run.

Demographics

Demographic information is self-reported in the entry-surveys administered at the beginning of training. The demographic variables analyzed were: age, education level, and geographic area of hometown.

Survey responses

On the entry- and exit- surveys, trainees were asked questions about their experience with sports, hobbies, swimming, as well as other questions about why they decided to volunteer for Recon, what was the most challenging thing that they had ever done, and their reasons for “drop on request” (DOR), if applicable. Survey responses were hand-written by trainees at the beginning of RTAP. Survey responses were transcribed with the help of undergraduate research assistants. Each research

assistant was given a portion of randomly selected surveys and was asked to transcribe all responses exactly as written. Standard operating procedures and recurrent check-ins ensured consistency and accuracy.

Survey responses were qualitatively coded into categories determined by expert review of the data. Inter-rater reliability was established with high agreement according to multiple measures of chance-adjusted indexes of categorical agreement. Two raters independently coded all survey responses, and disagreements were resolved by consensus. Responses could contain multiple categories, so agreement metrics were computed based on whether raters included each category in their coding. See [Appendix A](#) for descriptions of the qualitative categories for each survey question response.

Statistical analyses

Analyses were conducted using R open-source statistical software. Logistic regression models were fit for each predictor to obtain odds ratios which were then converted to probability of graduating. Figures containing results show the probability of selection for each level within categorized predictors and 95% confidence intervals (CI) were displayed as forest plots. Each plot denoted the average probability of selection with a vertical dashed line. Labels displayed for each level included descriptive statistics (mean, standard deviation, and frequency). Physical performance predictors were categorized at quartiles. Quartiles of 3-mile run times were displayed in reverse order such that higher quartiles correspond to faster times. The number of trainees from each level of a predictor were displayed for categorical predictors.

Results

The success rate for completion of RTAP ranged from 19% to 35%. Graduation rates were much higher in BRC ranging from 50% to 85%. [Figure 1](#) shows graduation

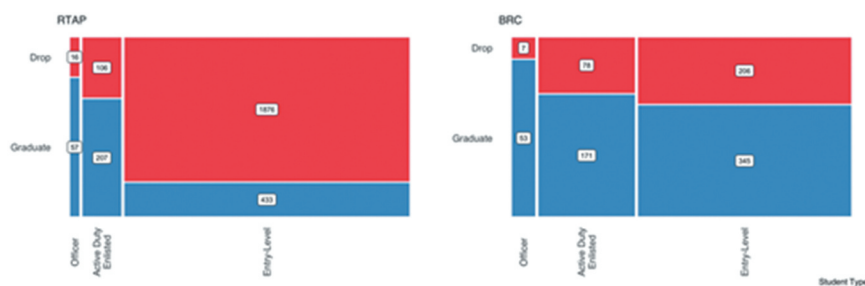


Figure 1. Course outcomes for RTAP and BRC displayed as a mosaic plot. Graduates are shown in blue and DOR's are shown in red, according to Marine characteristic of officer, active duty enlisted or entry level. Displayed data includes records of all course attempts by the study population (N = 2005).

status according to category for RTAP and BRC. In the initial 5-week RTAP phase, active duty enlisted and officers had a greater than threefold chance of successful completion of this phase compared to entry-level Marines. Entry-level Marines had 80% attrition rates in RTAP, primarily due to DOR's (70%). The majority of entry-level Marines that completed the RTAP Reconnaissance Training and Assessment Program course successfully went on to graduate the BRC training, although their graduation rates remained behind both active duty enlisted and officers. Officers are very

likely to complete both phases of RTC training. Graduation rates varied by year for RTAP (FY'16 = 35%, '17 = 22%, '18 = 19%, '19 = 31%), and BRC (FY'16 = 85%, '17 = 63%, '18 = 51%, '19 = 59%).

Physical fitness test

Figure 2 shows the probability of graduating RTAP based physical test standard assessments. For the pull-ups portion, trainees in the upper two quartiles were significantly more likely to graduate than average, while

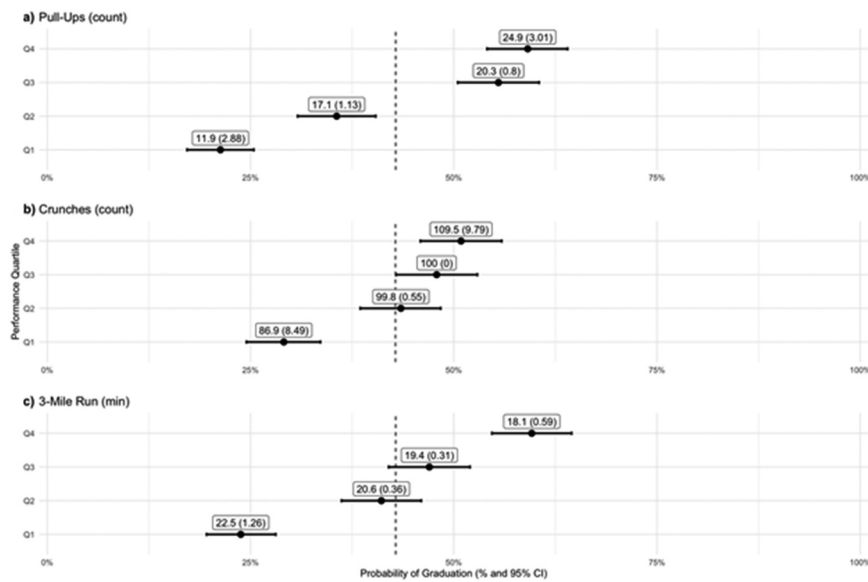


Figure 2. Probability of graduating the marine reconnaissance basic primer course according to physical performance predictors. Dotted line reflects the average probability of graduating. Points and error bars represent the probability of selection for each performance quartile with 95% confidence interval. Text labels show the mean and standard deviation of the performance for each quartile. (a) Pull up count, (b) number of crunches, (c) Run time minutes displayed in reverse order since lower quartiles correspond to faster times metric.

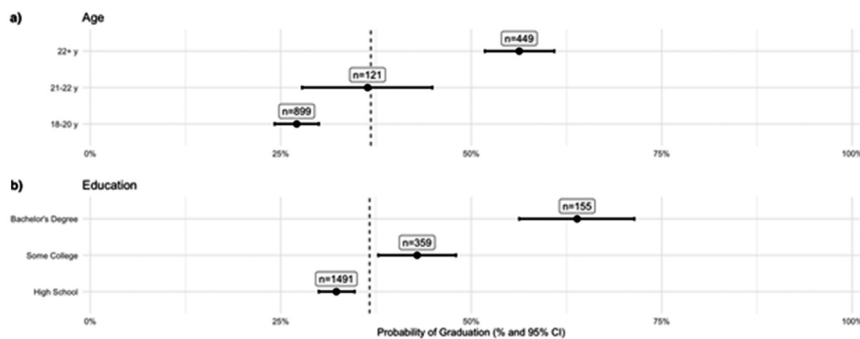


Figure 3. The probability of graduating BRPC according to demographic predictors is shown in Figure 3. Dotted line reflects the average probability of graduating. Points and error bars represent the probability of selection for each demographic category with 95% confidence interval. Age was a strong predictor of BRPC successful completion. The youngest Marines (18–20 years) had a < 50% probability of success whereas Marines greater than 22 years of age had >50% probability of success. Education was also a strong predictor; a college degree was associated with a greater than 60% chance of BRPC completion whereas only a high school degree had less than a 50% chance of success.

those in the lower quartiles were significantly more likely to fail. For all assessments, better performance was associated with graduation.

Demographics

Figure 3 shows the relationships between demographic characteristics and probability of graduating RTAP. Age was categorized into three age groups. Older trainees were significantly more likely to graduate compared to those 20 years or younger. A college degree or some college education was also associated with graduation success.

Hometown

Cell phone area codes were used to estimate the geographic location of the trainee's hometown. The log ratio (grad/drop) of course graduation was computed for each area code. Figure 4 shows the number of trainees from each area code depicted as circle size and fill color represents the grad/drop log ratio.

Survey responses – hobbies & athletic experiences

The relationship between the probability of success in RTAP and entry survey responses to a) hobbies, b) high school sports, c) family military history, and d) swimming experience are displayed in Figure 5. Hobbies that were most associated with probability of success were aquatic and running. Arts and video games were associated with a less than 20% likelihood of RTAP completion.

Survey responses – motivation and challenges

Entry survey answers' relationship to graduation probability are shown in Figure 6. No single reason listed was associated with a more probable chance of success. Those Marines giving a combination of reasons were associated with a greater than 50% chance of success. Entry-level Marines who identified a recruiter's suggestion as the reason for volunteering for Recon training have less than a 15% chance of RTAP successful completion. Marines identifying athletic or adventure activities as the most challenging events in their life were more likely to graduate compared to those identifying leaving family or a family tragedy, who were less likely to graduate.

DOR reason

Of the 2005 Marines who completed entry surveys, 826 were DOR's in RTAP and 366 (44.3%) completed the "Why did you DOR?" survey question. Table 1 lists the reasons disclosed for the DOR. Mental stress and aquatic rigor were the most common reasons for DOR. Less commonly cited were physical and family reasons.

Discussion

The results of our large study, based on Marines volunteering for Recon training, identify novel profiles of Marines that are both likely and less likely to complete the training. Since the initial 30-day RTAP course must be successfully completed to advance to BRC, our findings related to RTAP graduation rates are most relevant.

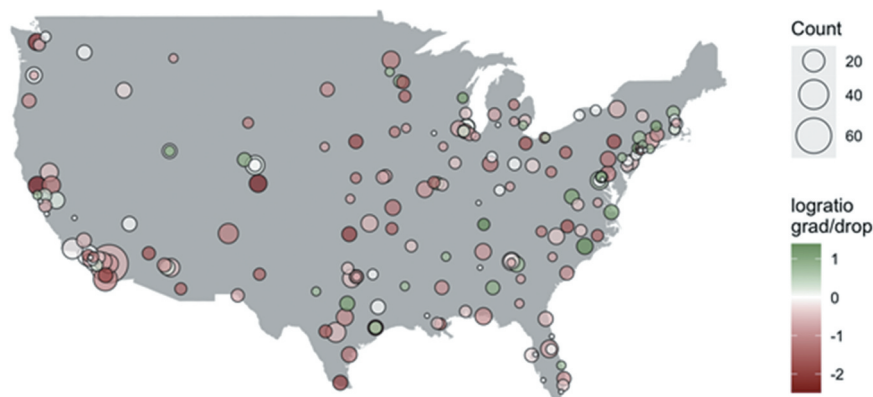


Figure 4. Trainee hometown area codes. Size of the circle on the map indicates the number of trainees and the circle color from red to green reflects the probability of failure versus success in RTAP. Successful trainees are clustered in the North Atlantic and Mid Atlantic coasts and parts of the South. Westcoast origin is less associated with success. Other areas producing successful graduates include the Northern Lakes and Southwestern states.

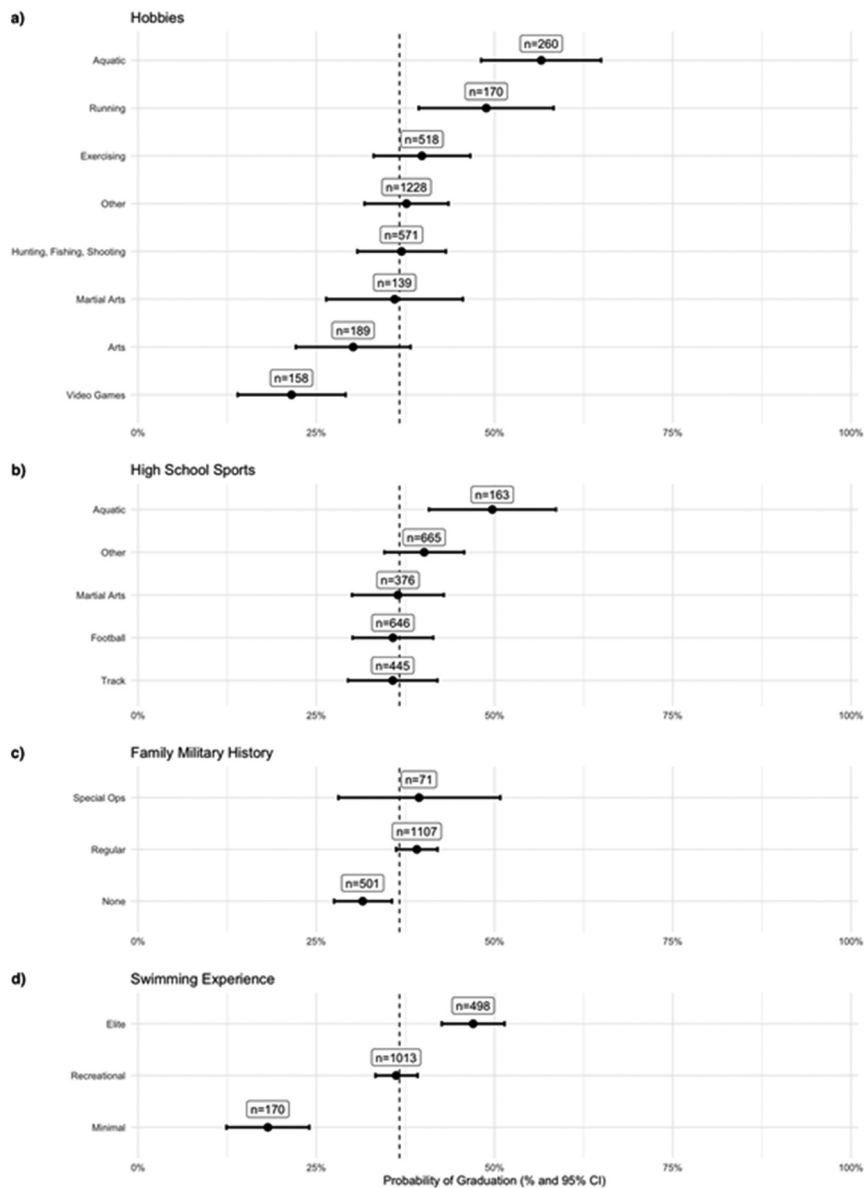


Figure 5. Probability of success in RTAP based on the entry survey responses to a) hobbies, b) high school sports, c) family military history, and d) swimming experience. Aquatic and running hobbies were most associated with probability of success whereas arts and especially video games were associated with a less than 20% likelihood of RTAP completion.

Physical training scores were predictive of success only if trainees were in the upper quartiles of scores in pull-ups, crunches, and timed runs. This is consistent with findings from a study performed on Soldiers undergoing Special Forces Assessment and Selection course, that found that better scores predicted graduation from the initial 19- to 20-day assessment. Graduation from Ranger School and a college degree also predicted selection in that study (Farina et al., 2019).

Officers constituted less than 5% of the study population, and were underrepresented as compared to the larger Marine Corp where the Enlisted to Officer to ratio is eight to one (Department of Defense, O. of the D. A. S. of D. for

M. C. and F. P., 2018). Nonetheless, officers had an 80% chance of graduating, whereas entry-level enlisted Marines, accounting for over 90% of the study subjects, had an 80% chance of failing. Lateral movers, or enlisted Marines with experience in another military occupational specialty (MOS), had a 30–65% chance of RTAP completion. While the Marine Corps has the highest percentage of enlisted personnel 20–24 years of age (70%), compared to other US Services, our data supports the notion that, within that group, there is a maturation gradient (Council on Foreign Relations, 2020). Both age greater than 22 years and some exposure to higher education after high school are associated with higher-than-average graduation rates.

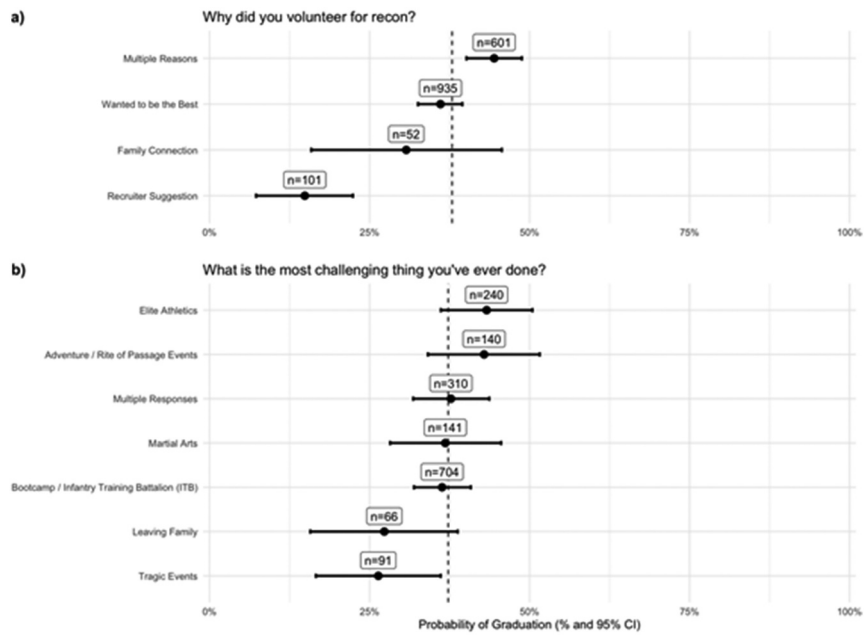


Figure 6. Probability of success in RTAP based on the entry survey responses to a) Why did you volunteer for Recon?, b) What is the most challenging thing you've ever done?

Table 1. Reasons for drop on request.

Why did you DOR? (n = 366)	n (%)
Can't (mental)	156 (43)
Aquatic Rigor	108 (30)
Can't (physical)	57 (16)
Family	36 (9)
Other Reason	9 (2)

Our data showing that place of origin may be predictive of Recon training success is interesting when compared to general demographic data for services recruitment (Department of Defense, O. of the D. A. S. of D. for M. C. and F. P., 2018). The top five states for enlisted recruits as a percentage of eligible 18–24 years of age are South Carolina, Georgia, Hawaii, Florida and Virginia. Our data showing higher graduation rates from other Mid-Atlantic states suggest these may be potential targets for Recon recruitment, if the other factors of success are also identified. The explanatory variables for these findings should be targets for future research.

Self-reported hobbies that were more sedentary, including video games and arts, were associated with lower graduation rates. In contrast, some but not all active hobbies were associated with higher graduation rates, especially swimming. Analysis suggests that an ideal Recon trainee has a history of

physical activity at a high level, as well as a strong comfort level in the water, even when compared to a history of martial arts or hunting as a hobby.

The survey data identifies another key aspect of RTAP training success, that is advanced aquatic experience. Those Marines that could identify a significant amount of competitive swimming or lifeguard experience were much more likely to graduate RTAP. This is consistent with our prior study that identified that many DOR's in RTAP were associated with temporal proximity to an aquatic training event (Saxon et al., 2020). Also, for those who did DOR as a reason for failing to graduate, 30% cited the rigor of aquatic training as the reason for the drop. These findings support consideration for an advanced swimming prerequisite assessment or training prior to entering the RTC pipeline.

Our finding that if an entry level Marine, cites a recruiter's suggestion as the primary motivation for wanting to become a Recon Marine, this can be regarded as a major predictor for lack of success in the course. Marines who could identify multiple reasons for wanting to become a Recon Marine were most apt to succeed, most likely reflecting a deeper thought process behind the decision to volunteer.

Finally, survey data identifying that 43% of all DOR's due difficulty coping with the mental stress of training supports the notion that a more experienced Marine

may be required for this training course. This is also supported by the increased graduation rates of lateral movers compared to entry-level Marines. We were not able to investigate whether these findings are directly associated with psychological or cognitive maturity, but suggest this as a target for future research.

Limitations

One limitation of this study is the lack of data on other cognitive test scores such as the ASVAB cognitive or TAPAS personality assessment (Hughes et al., 2020; Nowicki, 2017). Future studies should consider including these measures, in addition to those reported here to obtain even more fidelity to best identify successful candidates for particular military, but also to help best match recruits to training schools and MOS to optimize success. Additionally, due to the fact that the data were retrospective in nature we were not able to control for bias arising from incomplete survey data. While surveys were available for the majority of trainees going through Recon training – and the attrition rate of the analyzed subset of data was similar to the complete cohort, we were unable to determine whether our results were biased by potential selection effects. Consideration of this issue is important particularly for the exit survey data where responses to “why did you DOR?” were only available for less than half of those who chose to voluntarily drop the course.

Conclusion

This study, which aggregates individual motivation, demographic characteristics and training scores, performed in a large and contemporary cohort of Marines, identifies several important and novel criteria for success and failure. These data can be leveraged to best apply military resources and to help align service member experience and talents to training and MOS.

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Due to the retrospective nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data is not available due to ethical reasons.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix A

The following displays the question topics and qualitative answer categories for the surveys.

Question Topic	Qualitative Answer Categories
High School Sports	Aquatic
	Football
	Track
	Wrestling
	Other
University Sports	None
	Aquatic
	Football
	Track
	Wrestling
High School Clubs	Other
	None
	Academic
	Aquatic
	Football
University Clubs	Military
	Track
	Wrestling
	Other
	None
Hobbies	Academic
	Aquatic
	Football
	Military
	Track
Swim Experience	Wrestling
	Other
	None
	Aquatic
	Arts
Workout Experience	Exercising
	Hunting, Fishing, Shooting
	Martial Arts
	Running
	Video Games
Why did you volunteer for Recon?	Multiple
	None
	Elite
	Recreational
	None
Why did you volunteer for Recon?	True
	False
	Familial Connection
	Recruiter Strongly Suggested
	Wanted To Be The Best
Why did you volunteer for Recon?	Other

(Continued)

(Continued).

Question Topic	Qualitative Answer Categories
What is the most challenging thing you've ever done?	Adventure/Rite Of Passage Athletics Bootcamp/Infantry Training Battalion/Marine Combat Training Leaving Family Making Weight Tragic Event Other
Do you have any prior military experience or do you have any family members who have served in the military?	Special Operations/Special Operations Capable Regular None
Why did you DOR?	Aquatic Can't (Physical) Can't (Reasoning) Family Other

Appendix B

In January 2020, the Basic Reconnaissance Primer Course (BRPC) was restructured and renamed as the Reconnaissance Training and Assessment Program (RTAP). This restructuring condensed the previous program of instruction (POI) to allow for the inclusion of ten days of land navigation training. Our usage of RTAP in lieu of BRPC is for consistency with the modern, executed POI.