


# Relations of personality factors and suitability ratings to Swedish military pilot education completion

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## Abstract

Improved understanding of what it takes to be a pilot is an ongoing effort within aviation. We used an exploratory approach to examine whether there are personality-related differences in who completes the Swedish military pilot education. Assessment records of 182 applicants, accepted to the education between the years of 2004 and 2020 were studied (Mean age 24, SD 4.2 96% men, 4% women). Discriminant analysis was used to explore which personality traits and suitability ratings might be related to education completion. Analysis included suitability assessments made by senior pilots and by a psychologist, a number of traits assessed by the same psychologist, as well as the Commander Trait Inventory (CTI). The resulting discriminant function was significant (Wilk's Lambda = 0.808, (20) = 32.817,  $p = .035$ ) with a canonical correlation of 0.44. The model was able to classify 74.1% of sample cases correctly. The modeling suggests that senior pilot assessment and psychologist assessment both predict education completion. Also contributing were the traits energy, professional motivation, study forecast and leader potential.

## KEYWORDS

aviation, education, military, personality, selection, suitability

## Practitioner points

What is already known about this topic?

- Understanding what it takes to become a military pilot has been researched for a long time, with profiling commonly using the five-factor model in recent years.
- Personality trait patterns of pilots have been relatively well-established and noted as predictors of education outcomes in particular populations (e.g., US Air Force).

What does this paper add?

- Our study utilizes assessment data from the selection process for the Swedish military pilot education.

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- The Swedish system has its own specific selection process and adds new insights as personality traits and suitability are not assessed by the measures used in previous studies.

The implications of your study findings?

- The results of our study highlights the strength of general suitability assessments by senior pilots and psychologists as measures of military pilot cadets' potential.

Initial forays into measuring pilot suitability can be traced as far back as the time just after the First World War (Dockeray & Isaacs, 1921). Since then, there has been a long-standing interest in understanding what characterizes a good pilot and how to identify them (Hunter & Burke, 1987). Military aviation comes with additional critical factors when compared to general aviation, including greater risk for humans to come to harm as well as matters of national and international security (Pamplona & Alves, 2020). As training military pilots is a long and costly process, it becomes very important to be able to identify, recruit and train suitable candidates that have both the necessary skills and the characteristics to stay in the profession.

When assessing applicants, cognitive and personality tests are commonly used to select military pilot training candidates (see Martinussen & Hunter, 2017 for an overview). While much supporting research on the use of these tests is classified, open research exists; both cognitive and personality-based tests are significantly related to education outcome (Hunter & Burke, 1994). Meta studies indicate that cognitive tests are strong predictors of succeeding in military pilot training (see, e.g., Martinussen, 1996). While cognitive tests might well reflect one's assimilation of procedural flying knowledge (Martinussen & Hunter, 2017), the relation between personality, training success and working in the profession afterwards still needs further research. Indeed, early aviation researchers like Sells (1956) argued that beyond learning to be a pilot, personality might be more indicative of professional success in the long term. We suggest striving for a holistic (accounting for both cognition and personality) approach to military pilot education studies that does not discount the role of personality. To eventually arrive at such an approach, the less acknowledged factor of personality is the focus of the current study.

Previous research has not indicated an unimportance of personality factors, though they have been less predictive than cognition in becoming a pilot (Martinussen, 1996). In addition, recent examinations have suggested that the relevance of personality in military aviation might be greater than previously assumed as job performance ratings after education were found to relate to personality measures (Barron et al., 2016). Further, a job analysis of international fighter-pilot demands highlighted the importance of personality traits such as aggression, emotional stability, and risk taking (Carretta et al., 1993). Defining personality within the modern context of trait theory, these traits manifest as characteristic patterns of feelings, thoughts, and behaviors (Kassin, 2003). While various trait theories have been suggested and used over time (Allport & Odbert, 1936; Cattell (1957);

Eysenck & Eysenck, 1984), the prevalent model is, the five-factor model, which categorizes personal tendencies into five dimensions: openness (e.g., curiosity and creativity), conscientiousness (e.g., goal orienting, and perseverance), extroversion (e.g., sociability and energy), agreeableness (e.g., sympathy and compassion), and neuroticism (e.g., sensitivity and nervousness), which all are assessed on continuums (McCrae & Costa, 1987).

Research into the relationship between personality and general job performance suggests that personality measures can be used successfully in general personnel selection (Barrick & Mount, 1991; Rothstein & Goffin, 2006), but that the specific circumstances must be considered. Retzlaff and Gibertini (1987) noted that the personality of a military pilot needs to fit in with military life in general and to support the act of piloting and battling. A meta-analysis by Campbell et al. (2009) included a sample of 26 American studies on personality in relation to aviation training outcomes. The results suggest neuroticism, one of the big five, as a dimension most significantly related to failing training, while extroversion was most related to success. Additionally, later studies have shown that less aggressive, less impulsive, and less risk-taking individuals tend to drop out of training voluntarily more often, while those who are successful are more goal-oriented and confident (King et al., 2012). Relating to goal orientation, military pilots have also been shown to be driven by strong internal motivations (Walsh et al., 2017) and to be highly conscientious (Campbell et al., 2009).

In addition to previously mentioned security and safety concerns, education of military pilots also requires a time and resource commitment by the educational body and student. Dropouts and separations are especially costly in the military and other organizations, for which selection is crucial, but it is also costly for the individual regarding time spent. This further motivates for studies on military pilot selection processes, an area in which more research is required; a holistic image of the interaction between cognitive ability and personality has yet to be produced and could provide clearer information about why some drop out or are unable to complete training. In addition to building on previous research, there is a possibility for this study to uncover new, unobserved factors that might affect education outcomes based on differences between military pilot populations and their training. Previously mentioned research results are mainly conducted on American (Barron et al., 2016; Campbell et al., 2009) and Norwegian (Skoglund et al., 2021) pilot populations. Differences between these populations and the Swedish, based on variance in internal selection criteria and/or differences in education models, might carry factors

unaccounted for or yield differing results. The way of the Swedish model is to screen extensively before admitting applicants that are then expected to complete the education, as compared to ongoing selection during education in other models. This further motivates our research and this study.

In Sweden, the Special Selection Department at the Swedish Armed Forces Human Resources Centre collects test data on numerous aspects during the selection process for military pilot education, including cognitive abilities and aspects related to personality. This study is intended to further the understanding of how various personality factors might relate to military pilot education outcomes. We examine personality traits related to officer suitability (self-rated), psychologist-assessed personality traits related to military aviator suitability, and general military aviator suitability ratings based on psychologists' and senior pilots' observations (interviews). Hence, our research question is as follows: Do personality variables and suitability ratings relate to pilot cadets completing military aviation education?

## 1 | METHOD

The study was accepted by the regional ethics board (Dnr: 2019-02908) and by the Swedish Armed Forces.

### 1.1 | Study population

The Special Selection Department at the Swedish Armed Forces Human Resources Centre provided a data set which included entries for 4991 military pilot applicants from the Swedish register. Applicants had fulfilled all necessary requirements, such as having Swedish citizenship, having had satisfactory grades in basic schooling, having been approved in all comprehensive basic military examinations, and having completed all basic military conscription service. The provided data contains pilot aptitude test results for military pilot applicants and education status for pilot candidates between 2004 and 2021.

Eligible participants for this study were all applicants who had been accepted for officer education with an aviation profile (including military pilot training) and who had records of education completion or termination. After exclusion, the study sample comprised of 182 individuals (mean age = 24, SD = 4.2; 96% men, 4% women) who had been selected for military pilot training in the Swedish Air Force. Of the 182 pilots in the sample, 36 did not complete their education (19.7%). There were some cases of missing data, and as such, analysis included 135 passing students and 31 failing.

#### 1.1.1 | Summary of Swedish military pilot selection procedure

Individuals who want to apply to the Swedish military pilot education must complete a basic military conscription test. Applicants that pass screening based on conscription test scores may be called to the

military pilot selection testing, which is divided over multiple days. A military national aptitude test (Militärhögskoleprovet, MHS), cognitive tests, pilot aptitude tests and personality inventories are administered on Day 1, based on which further screening is conducted. Applicants passing to the next stage are interviewed on Day 2 by psychologists and senior pilots, who later act as a commission, conducting further screening. Aero-medical examinations of passing applicants are carried out on Day 3, after which several additional stages of commission conclude in the eventual admission of applicants to one of the different branches of military pilot education (fighter, transport, and helicopter). The personality inventories of Day 1 testing and interview results of Day 2 are what results in the measures of the current study, explained further in the following section.

## 1.2 | Measures

### 1.2.1 | Education completion and termination

Education termination is noted in the data set. Education termination can take the form of dropping out or separation. In this case, dropping out is the voluntary choice of terminating one's education based on personal motivations. Separation can occur based on abnormal training progression or compatibility issues. A binary classification variable was made, indicating whether each cadet completed training.

### 1.2.2 | Commander Trait Inventory (CTI)

The CTI is an 11-scale personality inventory that assesses cognitive style (six scales) and officer-relevant personality aspects (five scales; Table 1; Carstedt and Widen [2000]). All scores are Stanine-transformed (Thorndike, 1982). It should be noted that CTI scores are used to establish a personality profile and that the highest score (9) is not necessarily strictly better. In fact, it is desirable for egocentrism, impulsiveness, and ethnocentrism to be relatively low.

### 1.2.3 | Psychologist assessment

Licensed psychologists employed by the Swedish Armed Forces, with extensive training and experience in assessing pilot suitability, rated cadets after a semi-structured interview (90 min) on seven specific attributes and gave an additional general rating of suitability. Multiple psychologists were involved in the assessment procedure and the Special Selections Department considers inter-rater reliability throughout the process. Psychologists rated candidates' social ability, energy, emotional stability, maturity, leadership potential, and professional motivation, while also giving a study forecast rating. Social ability involves basic socialization, communication, and the ability to establish and maintain relationships, both in a general sense and with specific regard to being an officer. Energy encompasses

**TABLE 1** CTI subscales, number of items and sample items.

Scale	Number of items	Sample item
Sensation orientation	15	I seldom miss an opportunity that provides a challenge
Intuitive decision-making	12	I often see possibilities where others see difficulties
Concrete thinking	12	Concrete facts are the only things that matter
Abstract thinking	16	I spend quite a lot of time thinking and reflecting over different things
Superficial value orientation	14	I keep up with all new trends
Ideological value orientation	11	It is important to formulate your own ideals and to live by them
Empathy	15	I often comfort colleagues who have problems
Leader motivation	15	I am suited for leading positions
Egocentrism	14	My main purpose in life is to get as many goodies as I can
Impulsiveness	14	I quickly lose interest in tasks that I initiate
Ethnocentrism	9	There will be problems if immigrants to a greater extent come to command Swedes

Abbreviation: CTI, Commander Trait Inventory.

drive, initiative, perseverance, and stress tolerance. Emotional stability is a matter of impulsivity and aggression tendencies. Maturity encompasses humility, reflectivity, responsibility, and lack of prestige. Leadership potential covers the will to lead, teach, and develop other individuals while being diplomatic and motivating. Professional motivation involves the candidate's motivation to fly specifically and to work in an army context. Study forecast includes being conscientious, enjoying learning, and understanding the context of the education and work that the candidate is about to undertake. All ratings were given on a 1–9 scale.

### 1.2.4 | Senior pilot suitability assessment

Experienced senior military pilots assessed cadets' general suitability for the pilot profession. The assessing pilots made their assessments based on what they know of demands and expectations for cadets during education and their following profession. All ratings were given on a 1–9 scale.

### 1.2.5 | Statistical analysis

Descriptive discriminant analysis (DDA) was used in an explorative approach to understanding possible effects on education completion. DDA represents an attempt to assess variable importance by creating discriminant functions to explain group membership (completion or termination). In predictive efforts, it would be expected to optimize for a model with the highest classification power. However, because this is an exploratory approach, we included every assessment measure to note their relation to the discriminant function. Modeling included the binary education variable (completion/termination) as a grouping variable and the 11 CTI subscales, seven psychologist-assessed traits, and suitability ratings by psychologists and senior pilots as independents.

Independence of observations and approximate normal distribution of variables was established. Correlation and multicollinearity were controlled for. Psychologist suitability ratings and psychologist assessed traits were significantly related, but VIF values were <3, suggesting no concerning levels of multicollinearity.

## 2 | RESULTS

Both groups displayed high scores and similar variations on most variables (e.g. energy, emotional stability, and maturity) and lower scoring on variables where expected (i.e., ethnocentrism and impulsivity). Descriptive statistics of all personality factors are presented in Table 2.

Because of the binary dependent variable of education outcome (completion vs. termination), the analysis naturally results in a single discriminant function.

The discriminant function was found to be statistically significant ( $\Lambda = 0.808$ , [20] = 32.817,  $p = .035$ ). The canonical correlation is 0.44 and the squared canonical correlation is 0.19, indicating that 19% of variances can be explained by the relationship between predictors and group membership via the discriminant function.

As displayed in Table 3, the variable most heavily related to the discriminant function is senior pilot suitability rating, followed by the traits of energy, professional motivation, study forecast, leader potential, and the general psychologist suitability rating. Testing does not support significant group differences based on emotional stability ( $\Lambda = 0.978$ , [1] = 3.652,  $p = .058$ ) nor empathy ( $\Lambda = 0.978$ , [1] = 3.644,  $p = .058$ ). None of the other variables beyond the primary six in the structure matrix display significant group differences, either.

Classification using the discriminant function resulted in correct sorting in 74.1% of the cases. Performance in predicting membership in the completion and termination groups was about equal, with a slightly higher error rate in terms of predicting passing students as failing compared to the error of predicting failing students as passing (Table 4).

**TABLE 2** Means and standard deviations for CTI scores, personality traits ratings, and suitability ratings, by education outcome.

Assessed Factors	Category	Completion		Termination	
		Mean	SD	Mean	SD
Sensation orienting	CTI	5.5	1.62	5.49	1.50
Concrete thinking	CTI	6.15	1.55	6.03	1.67
Intuitive decision-making	CTI	6.24	1.64	5.89	1.57
Abstract thinking	CTI	4.68	1.62	4.74	1.65
Superficial value orienting	CTI	5.27	1.66	5.11	1.64
Ideological value orienting	CTI	4.49	1.72	4.40	1.67
Empathy	CTI	5.94	1.71	5.34	1.70
Leader motivation	CTI	5.43	1.60	5.17	1.12
Egocentricity	CTI	4.34	3.60	3.91	1.52
Impulsivity	CTI	3.90	1.59	4.23	1.44
Ethnocentrism	CTI	2.90	1.59	2.86	1.61
Social abilities	Trait	6.62	0.83	6.36	0.64
Energy	Trait	6.78	0.93	6.22	0.64
Emotional stability	Trait	6.70	0.86	6.39	0.60
Maturity	Trait	6.58	0.89	6.36	0.80
Leader potential	Trait	6.17	0.91	5.81	0.58
Professional motivation	Trait	6.54	0.99	6.06	0.86
Study forecast	Trait	6.91	0.93	6.53	1.00
Psychologist suitability rating	Suitability rating	6.71	0.75	6.36	0.54
Senior pilot suitability rating	Suitability rating	7.01	0.72	6.50	0.62

Abbreviations: CTI, Commander Trait Inventory; SD, standard deviation.  
Note. All measures are scored on a 1–9 scale.

### 3 | DISCUSSION

We set out to examine whether education completion is related to personality attributes and suitability ratings in Swedish military pilot education. Based on the comprehensive sampling and highly selective criteria for selection, both those that were terminated and those that completed the education were high performers and had similar scores. However, our results suggest that several of the factors from the selection process are related to education completion. The analysis shows that senior pilots' interview-based ratings of cadet suitability are most strongly related to education completion. This is followed by the various traits observed during

**TABLE 3** DDA structure matrix.

Assessed factors	Function 1
Senior pilot suitability rating	0.598
Energy	0.551
Professional motivation	0.428
Study forecast	0.388
Leader potential	0.376
Psychologist suitability rating	0.372
Emotional stability	0.306
Empathy	0.306
Social ability	0.228
Impulsivity	-0.192
Superficial value orienting	0.183
Intuitive decision-making	0.179
Maturity	0.169
Egocentricity	0.137
Leader motivation	0.118
Ethnocentrism	0.113
Abstract thinking	-0.071
Sensation orienting	0.037
Concrete thinking	0.025
Ideological value orienting	-0.001

Note:  $N = 166$ .

**TABLE 4** Classification results.

Termination (1) versus completion (0)	Predicted group membership		Total
	0	1	
Count 0	98	37	135
1	6	25	31
% 0	72.6	27.4	100
1	19.4	80.6	100

Note: 74.1% of original grouped cases were correctly classified.

the psychologist interview: energy, professional motivation, study forecast, and leader potential, as well as the general psychologist's suitability assessment.

Ratings from senior professional pilots contributed most to the outcome. This is underpinned by the logical assumption that active, experienced pilots are aware of expectations and demands during education, and in the profession beyond it. Our results support this notion and highlight the insight of these pilot assessors, similar to the observations of Barron et al. (2016). The results also support a broadened approach to military pilot selection, as a less studied factor provides the most significant prediction in our study.

In order: energy, professional motivation, study forecast, and leader potential are the psychologist-assessed traits that appear to be most related to education outcome. Energy encompasses initiative, perseverance, and stress tolerance, and the strong relation of this variable to education outcome could be emphasized in relation to previous studies that have relied on the five-factor model traits (Campbell et al., 2009; King et al., 2012). Indeed, low stress tolerance (higher neuroticism) has been found to relate to failure to finish aviation training, and higher conscientiousness has been connected to success. Professional motivation has also been examined in the context of military aviation (Walsh et al., 2017). These previous results suggest a higher degree of intrinsic (internally driven) motivation for pilot cadets, and our results suggest that the higher the motivation, the more likely the cadet is to persevere through the education. This is in line with the findings of Campbell et al. (2009) that note higher levels of conscientiousness, and as such goal orientation and perseverance, in military pilots completing training. This is also in agreement with research on motivation in relation to study and work performance (Liu et al., 2012; Locke & Latham, 1990). Leadership potential (diplomacy and motivation), as a significant trait contributing to success, can be related to previous mentions of the importance of motivation. In addition, the diplomatic aspect can be related to the facet of openness from the five-factor model, which has been shown to be higher than normal in some pilot populations (King et al., 2012). The traits found to be significant in our study can all be related to results found for personality traits in previous research, for which there is some conceptual overlap. It should be noted, however, that the Swedish trait model is not based on the five-factor model. As such, the level of overlap cannot be specified without further targeted studies.

At this stage of exploratory research, the smaller contribution of the general psychologist suitability rating should probably not be underscored. The trait scores, which are rated by the same psychologists, carry more specificity, and they might be more strongly related to outcome than a more general end variable, as was observed. This contrasts with the senior pilot suitability ratings, which only have one value. Further, regarding the significance of psychologist suitability judgements, these are a significant part of judging which applicants are allowed to start the military pilot education in the first place, and their judgements are based on significant amounts of experience as well as internal, classified statistical support. Both the psychologist assessment and other pilot aptitude testing are designed to identify trainable individuals who are supposed to make it through training and qualify as professional pilots in the future. In this way, it is imaginable that these assessments could retain some relation to success beyond the initial selection, which our results support.

This study provides insight that supports and adds to previous findings. Assessment of cadets by observers has been researched in a few studies, in which personality and performance have been related to cadet ratings (Barron et al., 2016; Skoglund et al., 2021). Professional assessment has not previously been found to be more strongly related to pilot success than other personality assessment,

however, highlighting again active pilots' proficiency of understanding the demands and expectations of pilot students.

Our results did not show relations between CTI subscales and education completion, suggesting that the predictive power of this inventory is spent during entry assessment. It is noteworthy that neuroticism, which has been tied to failed education (Campbell et al., 2009) has a similar subscale to the impulsivity subscale of the CTI. The lack of relation between impulsivity and education completion could possibly depend on the two scales not measuring the same construct. It is also important to note that our results cannot be interpreted to indicate that statistically insignificant variables, such as CTI scores or psychologist-assessed maturity, are unimportant in all stages of selection; these were still used to screen applicants, and excluding participants below cutoff points helped identify candidates successfully in the earlier stage.

It is interesting that the observed significant factors related to education completion retain some power after they have been used in the selection of candidates during applicant assessment. Previous research has provided this insight for military aviation organizations in other countries, and the current findings suggest that, for the Swedish Air Force, there is still more to understand about how to select military pilot candidates.

Some previous research has suggested that various personality-related measures are the least significant in predicting pilot performance when compared to cognitive and psychomotor measures (Martinussen, 1996). Our results support the insights of Barron et al. (2016) in providing a relatively stable basis for personality measures being significant. A possible reason for this significance may be the reliance on a separately developed framework that does not strictly relate to the five-factor model, which has been the major personality consideration in previous research. However, regardless of what level of importance personality traits are granted in terms of education completion, cognitive abilities remain strongly related as well, according to earlier research (Carretta et al., 2014; Martinussen, 1996). We argue that there might be a need for a more holistic approach to the understanding of pilot profiling that does not separate the efficacy of cognitive abilities and personality but rather attempts to interpret them together. Future studies on Swedish military pilot education should combine these identified relevant personality factors with cognitive testing to complement research such as that by Carretta et al. (2014) and provide a broader picture of assessment in relation to completion.

### 3.1 | Strengths and limitations

Discriminant analysis is commonly relied on for predictive statements (predictive discriminant analysis), but we would like to underscore the present use of discriminant analysis in an exploratory manner with the current DDA approach. It is not the aim of this methodology to establish a strong predictive model for education completion, but rather to start examining the relations of the factors to this variable. Optimizing the classification model by, for example, adjusting



included variables is as such outside of the purview of this exploration. In the case of predictive discriminant analysis modeling, a 74.1% prediction rate with about equal Type 1 error rates across groups would certainly not be sufficient to influence, for instance, choices about selection reform. For the current purpose however, it is informative regarding patterns and our understanding of relations.

A primary concern for a study of this nature is that of the restricted range of the sampled population. Participants display rather similar profiles (see Table 2). Had a larger variability been present, other results might have been observed. The narrow range is the result of the rigorous selection process of the Swedish system. The relatively small number of terminations might also be a vector for confounding results similarly to restriction of range, hiding effects which might have been found with a larger sample. The uneven group sizes for completions and terminations in the current data set is a limitation and could also be of potentially larger concern if one were to attempt predictive discriminant modeling, as discriminant analysis is generally considered strongest with equal size groups.

Regarding the analysis, the addition of a third grouping category (i.e., separating the failing cadets into voluntary dropouts and separations) would have enabled the DDA to construct two discriminant functions. Two discriminant functions could yield a different structure matrix for variable impacts on education completion, but this division of the outcome variable was not possible to conduct with the available data due to a reduction in statistical power. Future researchers might want to consider this division, if possible. This is not only an important suggestion for statistical reasons; voluntary termination could possibly be influenced by a cadet's level of motivation or energy, while separation could occur because of issues with progressing through training at expected rate. Variation in the profiles of these types of termination results could thus logically be expected and are appropriate topics for future research.

Further notes for future research include types of pilots being educated; the Air Force trains fighter pilots, transport pilots and helicopter pilots. Demands for these professions are certainly different, while they all remain within a military context. It would be informative to distinguish between the types, but this was not supported in the current data set. Despite this, and previously listed limitations, the current study is uniquely valuable in examining previously unstudied measures in an ecologically valid manner.

## 4 | CONCLUSION

Our results carry a first indication of the value of senior pilot judgements in selection, in addition to psychologist judgements and the previously unstudied traits energy, professional motivation, study forecast and leader potential. Senior pilots being highly accurate in identifying suitable candidates could have practical implications for military pilot selection procedures. More research is needed however, and these findings can be considered a starting off point for further

examinations, where researchers will want to account for additional predictors of education success, and setting results in relation to other populations.

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## CONFLICT OF INTEREST STATEMENT

The project is financially supported by SAAB Aeronautics, which has business relations with the Swedish Armed Forces, which supplied the study data. The remaining author declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

Due to the nature of this research, supporting data is not available.

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