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# Five Factor Model Personality Profiles of University of North Dakota Unmanned Aircraft Systems Students

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# FIVE FACTOR MODEL PERSONALITY PROFILES OF UNIVERSITY OF NORTH DAKOTA UNMANNED AIRCRAFT SYSTEMS STUDENTS

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This thesis, submitted by Zachary P. Waller, in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done, and is hereby approved.

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ABSTRACT

A great deal of effort has been made to quantify personality characteristics in the pilots of manned aircraft. However, analysis of similar characteristics of individuals interested in piloting Unmanned Aircraft (UA) remains relatively unexplored. This research examined the Five Factor Model (FFM) personality profiles of individuals pursuing Unmanned Aircraft Systems (UAS) studies at the University of North Dakota (UND). Using the Big Five Inventory (BFI) general personality index, the responses of a UAS Student group (N=65) were compared to a Normative sample group (N=248) previously collected by Petros (2013). Apart from the two highest scoring factors in each group (i.e. conscientiousness (C) for the UAS sample and agreeableness (A) for the normative sample), the ordinal rank of mean factor scores showed similarity between samples. The sample group, comprised of students with either Pre UAS Operations, or UAS Operations declared as a first or second major, scored significantly lower in neuroticism (N) ($p<0.001$), significantly higher in openness (O) ($p<0.01$), and significantly higher in conscientiousness (C) ($p<0.001$) than individuals in the Normative sample. Recommendations for future research encourage the inclusion of the BFI facet scores offered by Soto and John (2008), or application of the Revised NEO Personality Inventory for assessment of more specific traits within the domains of the FFM. Also recommended is the exploration of these personality traits as they appear within individuals, both civil and military, who have completed training for the operation of UAS platforms.

# CHAPTER I

# INTRODUCTION

The University of North Dakota (UND) offers a wide range of degree programs for manned aircraft, as well as the nation's first major in Unmanned Aircraft Systems (UAS) Operations. Students may be attracted to majors which specialize in commercial aviation, flight education, Air Traffic Control (ATC), aviation management, or Unmanned Aircraft Systems Operations for a variety of reasons. As significant investments of time and money are asked of these students in the completion of their degrees, one wonders whether an in depth understanding of their characteristics could enable better academic and career advising for these student pilots.

## Statement of the Problem

As the performance of pilots has been construed as "… a product of skill, attitude and personality factors" (Chidester, Helmreich, Gregorich, & Geis, 1991, p. 25), personnel specialists in both military and commercial aviation have worked to identify means to accurately measure the characteristics needed to be a well performing pilot (Carretta & Ree, Pilot Selection Methods, 2003). A great deal of effort has been made to quantify these characteristics in the pilots of manned aircraft. However, analysis of similar characteristics of individuals interested in piloting Unmanned Aircraft (UA) remains relatively unexplored.

Many contemporary efforts to optimize the operations of Unmanned Aircraft Systems have focused on the advancement and improvement of control stations

(Bustamante & Clark, 2010) (Drury & Scott, 2008). To the author's knowledge however, there have been no published studies within professional literature or peer-reviewed psychological journals regarding the normative personality traits of students pursuing studies in UAS. The results of this study will provide information valuable to interpreting the Five Factor Model (FFM) scores of the individuals pioneering this career field, and may stand to further research efforts assessing the relationship between personality traits and aspects of aviation such as pilot selection, training, retention, performance, and crew coordination in UA.

**Purpose of the Study**

The purpose of this study was to examine the five factor personality profiles of a contemporary sample of UND UAS students. Using the Big Five Inventory (BFI) general personality index, the responses of this group were juxtaposed against a normative sample group collected previously (Petros, 2013). This comparison allowed for the identification of differences and similarities between the personalities of those students interested in pursuing studies in UAS and the general population. Furthermore, the results of this analysis offer a foundation which may enable future studies to determine whether personality characteristics affect areas such as training success, career persistence, or crew performance for UAS pilots.

**Acronyms**

- AA (Aeronautically Adaptable)
- AES (Advanced Encryption Standard)
- AFOQT (Air Force Officer Qualifying Test)
- AFRL (Air Force Research Lab)

- ANOVA (Analysis of Variance)
- ATC (Air Traffic Controller)
- BFI (Big Five Inventory)
- CRM (Crew Resource Management)
- EPPS (Edwards Personal Preference Schedule)
- FAA (Federal Aviation Administration)
- FFM (Five Factor Model)
- MAB (Multidimensional Aptitude Battery)
- MANOVA (Multivariate Analysis of Variance)
- MBTI (Myers-Briggs Type Indicator)
- MCMI (Millon Clinical Multiaxial Inventory)
- MFS (Medical Flight Screening)
- NAA (Not Aeronautically Adaptable)
- NAMI (Navy Aerospace Medical Institute)
- NEO-FFI (NEO Five Factor Inventory)
- NEO PI (NEO Personality Inventory)
- NEO PI-R (Revised NEO Personality Inventory)
- PCI (Personal Characteristic Inventory)
- PCSM (Pilot Candidate Selection Method)
- PPQ (Pilot Personality Questionnaire)
- SDI+ (Self-Description Inventory)
- SME (Subject Matter Expert)
- SO (Sensor Operator)

- SUPT (Specialized Undergraduate Pilot Training)
- TBAS (Test of Basic Aviation Skills)
- UA (Unmanned Aircraft)
- UAS (Unmanned Aircraft System)
- UPT (Undergraduate Pilot Training)
- USAF (United States Air Force)

## Literature Review

This section provides a review of both empirical and theoretical research conducted on personality, as well as the development, factor structure, and validity of the BFI and Revised NEO Personality Inventory (NEO PI-R). Sections on aviation related personality research summarize scholarly efforts focused on a variety of occupations within the field of aviation. Exploratory research into the personality traits of commercial pilots, Air Traffic Controllers, and astronauts are each presented alongside efforts made within the United States Navy, Air Force, and Army. The final section is devoted to reviewing research on the pilot selection methods of the United States military and the place that personality measures have occupied in that process. It is essential to note that the tables throughout are not the work of the present author, but have rather been adapted from their respective studies into a standardized table format to ease comparisons and convenience for the reader throughout.

### Empirical and theoretical personality research.

As defined by Chidester, Helmrich, Gregorich, and Geis (1991), personality traits are "stable, deep-seated predispositions to respond in particular ways" (p. 27). Personality is also reflected in behaviors which are relatively stable over time and consistent across

situations (Chidester, Helmreich, Gregorich, & Geis, 1991). As will be noted in some of the exploratory personality research that follows, individual traits have a tendency to vary throughout adult life as a result of maturation and social factors (Conley, 1984). However, research has demonstrated that rank ordering of personality traits remains stable over spans of up to 45 years (Conley, 1984). The history of the BFI, and the widely used NEO PI-R, can be traced back through several models of personality, however both begin in earnest with the identification and development of the FFM of personality.

The FFM of personality is a hierarchical organization of personality traits in terms of five basic dimensions: neuroticism (N), extraversion (E), openness to experience (more often referred to as simply openness (O)), agreeableness (A), and conscientiousness (C) (McCrae & John, 1992). Development of this model has its origins in lexical theory, or studies of natural language trait terms. As reviewed by McCrae and John (1992), "The lexical hypothesis holds that all important individual differences [in personality] will have been noted by speakers of a natural language at some point in [its] evolution and encoded in trait terms" (p. 186). In more simple terms, personality has been defined by such terms as friendly, high-strung, or punctual. These trait terms are the basic ways in which individuals understand themselves and others (McCrae & John, 1992). It should therefore follow naturally, that, "A complete theory of personality must ultimately explain the phenomena to which these terms refer and the ways in which they are used in everyday life" (McCrae & John, 1992, p. 186). Allport and Odbert abstracted some 4,500 trait terms from an English dictionary, and Cattell formed these into synonym clusters. Cattell then created rating scales to contrast the different groups of adjectives, and

established his 16 Principal Factors model (Cattell, 1979). It was out of this work that the NEO PI-R was subsequently developed by Costa and McCrae (Costa & McCrae, 1992), and the BFI by John, Donahue, and Kentle (1991).

The BFI and NEO PI-R are general personality inventories which focus on identifying personality traits of the FFM (Costa & McCrae, 1992). As opposed to an aviation specific test or an inventory designed to identify pathology, these models allow for direct comparisons to the public. The NEO PI-R has been identified as the predominant measure of the FFM (Widiger & Trull, 1997), and consists of 240 statements in a self-report personality battery. However, due to the number of statements and the cost, the shorter and open source, BFI will be used for this study.

In contrast to the NEO PI-R, the BFI has only 44 statements which identify the same five factors of the FFM. Both inventories allow subjects to respond to each statement (e.g. 'I often feel helpless and want someone else to solve my problems', or 'I'm a superior person') on a five point Likert scale ranging from "strongly disagree" to "strongly agree." Each subject's scores are divided into the five basic domains of neuroticism (N), extraversion (E), openness (O), agreeableness (A), and conscientiousness (C). The NEO PI-R then further divides each of these factors into six facets through the use of additional facet specific statements. The neuroticism (N) factor is divided into the facets of anxiety, angry hostility, depression, self-consciousness, impulsiveness, and vulnerability. The extraversion (E) factor is divided into the facets of warmth, gregariousness, assertiveness, activity, excitement-seeking, and positive emotions. The openness (O) factor is divided into the factors of fantasy, aesthetics, feelings, actions, ideas, and values. The agreeableness (A) factor is divided into the facets

of trust, straightforwardness, altruism, compliance, modesty, and tender-mindedness. Finally, the conscientiousness (C) factor is divided into the facets of competence, order, dutifulness, achievement striving, self-discipline, and deliberation (Costa & McCrae, 1992) (Soto & John, 2008).

As summarized by Grice and Katz (2007) the factors of neuroticism (N), extraversion (E), openness (O), agreeableness (A), and conscientiousness (C) can be described simply as follows. The factor neuroticism contrasts emotional adjustment and stability with maladjustment such as a frequent depression or anxiety. High scores in this factor indicate maladjustment while low scores indicate emotional adjustment and stability. The factor extraversion contrasts aspects of sociability with a disposition towards introversion and independence. In this factor, higher scores indicate a tendency toward sociability. The openness factor contrasts aspects of imagination and curiosity with conventionality and obeying the rules. High scores in the openness (O) factor indicate a more active imagination and intellectual curiosity. The agreeableness factor contrasts aspects of altruism and compliance with aspects of antagonism and egocentrism. In this factor, high scores indicate increased tendencies toward altruism and a willingness to assist others. Finally, the conscientiousness factor contrasts aspects commonly associated with character such as self-discipline and dependability with impulsivity and disorganization. High scores in consciousness (C) are indicative of individuals who are purposeful, strong-willed, and determined.

The validity of the NEO PI-R is well documented, and its well established norms have led to its application in several studies (Boyd, Patterson, & Thompson, 2005). Briggs (1992) reviews that in the development of the NEO Personality Inventory (NEO

PI)[1], Costa and McCrae relied heavily on item and factor analysis to produce an inventory which measured the five factors as cleanly and as faithfully as possible (Briggs, 1992). In validating the NEO PI, Costa and McCrae "produced an impressive series of studies that underscore the ubiquity of the [FFM] in personality measurement" (Briggs, 1992, p. 277). Using the NEO PI as a standard, "they have almost single-handedly achieved the goal of systematically mapping the relations among instruments… developed by different researchers for different purposes, using different models, formats, methods, and items" (Briggs, 1992, p. 277). It has been determined that the NEO PI provides a faithful representation of the FFM, along with more precisely identified facets within each factor (Briggs, 1992). Furthermore, the factor scales have proven robust across a variety of settings and have shown evidence of construct validity (Briggs, 1992). Similar reviews of the NEO PI-R reflect the findings of Briggs (1992), and relay that the NEO PI-R demonstrates consistent convergent and discriminant validity with respect to adjective checklist measures of the FFM (Widiger & Trull, 1997).

To address the need for a short instrument measuring FFM components, John, Donahue, and Kentle (1991) constructed the BFI. The BFI consists of 44 statements and was developed to create a brief inventory which would allow efficient and flexible assessment of the five factors when there is no need for more differentiated measurement of the facets discussed above which offer greater resolution. While the BFI scales include only eight or ten items for each factor, "…they do not sacrifice either content coverage or good psychometric properties" (John & Srivastava, 1999, p. 115). In U.S. and Canadian samples, the alpha reliabilities of the BFI scales typically range from 0.75 to 0.90 and

[1] The NEO PI, is an earlier version of the NEO PI-R which only includes facets for the factors of neuroticism, extraversion, and openness.

average above 0.80. Three month test-retest reliabilities of the inventory range from 0.80 to 0.90 and average 0.85 (John & Srivastava, 1999). While no direct comparisons will be made between the NEO PI-R and BFI scales in this study, tests have shown strong cross instrument validity correlations between the BFI and an abbreviated form of the NEO PI-R, the NEO Five Factor Inventory (NEO-FFI). Across all five factors, the convergent validity correlation between these instruments was r=0.73 (John & Srivastava, 1999).

Two meta-analyses (Barrick & Mount, 1991) (Tett, Jackson, & Rothstein, 1991) reviewed relationships between the FFM traits of personality and job performance. They first investigated the relation of these factors to job performance criteria (i.e. job proficiency, training proficiency, and personnel data) in five occupational groups (Barrick & Mount, 1991). Study results indicated that the factor conscientiousness was consistently and positively related to all criteria in each occupation. The factors of openness and extraversion were found to be valid predictors of job performance across all occupations, and extraversion was a valid predictor of all three criteria in the two occupations involving social interaction (Barrick & Mount, 1991). Overall, Barrick and Mount (1991) concluded "…the results illustrate the benefits of using the [FFM] of personality to accumulate and communicate empirical findings" (p. 1). The second study reviewed 494 previous studies with 97 independent samples (total N = 13,521). Corrected mean personality scale validity was determined for several subsets of study. First, studies using confirmatory research strategies (i.e. theoretically driven studies) produced corrected mean personality scale validity (.29), more than twice as high as those studies adopting exploratory (i.e. empirically driven studies) strategies (.12) (Tett, Jackson, & Rothstein, 1991). Compared to both of these study subsets, it was found that studies

which explicitly used job analysis (i.e. identification of a job's content) in the selection of their personality measures produced an even higher corrected mean personality scale validity (.38) (Tett, Jackson, & Rothstein, 1991). The study aggregated FFM trait correlations for the confirmatory subset of studies and further calculated corrected mean correlations (-.22), (.16), (.27), (.33), and (.18) for the factors of neuroticism, extraversion, openness, agreeableness, and conscientiousness respectively. While these results firmly support the use of personality scales in personnel selection as well as the results reported by Barrick and Mount (1991), Tett, Jackson, and Rothstein (1991) suggest that they underestimate the value of personality information.

**Aviation related personality research.**

Many exploratory research efforts have addressed the issue of identifying distinguishable personality profiles among pilot populations as well as other professionals within aviation. While the majority of studies make use of the FFM of personality, several also seized the opportunity to evaluate their samples against other measures of personality. Given the focus of this proposed research, the included tables primarily address the NEO PI-R results of each study. Again, it must be stressed that these tables are not the work of the present author, but have been adapted to increase convenience and ease of comparison across studies.

***Regarding civilian pilots.***

With regards to the personalities of civilian pilots, Kreienkamp and Luessenheide (1985) conducted a quantitative study assessing whether similarities or differences in personality between student pilots and their flight instructors might account, in part, for the wide range of flying hours required to obtain a private pilot certificate. The Myers-

Briggs Type Indicator (MBTI) was administered to 22 male and 10 female college students who completed the private pilot curriculum at a large university program in 1982. Results indicated a significant relationship between the similarity of the flight instructors and the male student pilots on the Extravert-Introvert (E/I) measure. In this case, similarity was associated with briefer training periods and more efficient performance by student pilots.

A second qualitative study conducted by Schutte, Fitzgibbons, and Davis (2004) focused on identifying the stable personality characteristics of commercial pilots, namely assessing whether the NEO-PI-R would provide a personality profile for commercial aviation pilots. Ninety-three commercial pilots (88 male and 5 female) completed the NEO-PI-R. These subjects ranged in age from 23 to 65, with a mean age of 42, and were employed by 14 different commercial airlines (Schutte, Fitzgibbons, & Davis, 2004). The results, which have been adapted into Table 1 below, illustrate the percentage of this commercial pilot sample which scored in the very low or low, and high or very high ranges for each factor and facet relative to the general public. It was found that the commercial pilots reported low levels of neuroticism (N), high levels of extraversion (E), average levels of openness (O) and agreeableness (A), and very high levels of conscientiousness (C) relative to the general public.

Table 1.NEO PI-R Dimensions and Facets Pertaining to the Civil Pilot Personality

| Domains/Facets | | Very Low/ Low | High/ Very High |
|---|---|---|---|
| NEUROTICISM | (N) | 60% | 13% |
| Anxiety | (N1) | 61% | 15% |
| Angry Hostility | (N2) | 62% | 14% |
| Depression | (N3) | 61% | 13% |
| Self-consciousness | (N4) | 47% | 15% |
| Impulsiveness | (N5) | 57% | 16% |
| Vulnerability | (N6) | 71% | 2% |
| EXTRAVERSION | (E) | 23% | 42% |
| Warmth | (E1) | | |
| Gregariousness | (E2) | 24% | 44% |
| Assertiveness | (E3) | 4% | 71% |
| Activity | (E4) | 9% | 56% |
| Excitement-Seeking | (E5) | | |
| Positive Emotions | (E6) | 29% | 54% |
| OPENNESS | (O) | 36.5% | 29% |
| Fantasy | (O1) | | |
| Aesthetics | (O2) | | |
| Feelings | (O3) | | |
| Actions | (O4) | | |
| Ideas | (O5) | | |
| Values | (O6) | | |
| AGREEABLENESS | (A) | 32% | 27% |
| Trust | (A1) | 19% | 53% |
| Straightforwardness | (A2) | 23% | 45% |
| Altruism | (A3) | | |
| Compliance | (A4) | | |
| Modesty | (A5) | 45% | 27% |
| Tender-Mindedness | (A6) | 45% | 25% |
| CONSCIENTIOUSNESS | (C) | 7.5% | 58% |
| Competence | (C1) | 4% | 65% |
| Order | (C2) | 12% | 41% |
| Dutifulness | (C3) | 11% | 55% |
| Achievement Striving | (C4) | 9% | 65% |
| Self-Discipline | (C5) | 11% | 40% |
| Deliberation | (C6) | 14% | 61% |

*Note:* The above has been adapted from Schutte, Fitzgibbons, & Davis (2004). Data such as scores for the facets Warmth (E1) and Fantasy (O1) were not published by Schutte, Fitzgibbons, & Davis (2004) and have been accurately omitted above to make identification of the missing data more apparent.

While the applicable pool of research regarding civilian pilots is dwarfed by the efforts found among military branches, these results do support the capacity of

personality measures to enable briefer training periods and more efficient performance by student pilots (Kreienkamp & Luessenheide, 1985). Furthermore, the qualitative profile of Schutte, Fitzgibbons, and Davis (2004) illustrates congruence with many pilot personality profiles examined in the studies below.

***Regarding air traffic controllers.***

Within the area of Air Traffic Control, Luuk, K, Luuk, A, and Aluoja (2009) conducted a quantitative study evaluating the relationships among cognitive abilities, personality characteristics, and Air Traffic Controller (ATC) performance. Sixty ATC candidates (37 male and 23 female) who had entered Tartu Aviation College between 1994 and 2001 formed the sample, which explored the usefulness of NEO-PI personality traits for predicting ATC's performance at admission to ab initio training (Luuk, Luuk, & Aluoja, 2009). Results showed that extroversion (E) and its facets gregariousness (E2) and positive emotions (E6) were significant ($p< 0.05$, $p<0.01$, and $p<0.01$ respectively) negative predictors of objective performance over and above the study's measure of cognitive ability level. E, E2 and E6 added to the variance of success in career (8.2%, 12.6%, and 12.7% respectively). The results furthermore provided a personality profile of ATC candidates as compared to a normative sample, which has been adapted by the present author into Table 2 below. It is interesting to note that the factor scores of neuroticism (N), extraversion (E), and conscientiousness (C) each indicate significant differences at the $p < 0.001$ level between males and the general population. These results for scores relatively low in neuroticism (N), high in extraversion (E), and high in consciousness (C), are similar to the qualitative sample results noted by Schutte, Fitzgibbons, and Davis (2004).

Table 2. NEO PI-R Comparisons between ATC Candidates and the General Population

| Domains/Facets | | ATC Candidates (N = 60) Mean | SD |
|---|---|---|---|
| NEUROTICISM | (N) | 47.17 | 23.94 |
| Males | | 44.95*** | 26.46 |
| Females | | 50.74*** | 19.23 |
| EXTRAVERSION | (E) | 139.40 | 22.63 |
| Males | | 142.08*** | 18.42 |
| Females | | 135.09 | 28.05 |
| OPENNESS | (O) | 118.17 | 22.57 |
| Males | | 117.14 | 24.38 |
| Females | | 119.83 | 19.71 |
| AGREEABLENESS | (A) | 52.17 | 7.10 |
| Males | | 51.51** | 7.66 |
| Females | | 53.22* | 6.11 |
| CONSCIENTIOUSNESS | (C) | 60.83 | 8.87 |
| Males | | 60.68*** | 9.95 |
| Females | | 61.09*** | 7.00 |

*Note*. Asterisks in the column "Mean" depict statistically significant differences between the means of current samples and the normative sample data.
*p < .05. **p < .01. ***p < .001.

***Regarding astronauts.***

A second aviation related occupation that was represented in the literature was that of the astronaut. A quantitative study conducted by Musson, Sandal, and Helmreich (2004) sought to further define the relationship between astronaut personality and performance. The Personal Characteristic Inventory (PCI) and the NEO Five Factor Inventory (NEO-FFI), which is an abbreviated form of the NEO-PI inventory, data from final stage NASA astronaut applicants were examined to see if "Right Stuff", "Wrong Stuff", and "No Stuff" clusters would emerge. Cluster analysis of the PCI data (N=259) suggested the presence of these three clusters, however Chi-squared tests showed no significant differences between cluster membership and applicant success (Musson, Sandal, & Helmreich, 2004). Furthermore, assessment of applicant NEO-FFI data

(N=147) revealed significant correlation between the factors of the NEO-FFI and to PCI scales. These correlations are summarized in Table 3 below, adapted again by the present author from Musson, Sandal, and Helmreich (2004).

Table 3. Correlations between Scales of the PCI and the Abbreviated Scales of the NEO PI-R Among Astronaut Applicants

| Scales | Neuroticism | Extraversion | Openness | Agreeableness | Conscientiousness |
|---|---|---|---|---|---|
| Instrumentality | -0.39** | 0.25** | 0.13 | -0.09 | 0.42** |
| Expressivity | 0.03 | 0.16 | 0.22** | 0.50** | 0.12** |
| Negative Instrumentality | 0.13 | 0.07 | -0.11 | -0.54** | -0.18* |
| Verbal Aggressiveness | 0.27** | -0.05 | -0.04 | -0.27** | -0.29** |
| Mastery | -0.24** | 0.33** | 0.27** | 0.00 | 0.32** |
| Work Orientation | -0.22** | 0.22** | 0.15 | 0.03 | 0.29** |
| Competitiveness | 0.09 | -0.06 | -0.21* | -0.39** | -0.08 |
| Achievement Strivings | -0.20* | 0.26** | 0.10 | -0.03 | 0.43** |

*Note:* Correlations are significant at the **0.01 level (2-tailed) and the *0.05 level (2-tailed).

Musson, Sandal, and Helmreich (2004) additionally analyzed the NEO-FFI data with respect to PCI cluster membership. Results found that compared to the "Wrong Stuff" cluster, the "Right Stuff" cluster had significantly higher ($p<0.001$) self-reported scores in conscientiousness (C) and agreeableness (A) than the "Wrong Stuff" cluster, and also self-reported similar (C) and (A) scores but significantly lower scores ($p<.05$) in neuroticism (N) than the "No Stuff" cluster. The authors offer that the lack of significant personality differences between successful and unsuccessful astronaut applicants may be due to population homogeneity, as these individuals were already highly selected through the initial application process. While the results of this study showed no relationship between cluster membership and applicant success, the significant differences in the NEO PI scores of each cluster continue to strengthen precedence on the personality profile of aviation professionals deemed to have the "Right Stuff".

***Regarding military pilots.***

*United states navy.*

Beginning the review of personality research in the military branches is a 1993, quantitative study conducted by Helton and Street. This study analyzed responses from the Edwards Personal Preference Schedule (EPPS) and Pilot Personality Questionnaire (PPQ), used at the time of publication in the selection process for naval aviators, to ascertain if a five-factor solution comparable to those found in the NEO PI would emerge. The study sampled the EPPS and PPQ test results of U.S. Navy and Marine Corps aviator candidates (N = 158) who completed these tests at the Naval Aerospace Medical Research Laboratory between January of 1990 and February of 1991. Results showed a five-factor solution from the responses of the above tests, suggesting "… that a robust five-factor solution may describe the underlying personality testing constructs in Navy/Marine Corps student aviators" (Helton & Street, 1993, p. 9). Based on these findings, it was recommended that personality research in naval aviation be centered around prediction systems based on the grouping of various personality scales into a five-factor model (Helton & Street, 1993).

Continuing with research applied to aviators within the U.S. Navy, Campbell, Moore, Poythress, and Kennedy (2009) conducted a quantitative study to assess whether a sample of clinically referred military aviators exhibited commonly occurring personality clusters. The NEO-PI-R profiles of 956 clinically referred U.S. Naval aviators and flight officers (N = 956) were analyzed using model-based cluster analysis and the emergent personality clusters were compared to clinical outcome. Two personality profiles emerged from the model-based cluster analysis, and significant differences, at the

$p < 0.001$ level, in the factors of neuroticism (N), extraversion (E), agreeableness (A), and conscientiousness (C) were noted. It was found that the first group (N=291) reported significantly higher scores in neuroticism (N) and significantly lower scores in the extraversion (E), agreeableness (A), and conscientiousness (C) as compared to the second group (N = 665). Furthermore, when the clinical outcomes of each group were analyzed, it was found that significantly more members of Group 1 were deemed Not Aeronautically Adaptable (NAA), or not suited for flight duty, than of Group 2 ($p<0.001$).

Finally, Campbell, Ruiz, and Moore (2010) conducted a quantitative study analyzing clinically referred military aviators, who had been evaluated using the NEO-PI-R, to determine whether specific facet differences were consistent with U.S. Navy guidelines concerning Aeronautical Adaptability (AA). The NEO-PI-R scores of clinically evaluated U.S. Naval aviators and flight officers (N = 954), who were determined either AA or NAA, were compared controlling for NAA statuses which were attributable to conditions other than psychological standards. The results which have been adapted into Table 4 below, indicated significant differences ($p < 0.001$) between the AA and NAA groups for the neuroticism (N), extraversion (E), agreeableness (A), and conscientiousness (C) factors, and significant differences (p , 0.01) in the openness (O) factor.

Table 4. Descriptive (T-Score) Information for the Aeronautically Adaptable and Non-Aeronautically Adaptable Groups

| Domains/Facets | | AA (N = 817) Mean | AA (N = 817) SD | NAA (N = 137) Mean | NAA (N = 137) SD | F (1, 952) |
|---|---|---|---|---|---|---|
| NEUROTICISM | (N) | | | | | |
| Anxiety | (N1) | 49.7 | 10.6 | 59.5 | 13.5 | 98.82* |
| Angry Hostility | (N2) | 50.0 | 10.6 | 55.9 | 12.4 | 34.57* |
| Depression | (N3) | 50.1 | 10.8 | 61.6 | 13.9 | 121.59* |
| Self-consciousness | (N4) | 50.0 | 10.2 | 56.9 | 11.9 | 51.56* |
| Impulsiveness | (N5) | 50.1 | 11.0 | 55.3 | 13.5 | 24.75* |
| Vulnerability | (N6) | 50.7 | 11.0 | 63.4 | 16.5 | 132.57* |
| EXTRAVERSION | (E) | | | | | |
| Warmth | (E1) | 49.7 | 10.5 | 45.3 | 10.8 | 20.10* |
| Gregariousness | (E2) | 50.0 | 10.2 | 46.3 | 11.4 | 15.12* |
| Assertiveness | (E3) | 49.8 | 10.1 | 42.7 | 12.8 | 53.59* |
| Activity | (E4) | 49.1 | 10.3 | 45.5 | 10.9 | 14.23* |
| Excitement-Seeking | (E5) | 49.9 | 9.8 | 46.8 | 10.5 | 11.12* |
| Positive Emotions | (E6) | 49.4 | 10.8 | 43.4 | 12.3 | 35.04* |
| OPENNESS | (O) | | | | | |
| Fantasy | (O1) | 48.9 | 9.9 | 51.5 | 12.4 | 7.66* |
| Aesthetics | (O2) | 49.4 | 9.9 | 51.1 | 11.4 | 3.15 |
| Feelings | (O3) | 49.5 | 9.9 | 52.0 | 11.1 | 7.31* |
| Actions | (O4) | 50.0 | 9.9 | 47.9 | 10.5 | 5.41* |
| Ideas | (O5) | 49.6 | 10.0 | 50.3 | 11.2 | 0.64 |
| Values | (O6) | 50.0 | 10.0 | 49.8 | 10.5 | 0.05 |
| AGREEABLENESS | (A) | | | | | |
| Trust | (A1) | 50.5 | 10.0 | 45.1 | 12.6 | 31.04* |
| Straightforwardness | (A2) | 50.5 | 9.9 | 49.0 | 11.4 | 2.37 |
| Altruism | (A3) | 49.9 | 10.3 | 47.1 | 10.9 | 8.62* |
| Compliance | (A4) | 50.0 | 10.3 | 49.8 | 12.6 | 0.04 |
| Modesty | (A5) | 50.7 | 10.3 | 54.2 | 11.2 | 13.76* |
| Tender-Mindedness | (A6) | 50.3 | 9.9 | 52.0 | 10.0 | 3.62 |
| CONSCIENTIOUSNESS | (C) | | | | | |
| Competence | (C1) | 49.8 | 10.2 | 41.5 | 13.6 | 70.93* |
| Order | (C2) | 49.7 | 10.0 | 47.0 | 12.6 | 7.60* |
| Dutifulness | (C3) | 49.7 | 10.4 | 43.7 | 12.3 | 36.16* |
| Achievement Striving | (C4) | 49.3 | 10.4 | 44.0 | 12.4 | 29.56* |
| Self-Discipline | (C5) | 50.0 | 10.3 | 42.4 | 13.5 | 59.31* |
| Deliberation | (C6) | 49.9 | 10.2 | 46.2 | 11.7 | 14.86* |

*Note:* * P , 0.01.

To summarize, personality research conducted within the U.S. Navy has indicated support for the grouping of various personality scales into five-factor models, and further a recommendation that such models be central in U.S. Navy prediction systems (Helton & Street, 1993). Additionally, in the area of identifying personality profiles which may be incompatible with work in stressful occupations, individuals low in the neuroticism (N) factor and high in the factors of extraversion (E), and conscientiousness (C) again appear to be better suited to aeronautical duties (Campbell, Moore, Poythress, & Kennedy, 2009) (Campbell, Ruiz, & Moore, 2010). Unlike the profiles outlined in previous sections however, the agreeableness (A) and openness (O) seem to have more significant roles in the naval aviator personality.

*United states air force.*

Research regarding populations within the USAF, the largest component of this review, are traced back to 1997 and the work of King, Callister, Retzlaff, and McGlohn (1997). This quantitative study examined two primary issues, (1) the comparison of male USAF student pilots, with female USAF pilots, as well as a sample of female college students on the NEO PI-R, and (2) comparison of the scores of both male and female college students, USAF student pilots, and USAF mid-career pilots on the NEO-FFI[2] (King, Callister, Retzlaff, & McGlohn, 1997). Participants in the first part of the study included male USAF student pilots (N = 103), female USAF pilots (N = 103), and female college students (N = 103). Meanwhile, the second part of the study included ninety-one of the male and female USAF student pilots from the first part as well as male and female

[2] It should be noted that it is possible to re-score a NEO PI-R to reveal NEO-FFI scores, which allowed for the comparison of samples across testing formats.

mid-career USAF pilots (N = 64 and N = 48 respectively), and male and female college students (N = 58 and N = 103 respectively).

As outlined in Table 5 below, adapted from King, Callister, Retzlaff and McGlohn (1997), significant differences ($p < 0.001$) were found between the NEO PI-R scores of three groups. All three groups reported significantly different scores in the neuroticism (N) factor, the USAF males being lowest followed by the USAF females. On the openness (O) factor, USAF males were significantly lower than both female groups, and significant differences were found between all groups on the conscientiousness (C) factor.

At the facet level, significant differences were found between all groups on anxiety (N1), Depression (N3), and vulnerability (N6) the USAF male group being lowest followed by the USAF female group in each case. The normative female group scored significantly higher than both USAF groups in angry hostility (N2). Finally the USAF male group scored significantly lower on the impulsiveness (N5) and self-consciousness (N4) facets than both female groups. In the openness (O) factor, the USAF male group scored significantly lower than both female groups on the aesthetics (O2) factor. Furthermore, significant differences were found between all groups on the values (O6) factor. In this facet, the normative female group scored highest followed by the USAF female group. Though no factor level difference was noted in agreeableness (A), its tender-mindedness (A6) scale revealed significant differences between all groups. This facet mimicked vales (O6) in that the normative female group scored highest followed by the USAF female group. Finally, in the conscientiousness (C) facets, the USAF male group scored significantly higher than both female groups in competence

(C1), and the normative female sample scored significantly lower than the USAF groups in the facets of dutifulness (C3), achievement striving (C4), and self-discipline (C5).

Table 5. NEO PI-R Descriptive Information for USAF Female, USAF Male, and Normative Female Groups

| | | Air Force Females (l) | | College Females (2) | | Air Force Males (3) | | |
|---|---|---|---|---|---|---|---|---|
| Domains/Facets | | Mean | SD | Mean | SD | Mean | SD | F (2,306) |
| NEUROTICISM | (N) | 82.52 | 23.33 | 97.12 | 22.64 | 68.55 | 17.83 | 45.85*a |
| Anxiety | (N1) | 16.00 | 5.05 | 18.75 | 4.91 | 12.99 | 4.40 | 37.18*a |
| Angry Hostility | (N2) | 12.98 | 5.03 | 15.49 | 5.46 | 12.00 | 4.93 | 12.61*c |
| Depression | (N3) | 13.00 | 5.75 | 15.94 | 6.07 | 9.99 | 4.09 | 31.53*a |
| Self-consciousness | (N4) | 14.42 | 4.95 | 16.25 | 5.48 | 12.80 | 4.15 | 12.79*d |
| Impulsiveness | (N5) | 16.94 | 5.17 | 18.66 | 4.44 | 14.32 | 4.36 | 22.52*b |
| Vulnerability | (N6) | 9.16 | 3.69 | 12.01 | 4.60 | 6.44 | 3.01 | 54.66*a |
| EXTRAVERSION | (E) | 128.35 | 19.79 | 126.63 | 20.63 | 127.77 | 17.36 | 0.21 |
| Warmth | (E1) | 23.70 | 4.64 | 24.21 | 4.74 | 22.86 | 4.11 | 2.35 |
| Gregariousness | (E2) | 18.95 | 5.82 | 19.69 | 5.91 | 18.35 | 4.71 | 1.53 |
| Assertiveness | (E3) | 19.18 | 4.65 | 17.89 | 5.60 | 20.48 | 4.25 | 7.28 |
| Activity | (E4) | 21.12 | 3.40 | 19.77 | 4.22 | 21.68 | 3.86 | 6.73 |
| Excitement-Seeking | (E5) | 22.29 | 3.92 | 21.70 | 4.91 | 22.73 | 3.42 | 1.60 |
| Positive Emotions | (E6) | 23.09 | 4.57 | 23.33 | 5.11 | 21.64 | 4.40 | 3.92 |
| OPENNESS | (O) | 124.32 | 17.81 | 128.01 | 20.13 | 111.93 | 19.83 | 19.65*b |
| Fantasy | (O1) | 19.85 | 5.29 | 21.13 | 5.44 | 18.48 | 4.75 | 6.76 |
| Aesthetics | (O2) | 20.08 | 5.26 | 21.75 | 6.23 | 16.10 | 5.84 | 25.85*b |
| Feelings | (O3) | 22.97 | 4.19 | 24.83 | 3.78 | 20.42 | 4.82 | 27.42*a |
| Actions | (O4) | 18.73 | 3.98 | 16.95 | 4.03 | 16.96 | 4.05 | 6.74 |
| Ideas | (O5) | 21.19 | 4.46 | 19.97 | 5.68 | 21.20 | 5.61 | 1.85 |
| Values | (O6) | 21.47 | 3.54 | 23.36 | 4.32 | 18.74 | 4.44 | 32.71*a |
| AGREEABLENESS | (A) | 118.39 | 18.36 | 121.35 | 17.04 | 112.26 | 17.02 | 7.25 |
| Trust | (A1) | 20.59 | 5.34 | 19.65 | 4.93 | 19.91 | 4.82 | 0.96 |
| Straightforwardness | (A2) | 19.97 | 4.80 | 20.61 | 4.82 | 19.23 | 4.04 | 2.34 |
| Altruism | (A3) | 24.00 | 3.80 | 24.58 | 3.72 | 23.00 | 3.50 | 4.81 |
| Compliance | (A4) | 16.25 | 4.32 | 16.48 | 5.20 | 15.98 | 4.15 | 0.31 |
| Modesty | (A5) | 18.28 | 4.52 | 18.76 | 4.72 | 16.55 | 4.44 | 6.69 |
| Tender-Mindedness | (A6) | 19.30 | 3.44 | 21.26 | 3.23 | 17.57 | 3.93 | 27.86*a |
| CONSCIENTIOUSNESS | (C) | 124.70 | 20.17 | 114.91 | 21.82 | 132.65 | 15.60 | 21.65*e |
| Competence | (C1) | 22.68 | 3.79 | 21.60 | 3.69 | 24.80 | 2.88 | 22.55*g |
| Order | (C2) | 18.82 | 4.95 | 17.93 | 5.33 | 19.59 | 4.27 | 2.99 |
| Dutifulness | (C3) | 22.72 | 4.44 | 20.72 | 3.96 | 24.28 | 3.40 | 20.81*f |
| Achievement Striving | (C4) | 22.12 | 4.05 | 19.51 | 4.81 | 23.39 | 3.56 | 23.14*f |
| Self-Discipline | (C5) | 21.38 | 4.69 | 19.09 | 5.70 | 23.00 | 3.50 | 17.87*f |
| Deliberation | (C6) | 16.95 | 4.08 | 16.03 | 5.00 | 17.56 | 3.97 | 3.16 |
| N | | 103 | | 103 | | 103 | | |

NOTE: * DENOTES SIGNIFICANCE AT .0001. TUKEY'S MULTIPLE COMPARISONS at .01 with not significantly different means underlined:
a=2 1 3, b=2 1 3, c=2 1 3, d=2 1 3, e=3 1 2, f=3 1 2, g=3 1 2

The results from part two of the study, regarding career level differences between both male and female pilots, illustrate a number of gender and career level differences between subjects. Examining first gender, the authors found that female college students scored significantly higher on agreeableness (A) and conscientiousness (C) than their

male counterparts. Among USAF student pilots, the USAF female group scored higher on the factors of neuroticism (N) and openness (O), but no significant differences were found in the extraversion (E), agreeableness (A) or consciousness (C) factors. Finally, the only difference noted between the mid-career pilots was in the agreeableness (A) factor. Here the USAF female group scored significantly higher than their male counterparts. While some of this data may seem contrary to the results of the first study, it should be noted that,

> "Those results were based upon t-test statistical analysis… this data was first analyzed with ANOVA and then multiple comparison tests were calculated with the Tukey statistic. The Tukey procedure is far more conservative than [t-tests]… when there are a large number of groups and paired comparisons." (King, Callister, Retzlaff, & McGlohn, 1997, p. 8)

Attention was also drawn to the fact that the only career level difference found among either the male or female groups was in the agreeableness (A) and neuroticism (N) factors of the female groups. Here, results showed that mid-career female pilots were lower in neuroticism (N) and higher in agreeableness (A) as compared to the USAF female pilot group. While this lends support to the concept that there is little change in pilot's personality over time, three possibilities explaining the differences between female USAF pilots are offered,

> "First, it may be that female pilots change personalities to some degree across a career by becoming less affective and more agreeable. Second, it could be that agreeable female pilots are retained and the affective female pilots leave the

service. Third, it could be that some societal cohort effect is at work." (King, Callister, Retzlaff, & McGlohn, 1997, p. 9)

In 1999, Callister, King, Retzlaff, and Marsh conducted a quantitative study to describe the normative personality characteristics of USAF pilots based on the NEO PI-R. Rather than using these personality profiles as predictors of training outcomes, the focus of this study rested in establishing normative personality characteristics to ensure valid clinical assessment. The study aggregated the NEO PI-R test results of USAF student pilots (N = 1,301) and compared them to both male and female adult norms. Results of the study revealed that as a group, the student pilots' scores were at least 10% higher than the general population norms in extraversion (E) and openness (O), and at least 10% lower in the agreeableness (A) factor. Interestingly, at the facet level, the group reported low vulnerability (N6), values (O6), trust (A1), straightforwardness (A2), compliance (A4), modesty (A5), and tender-mindedness (A6), and high scores on gregariousness (E2), assertiveness (E3), activity (E4), excitement-seeking (E5), positive emotions (E6), fantasy (O1), feelings (O3), actions (O4), ideas (O5), competence (C1), dutifulness (C3), and achievement seeking (C4) compared to the scores of the general public. These results have been summarized in Table 6 below, which was adapted from Callister, King, Retzlaff, and Marsh (1999).

Table 6. NEO PI-R Descriptive Information for the Total Sample of USAF Pilots

| Domains/Facets | | USAF Total Sample (N = 1,301) Mean | SD | Percentile |
|---|---|---|---|---|
| NEUROTICISM | (N) | 71.92 | 19.92 | 42 |
| Anxiety | (N1) | 13.01 | 4.72 | 46 |
| Angry Hostility | (N2) | 12.44 | 4.85 | 54 |
| Depression | (N3) | 11.00 | 4.79 | 48 |
| Self-consciousness | (N4) | 13.11 | 4.57 | 45 |
| Impulsiveness | (N5) | 15.25 | 4.69 | 48 |
| Vulnerability | (N6) | 7.09 | 3.54 | 21* |
| EXTRAVERSION | (E) | 126.31 | 18.15 | 83* |
| Warmth | (E1) | 22.85 | 4.17 | 50 |
| Gregariousness | (E2) | 18.37 | 5.30 | 62* |
| Assertiveness | (E3) | 19.75 | 4.48 | 84* |
| Activity | (E4) | 20.84 | 3.82 | 80* |
| Excitement-Seeking | (E5) | 22.87 | 3.83 | 92* |
| Positive Emotions | (E6) | 21.61 | 4.54 | 70* |
| OPENNESS | (O) | 115.18 | 18.87 | 60* |
| Fantasy | (O1) | 19.20 | 5.18 | 72* |
| Aesthetics | (O2) | 17.24 | 5.98 | 48 |
| Feelings | (O3) | 21.09 | 4.49 | 62* |
| Actions | (O4) | 16.70 | 4.02 | 61* |
| Ideas | (O5) | 21.82 | 5.27 | 74* |
| Values | (O6) | 19.09 | 4.71 | 38* |
| AGREEABLENESS | (A) | 113.32 | 18.49 | 20* |
| Trust | (A1) | 20.09 | 4.88 | 35* |
| Straightforwardness | (A2) | 18.81 | 4.72 | 30* |
| Altruism | (A3) | 23.32 | 3.86 | 48 |
| Compliance | (A4) | 16.19 | 4.42 | 26* |
| Modesty | (A5) | 16.89 | 4.85 | 33* |
| Tender-Mindedness | (A6) | 17.99 | 4.10 | 25* |
| CONSCIENTIOUSNESS | (C) | 127.96 | 19.23 | 58 |
| Competence | (C1) | 23.95 | 3.50 | 76* |
| Order | (C2) | 18.76 | 4.69 | 54 |
| Dutifulness | (C3) | 23.64 | 3.80 | 61* |
| Achievement Striving | (C4) | 22.49 | 4.34 | 77* |
| Self-Discipline | (C5) | 21.69 | 4.57 | 52 |
| Deliberation | (C6) | 17.40 | 4.28 | 47 |

*Note:* * indicates 10% above or below general population norms

Of the male students (N= 1198) factor scores, extraversion (E) was high, with agreeableness (A) low. At the facet level, low scores were found in the vulnerability (N6), values (O6), trust (A1), straightforwardness (A2), compliance (A4), and tender-mindedness (A6) facets, with high scores in gregariousness (E2), assertiveness (E3), activity (E4), excitement-seeking (E5), positive emotions (E6), fantasy (O1), feelings

(O3), actions (O4), ideas (O5), competence (C1), dutifulness (C3), and achievement striving (C4). In the female students (N= 103) factor level differences were noted in high extraversion (E) and openness (O) scores, and low agreeableness (A). At the facet level, the female students had high scores in angry hostility (N2), impulsiveness (N5), gregariousness (E2), assertiveness (E3), activity (E4), excitement-seeking (E5), positive emotions (E6), fantasy (O1), aesthetics (O2), feelings (O3), actions (O4), ideas (O5), values (O6), competence (C1), and achievement striving (C4), with low scores in self-consciousness (N4), vulnerability (N6), straightforwardness (A2), compliance (A4), modesty (A5), and tender-mindedness (A6). A summary of these results can be found in Table 7 below, which was adapted from Callister, King, Retzlaff, and Marsh (1999).

Results of this study were further developed into percentile tables which have been adapted and included in Appendix A. Such tables would allow an individual to be more readily compared to USAF norms in clinical assessments (Callister, King, Retzlaff, & Marsh, 1999).

Table 7. NEO PI-R Descriptive Information for USAF Male and Female Pilot Groups

| | | USAF Male (N = 1,198) | | | USAF Female (N = 103) | | |
|---|---|---|---|---|---|---|---|
| Domains/Facets | | Mean | SD | Percentile | Mean | SD | Percentile |
| NEUROTICISM | (N) | 71.00 | 19.60 | 43 | 82.52 | 23.33 | 51 |
| Anxiety | (N1) | 12.75 | 4.69 | 53 | 16.00 | 5.05 | 57 |
| Angry Hostility | (N2) | 12.39 | 4.84 | 55 | 12.98 | 5.03 | 60* |
| Depression | (N3) | 10.82 | 4.70 | 53 | 13.00 | 5.75 | 58 |
| Self-consciousness | (N4) | 12.99 | 4.54 | 51 | 14.42 | 4.95 | 39* |
| Impulsiveness | (N5) | 15.11 | 4.65 | 51 | 16.94 | 5.17 | 62* |
| Vulnerability | (N6) | 6.91 | 3.53 | 27* | 9.16 | 3.69 | 37* |
| EXTRAVERSION | (E) | 126.13 | 18.01 | 85* | 128.35 | 19.79 | 81* |
| Warmth | (E1) | 22.77 | 4.13 | 55 | 23.70 | 4.64 | 59 |
| Gregariousness | (E2) | 18.32 | 5.25 | 67* | 18.95 | 5.82 | 68* |
| Assertiveness | (E3) | 19.80 | 4.47 | 81* | 19.18 | 4.65 | 80* |
| Activity | (E4) | 20.81 | 3.85 | 82* | 21.12 | 3.40 | 78* |
| Excitement-Seeking | (E5) | 22.92 | 3.82 | 91* | 22.29 | 3.92 | 91* |
| Positive Emotions | (E6) | 21.48 | 4.54 | 66* | 23.09 | 4.57 | 73* |
| OPENNESS | (O) | 114.39 | 18.96 | 59 | 124.32 | 17.81 | 79* |
| Fantasy | (O1) | 19.15 | 5.17 | 69* | 19.85 | 5.29 | 81* |
| Aesthetics | (O2) | 17.00 | 6.04 | 54 | 20.08 | 5.26 | 63* |
| Feelings | (O3) | 20.93 | 4.51 | 67* | 22.97 | 4.19 | 74* |
| Actions | (O4) | 16.52 | 4.02 | 63* | 18.73 | 3.98 | 75* |
| Ideas | (O5) | 21.88 | 5.33 | 68* | 21.19 | 4.46 | 74* |
| Values | (O6) | 18.89 | 4.79 | 35* | 21.47 | 3.54 | 62* |
| AGREEABLENESS | (A) | 112.89 | 18.51 | 28* | 118.39 | 18.36 | 23* |
| Trust | (A1) | 20.05 | 4.83 | 39* | 20.59 | 5.34 | 40 |
| Straightforwardness | (A2) | 18.71 | 4.71 | 38* | 19.97 | 4.80 | 31* |
| Altruism | (A3) | 23.26 | 3.87 | 57 | 24.00 | 3.80 | 57 |
| Compliance | (A4) | 16.19 | 4.42 | 30* | 16.25 | 4.32 | 21* |
| Modesty | (A5) | 16.78 | 4.88 | 43 | 18.28 | 4.52 | 35* |
| Tender-Mindedness | (A6) | 17.88 | 4.15 | 33* | 19.30 | 3.44 | 31* |
| CONSCIENTIOUSNESS | (C) | 128.24 | 19.15 | 57 | 124.70 | 20.17 | 52 |
| Competence | (C1) | 24.06 | 3.48 | 72* | 22.68 | 3.79 | 68* |
| Order | (C2) | 18.76 | 4.67 | 54 | 18.82 | 4.95 | 53 |
| Dutifulness | (C3) | 23.72 | 3.74 | 61* | 22.72 | 4.44 | 53 |
| Achievement Striving | (C4) | 22.52 | 4.37 | 84* | 22.12 | 4.05 | 77* |
| Self-Discipline | (C5) | 21.71 | 4.56 | 51 | 21.38 | 4.69 | 42 |
| Deliberation | (C6) | 17.44 | 4.30 | 44 | 16.95 | 4.08 | 50 |

*Note:* * indicates 10% above or below general population norms

Boyd, Patterson, and Thompson (2005) conducted a quantitative study to determine whether significant psychological differences could predict which USAF student pilots are selected to become fighter pilots (FP), bomber pilots (BP), and airlift/tanker pilots (AP). The study linked the Multidimensional Aptitude Battery (MAB) and NEO-PI-R test results of pilots (N = 2,105) to the airframe they were later assigned.

Results indicated that, in terms of the NEO-PI-R, students assigned to fighters reported significantly higher scores in assertiveness (E3), activity (E4), conscientiousness (C), competence (C1), and achievement seeking (C4) than those assigned to airlift/tankers. Students assigned to fighters also reported significantly lower scores in anxiety (N1), self-consciousness (N4), vulnerability (N6), warmth (E1), agreeableness (A), and tender-mindedness (A6) than those assigned to airlift/tankers. Finally, students assigned to bombers reported significantly higher scores in altruism (A3), and tender-mindedness (A6) than those assigned to fighters. These results have been summarized in Tables 8 and 9 below. Again, these tables were adapted into a standardized format by the author from the works of Boyd, Patterson, and Thompson (2005).

Table 8. NEO PI-R Descriptive Information for USAF Fighter, Bomber, and Airlift/Tanker Groups

| Domains/Facets | | Fighter (N = 870) Mean | Fighter (N = 870) SD | Bomber (N = 159) Mean | Bomber (N = 159) SD | Airlift/Tanker (N = 1076) Mean | Airlift/Tanker (N = 1076) SD | P* |
|---|---|---|---|---|---|---|---|---|
| NEUROTICISM | (N) | 45.81 | 9.49 | 47.16 | 9.27 | 46.76 | 9.32 | 0.083 |
| Anxiety | (N1) | 46.34 | 9.30 | 46.69 | 8.72 | 48.15 | 9.30 | 0.000** |
| Angry Hostility | (N2) | 48.37 | 10.40 | 47.63 | 9.72 | 48.02 | 9.72 | 1.000 |
| Depression | (N3) | 46.32 | 7.95 | 46.18 | 7.57 | 46.65 | 7.95 | 1.000 |
| Self-consciousness | (N4) | 45.73 | 9.57 | 46.87 | 10.04 | 47.30 | 9.66 | 0.002** |
| Impulsiveness | (N5) | 48.05 | 11.28 | 47.80 | 10.46 | 48.55 | 10.81 | 1.000 |
| Vulnerability | (N6) | 41.30 | 8.52 | 42.08 | 8.49 | 43.21 | 8.42 | 0.000** |
| EXTRAVERSION | (E) | 57.27 | 9.49 | 58.01 | 10.56 | 57.75 | 9.04 | 0.798 |
| Warmth | (E1) | 51.12 | 9.65 | 51.04 | 10.54 | 52.39 | 9.25 | 0.014** |
| Gregariousness | (E2) | 54.77 | 10.04 | 54.57 | 10.61 | 55.46 | 9.86 | 0.431 |
| Assertiveness | (E3) | 59.23 | 9.06 | 58.02 | 9.63 | 57.20 | 9.03 | 0.000** |
| Activity | (E4) | 59.59 | 8.40 | 58.78 | 9.96 | 57.12 | 8.89 | 0.000** |
| Excitement-Seeking | (E5) | 61.73 | 8.53 | 61.51 | 7.87 | 61.23 | 8.21 | 0.601 |
| Positive Emotions | (E6) | 55.06 | 9.61 | 54.30 | 10.31 | 55.13 | 9.84 | 1.000 |
| OPENNESS | (O) | 50.70 | 10.93 | 50.67 | 9.32 | 51.06 | 9.90 | 1.000 |
| Fantasy | (O1) | 52.61 | 10.99 | 52.49 | 11.01 | 52.96 | 10.28 | 1.000 |
| Aesthetics | (O2) | 48.86 | 11.09 | 48.98 | 10.22 | 49.86 | 10.52 | 0.139 |
| Feelings | (O3) | 51.92 | 11.21 | 52.49 | 9.50 | 53.17 | 11.26 | 0.055 |
| Actions | (O4) | 52.24 | 10.55 | 54.36 | 9.41 | 52.43 | 10.39 | 1.000 |
| Ideas | (O5) | 54.85 | 10.71 | 53.86 | 10.46 | 53.85 | 10.42 | 0.128 |
| Values | (O6) | 46.46 | 10.82 | 45.10 | 10.00 | 47.33 | 10.37 | 0.238 |
| AGREEABLENESS | (A) | 43.45 | 11.03 | 44.94 | 11.07 | 45.33 | 10.66 | 0.000** |
| Trust | (A1) | 50.48 | 10.15 | 49.67 | 11.08 | 50.17 | 10.47 | 1.000 |
| Straightforwardness | (A2) | 48.64 | 10.01 | 48.53 | 10.63 | 48.13 | 10.33 | 0.897 |
| Altruism | (A3) | 51.67 | 10.14 | 54.03 | 9.84 | 52.80 | 10.26 | 0.054 |
| Compliance | (A4) | 46.01 | 11.80 | 46.96 | 12.02 | 47.16 | 10.93 | 0.090 |
| Modesty | (A5) | 46.72 | 10.50 | 47.13 | 12.18 | 47.75 | 10.66 | 0.123 |
| Tender-Mindedness | (A6) | 45.35 | 10.24 | 48.01 | 9.46 | 46.60 | 10.05 | 0.026** |
| CONSCIENTIOUSNESS | (C) | 55.39 | 10.20 | 55.51 | 9.97 | 53.83 | 10.02 | 0.002** |
| Competence | (C1) | 56.81 | 8.86 | 54.91 | 8.68 | 55.06 | 9.04 | 0.000** |
| Order | (C2) | 50.21 | 10.46 | 51.57 | 10.68 | 50.41 | 10.87 | 1.000 |
| Dutifulness | (C3) | 52.89 | 8.82 | 54.14 | 8.67 | 52.07 | 9.19 | 0.165 |
| Achievement Striving | (C4) | 60.22 | 9.15 | 60.29 | 9.85 | 57.95 | 9.40 | 0.000** |
| Self-Discipline | (C5) | 53.07 | 9.53 | 53.09 | 8.08 | 52.01 | 9.60 | 0.055 |
| Deliberation | (C6) | 50.32 | 10.35 | 51.17 | 9.14 | 50.47 | 10.09 | 1.000 |

*p-value comparing fighter and airlift/tanker pilots: Bonferroni α adjustment for multiple comparisons.
**The mean difference is significant at the 0.05 level.

Table 9. NEO PI-R Mean Differences and P-Value for USAF Aircraft Groups

| Domains/Facets | | Fighter vs Airlift/Tanker | | Fighter vs Bomber | |
|---|---|---|---|---|---|
| | | Mean Difference | P* | Mean Difference | P* |
| NEUROTICISM | (N) | 0.094 | 0.083 | 1.349 | 0.288 |
| Anxiety | (N1) | 1.802 | 0.000** | 0.345 | 1.000 |
| Angry Hostility | (N2) | 0.361 | 1.000 | 0.751 | 1.000 |
| Depression | (N3) | 0.329 | 1.000 | 0.139 | 1.000 |
| Self-consciousness | (N4) | 1.569 | 0.002** | 1.145 | 0.637 |
| Impulsiveness | (N5) | 0.497 | 1.000 | 0.254 | 1.000 |
| Vulnerability | (N6) | 1.916 | 0.000** | 0.781 | 0.994 |
| EXTRAVERSION | (E) | 0.474 | 0.798 | 0.732 | 1.000 |
| Warmth | (E1) | 1.269 | 0.014** | 0.008 | 1.000 |
| Gregariousness | (E2) | 0.688 | 0.431 | 0.201 | 1.000 |
| Assertiveness | (E3) | 2.027 | 0.000** | 1.216 | 0.478 |
| Activity | (E4) | 2.472 | 0.000** | 0.814 | 0.992 |
| Excitement-Seeking | (E5) | 0.502 | 0.601 | 0.224 | 1.000 |
| Positive Emotions | (E6) | 0.007 | 1.000 | 0.769 | 1.000 |
| OPENNESS | (O) | 0.368 | 1.000 | 0.003 | 1.000 |
| Fantasy | (O1) | 0.351 | 1.000 | 0.117 | 1.000 |
| Aesthetics | (O2) | 1.006 | 0.139 | 0.126 | 1.000 |
| Feelings | (O3) | 1.241 | 0.055 | 0.568 | 1.000 |
| Actions | (O4) | 0.193 | 1.000 | 2.121 | 0.095 |
| Ideas | (O5) | 1.007 | 0.128 | 0.991 | 0.965 |
| Values | (O6) | 0.869 | 0.238 | 1.365 | 0.514 |
| AGREEABLENESS | (A) | 1.877 | 0.000** | 1.494 | 0.331 |
| Trust | (A1) | 0.307 | 1.000 | 0.805 | 1.000 |
| Straightforwardness | (A2) | 0.502 | 0.897 | 0.106 | 1.000 |
| Altruism | (A3) | 1.139 | 0.054 | 2.365 | 0.044** |
| Compliance | (A4) | 1.157 | 0.090 | 0.956 | 1.000 |
| Modesty | (A5) | 1.033 | 0.123 | 0.408 | 1.000 |
| Tender-Mindedness | (A6) | 1.249 | 0.026** | 2.660 | 0.017** |
| CONSCIENTIOUSNESS | (C) | 1.554 | 0.002** | 0.122 | 1.000 |
| Competence | (C1) | 1.742 | 0.000** | 1.898 | 0.078 |
| Order | (C2) | 0.197 | 1.000 | 1.357 | 0.549 |
| Dutifulness | (C3) | 0.819 | 0.165 | 1.250 | 0.437 |
| Achievement Striving | (C4) | 2.270 | 0.000** | 0.006 | 1.000 |
| Self-Discipline | (C5) | 1.057 | 0.055 | 0.002 | 1.000 |
| Deliberation | (C6) | 0.146 | 1.000 | 0.847 | 1.000 |

*p-value: Bonferroni α adjustment for multiple comparisons.
**The mean difference is significant at the 0.05 level.

In 2010, Chappelle, Novy, Sowin, and Thompson conducted a quantitative study evaluating the NEO PI-R scores of female USAF pilots. Aiming to illuminate objective traits and differences in personality traits as well as assist clinical psychologists in their evaluation of USAF female pilots, this study compared the personality traits of USAF female pilots to male USAF pilots, as well as non-pilot females in the civilian population.

Furthermore, the study analyzed the NEO PI-R scores across platform assignment, looking for significant differences between personality profiles and assigned platform. The data for this study was collected from female and male USAF pilots (N = 512 and N = 9,630 respectively). Within the sample of female USAF pilots, fifty-eight were classified as fighter/bomber pilots, three hundred thirty-five were tanker/transport pilots, thirty-eight were classified as reconnaissance pilots, twelve were helicopter pilots, and sixty-nine were instructor pilots. Results of the study have been summarized in Tables 10 and 11 below, as well as Table 18 found in Appendix A. These tables were adapted from Chappelle, Novy, Sowin, and Thompson (2010). Results revealed that the NEO PI-R personality profiles of female USAF pilots are closer to those of male USAF pilots than to non-pilot females in the civilian population. With regard to differences in personality according to aircraft assignment, no significant differences were discovered between the personality profiles of female USAF pilots operating different airframes (Chappelle, Novy, Sowin, & Thompson, 2010).

Table 10. NEO PI-R Descriptive Information for USAF Female, USAF Male, and Female Normative Sample Groups

| Domains/Facets | | Female Pilots | | *Female Normative Sample | | Male Pilots | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD |
| NEUROTICISM | (N) | 74.46 | 20.9 | 83.1 | 21.7 | 68.22 | 18.2 |
| Anxiety | (N1) | 14.30 | 5.1 | 15.4 | 5.4 | 12.25 | 4.5 |
| Angry Hostility | (N2) | 12.11 | 4.8 | 12.6 | 4.8 | 11.87 | 4.4 |
| Depression | (N3) | 10.79 | 4.7 | 12.9 | 5.6 | 9.98 | 4.2 |
| Self-consciousness | (N4) | 13.44 | 4.7 | 15.0 | 4.5 | 12.61 | 4.3 |
| Impulsiveness | (N5) | 15.92 | 4.8 | 16.3 | 4.6 | 14.87 | 4.4 |
| Vulnerability | (N6) | 7.91 | 3.4 | 10.9 | 4.0 | 10.90 | 3.2 |
| EXTRAVERSION | (E) | 132.83 | 17.6 | 110.3 | 18.4 | 127.73 | 17.0 |
| Warmth | (E1) | 24.37 | 4.0 | 23.6 | 3.8 | 23.06 | 3.8 |
| Gregariousness | (E2) | 19.67 | 5.2 | 17.0 | 4.7 | 19.00 | 4.9 |
| Assertiveness | (E3) | 20.15 | 4.3 | 15.4 | 4.8 | 20.17 | 4.3 |
| Activity | (E4) | 21.92 | 3.9 | 17.8 | 4.4 | 20.72 | 3.7 |
| Excitement-Seeking | (E5) | 22.84 | 3.9 | 15.7 | 5.1 | 23.29 | 3.6 |
| Positive Emotions | (E6) | 23.89 | 4.3 | 20.8 | 4.5 | 21.49 | 4.3 |
| OPENNESS | (O) | 123.63 | 17.6 | 111.0 | 17.2 | 112.94 | 18.1 |
| Fantasy | (O1) | 19.38 | 5.0 | 18.5 | 5.0 | 18.20 | 4.9 |
| Aesthetics | (O2) | 19.43 | 5.7 | 18.5 | 5.1 | 16.12 | 5.7 |
| Feelings | (O3) | 22.77 | 3.9 | 20.8 | 4.5 | 20.66 | 4.2 |
| Actions | (O4) | 18.54 | 3.8 | 16.8 | 3.6 | 16.80 | 3.9 |
| Ideas | (O5) | 21.90 | 4.9 | 18.2 | 5.0 | 21.85 | 5.2 |
| Values | (O6) | 21.62 | 4.0 | 20.5 | 3.8 | 19.30 | 4.5 |
| AGREEABLENESS | (A) | 119.94 | 16.1 | 128.5 | 14.4 | 114.43 | 16.6 |
| Trust | (A1) | 21.33 | 4.6 | 21.7 | 4.0 | 20.46 | 4.3 |
| Straightforwardness | (A2) | 20.34 | 4.4 | 22.2 | 4.3 | 18.96 | 4.4 |
| Altruism | (A3) | 24.44 | 3.6 | 24.3 | 3.2 | 23.61 | 3.6 |
| Compliance | (A4) | 16.53 | 4.3 | 19.6 | 4.1 | 16.17 | 4.1 |
| Modesty | (A5) | 18.11 | 4.6 | 19.7 | 3.8 | 16.76 | 4.7 |
| Tender-Mindedness | (A6) | 19.19 | 3.3 | 21.0 | 3.1 | 18.47 | 3.7 |
| CONSCIENTIOUSNESS | (C) | 129.60 | 17.8 | 122.7 | 17.8 | 130.86 | 17.4 |
| Competence | (C1) | 23.74 | 3.3 | 21.8 | 3.5 | 24.45 | 3.3 |
| Order | (C2) | 19.29 | 4.6 | 19.1 | 4.2 | 18.99 | 4.3 |
| Dutifulness | (C3) | 23.35 | 3.8 | 23.2 | 3.8 | 24.04 | 3.6 |
| Achievement Striving | (C4) | 23.36 | 3.9 | 19.6 | 3.9 | 23.07 | 3.8 |
| Self-Discipline | (C5) | 22.47 | 4.3 | 21.7 | 4.4 | 22.64 | 4.1 |
| Deliberation | (C6) | 17.39 | 4.1 | 17.3 | 4.3 | 17.69 | 4.2 |

*Note*: *Adapted and reproduced by special permission of the publisher Psychological Assessment Resources, Inc., 16204 North Florida Avenue, Lutz Florida 33549, from the NEO Personality Inventory—Revised Manual, by Paul T. Costa, Jr., PhD, and Robert McCrae, PhD. Copyright 1985, 1992 by Psychological Assessment Resources, Inc. Further reproduction is prohibited without permission of PAR.

Table 11. Comparisons between NEO PI-R Scores of the USAF Female Group and the Normative Female and USAF Male Groups

| Domains/Facets | | Female Pilots vs. Female Normative Sample | | Female Pilots vs. Male Pilots | |
|---|---|---|---|---|---|
| | | P-Value | Effect Size | P-Value | Effect Size |
| NEUROTICISM | (N) | .00 | –.41 | .00 | .32 |
| Anxiety | (N1) | .00 | –.21 | .00 | .39 |
| Angry Hostility | (N2) | .11 | –.10 | .27 | .05 |
| Depression | (N3) | .00 | –.41 | .00 | .16 |
| Self-consciousness | (N4) | .00 | –.34 | .00 | .18 |
| Impulsiveness | (N5) | .20 | –.08 | .20 | .22 |
| Vulnerability | (N6) | .00 | –.80* | .00 | –.80* |
| EXTRAVERSION | (E) | .00 | 1.25* | .00 | .28 |
| Warmth | (E1) | .00 | .20 | .00 | .34 |
| Gregariousness | (E2) | .00 | .54* | .00 | .14 |
| Assertiveness | (E3) | .00 | 1.04* | .92 | .00 |
| Activity | (E4) | .00 | 1.05* | .00 | .31 |
| Excitement-Seeking | (E5) | .00 | 1.60* | .01 | –.10 |
| Positive Emotions | (E6) | .00 | .71* | .00 | .55* |
| OPENNESS | (O) | .00 | .73* | .00 | .61* |
| Fantasy | (O1) | .01 | .18 | .00 | .24 |
| Aesthetics | (O2) | .01 | .17 | .00 | .62* |
| Feelings | (O3) | .00 | .50* | .00 | .52* |
| Actions | (O4) | .00 | .47 | .00 | .47 |
| Ideas | (O5) | .00 | .75* | .82 | .01 |
| Values | (O6) | .00 | .29 | .00 | .59* |
| AGREEABLENESS | (A) | .00 | –.56* | .00 | .36 |
| Trust | (A1) | .17 | –.09 | .00 | .20 |
| Straightforwardness | (A2) | .00 | –.43 | .00 | .32 |
| Altruism | (A3) | .51 | .04 | .00 | .25 |
| Compliance | (A4) | .00 | .73* | .07 | .09 |
| Modesty | (A5) | .00 | –.38 | .00 | .32 |
| Tender-Mindedness | (A6) | .00 | –.56* | .00 | .22 |
| CONSCIENTIOUSNESS | (C) | .00 | .39 | .12 | –.07 |
| Competence | (C1) | .00 | .57* | .00 | –.21 |
| Order | (C2) | .50 | .04 | .16 | .07 |
| Dutifulness | (C3) | .53 | .04 | .00 | –.18 |
| Achievement Striving | (C4) | .00 | .96* | .10 | .07 |
| Self-Discipline | (C5) | .01 | .18 | .38 | –.04 |
| Deliberation | (C6) | .73 | .02 | .11 | –.07 |

*Note.* * indicates scores that are considered to be clinically meaningful based upon a significant t-test with moderate to large effect size and power of .80 or larger.

In the same year, Chappelle, McDonald, and King (2010) conducted a qualitative study consolidating data from several Subject Matter Experts (SMEs) regarding the attributes needed to successfully complete training and adapt to the operational demands of the sensor operator position in the MQ-1 Predator, and MQ-9 Reaper. Data for this

study was collected from UAS SMEs (N = 69) including, forty-seven MQ-1 Predator and MQ-9 Reaper pilots, sixteen Sensor Operators, and six mission intelligence coordinators. While the study identified four domains within the responses of these SMEs including (1) physical health, (2) cognitive ability, (3) personality traits, and (4) motivation, only the results for domains (2) through (4) will be reported here. Within cognitive ability, SMEs perceived that SOs with high levels of the following aptitudes performed well and more readily adapted to the rigors and unique demands of UAS platforms, Cognitive Proficiency, Visual Perception, Attention, Spatial Processing, Memory, and Reasoning. It was perceived that SOs without adequate levels of these aptitudes struggled with timely skills acquisition, task management and prioritization, situational awareness, channelized attention, and general problem solving[3].

With regard to personality traits, the SMEs identified the following non-cognitive capabilities and traits which they perceived affected SO duty performance and adaptation to the unique nature of UAS operations, Composure, Resilience, Self-Certainty, Conscientiousness, Success Orientated, Perseverance, Decisiveness, Humility, Cohesiveness, Assertiveness, and Adaptability. These traits and their operational definitions are summarized in Table 12 which has been adapted from Chappelle, McDonald, and King (2010). Finally, within the final domain of motivation, the SMEs identified the factors of Moral Interest, and Occupational Interest as affecting SO performance and longevity. The authors hope that these study results increase the

[3] Authors note that at the time of writing it was unclear which cognitive attributes have the greatest impact on performance and if lack of success was truly the result of inadequate levels of cognitive aptitudes.

understanding of specific psychological attributes critical to SO performance and improve aeromedical assessment and selection procedures in this field.

Table 12. Personality Traits Reported as Critical to Training and Operational Performance of USAF MQ-1 and MQ-9 SOs

| DOMAIN | ATTRIBUTE | OPERTIONAL DEFINITION |
|---|---|---|
| PERSONALITY TRAITS | Composure | • Remains composed and in control of behavior and emotions under stress<br>• Effectively compartmentalizes emotions |
| This domain refers to non-cognitive capabilities and traits that effect SO duty performance and adaptation to the unique nature of UAS operations and community | Resilience | • Emotional stamina and hardiness in response to monotony, confined workspace, and high pressure situations |
| | Self– Certainty | • Clear sense of self-confidence<br>• Clear sense of role as war-fighter<br>• Maintains confidence during performance feedback |
| | Conscientiousness | • Deliberate, methodical, and organized<br>• Self-disciplined |
| | Success Oriented | • Self-motivated and driven to succeed<br>• Committed to self-improvement |
| Common elements related to performance include: general ability to identify and regulate emotions, positive self-regard, self-confidence, self-discipline, self-esteem, hardiness, impulse control, self-direction, general emotional disposition, and motivation to realize and act upon one's potentials. | Perseverance | • Sustains a high level of effort over long periods of time despite hardships |
| | Decisiveness | • "Real time" decision making during monotony and high pressure situations |
| | Humility | • Effectively recognizes the need and asks for help<br>• Seeks and accepts performance feedback from others |
| | Cohesiveness | • Values the role and support of other personnel<br>• Participates in morale building exchanges |
| | Assertiveness | • Speaks up and effectively voices concerns in "real time"<br>• Provides appropriate and decisive feedback |
| | Adaptation | • Generally flexible, realistic, and effectively responds to change and unpredictable stressors |

Barto, et al (2011) conducted a quantitative study comparing the NEO PI-R scores of a large USAF pilot sample to those of commercially published norms in an effort to support the use of both sets of norms in clinical evaluation. The study sampled USAF pilot training candidates (N = 12,702) prior to their admission to SUPT. Study results indicated substantial mean differences between the pilot sample and the normative data for the neuroticism (N), extraversion (E), agreeableness (A), and consciousness (C) factors. Subjects in the pilot group scored lower on neuroticism (N) and agreeableness

(A) and higher on extraversion (E), openness (O) and consciousness (C) (Barto, Chappelle, King, Ree, & Teachout, 2011). Of particular note was that female pilots scored much higher on extraversion (E) and openness (O) than their normative counterparts, which was consistent with the findings of (Chappelle, Novy, Sowin, & Thompson, 2010). The results of each of these analyses have been summarized in Tables 13, 14, and 15 below, which have been adapted from the work of Barto, et al (2010). The significant differences between pilots and the normative population suggest that USAF pilots are a highly selected group and "that clinical evaluations might be quite different if only the normative population was used as a comparison group" (Barto, Chappelle, King, Ree, & Teachout, 2011, p. 12). Other research has concluded that highly selected and trained aviators should be compared to other aviators rather than the general population (King, 1994).

Table 13. NEO PI-R Descriptive Information for USAF Male and Male Normative Sample Groups

| Domains/Facets | | USAF Male Pilots (N = 11,725) Mean | USAF Male Pilots (N = 11,725) SD | Male Normative Sample (N = 500) Mean | Male Normative Sample (N = 500) SD |
|---|---|---|---|---|---|
| NEUROTICISM | (N) | 67.88 | 18.39 | 75.2 | 19.9 |
| Anxiety | (N1) | 12.19 | 4.51 | 13.3 | 4.9 |
| Angry Hostility | (N2) | 11.78 | 4.44 | 12.2 | 4.5 |
| Depression | (N3) | 9.97 | 4.30 | 12.6 | 5.2 |
| Self-consciousness | (N4) | 12.58 | 4.25 | 13.7 | 4.3 |
| Impulsiveness | (N5) | 14.69 | 4.44 | 15.3 | 4.2 |
| Vulnerability | (N6) | 6.66 | 3.25 | 9.2 | 3.7 |
| EXTRAVERSION | (E) | 127.68 | 17.15 | 108.5 | 18.5 |
| Warmth | (E1) | 23.11 | 3.88 | 22.3 | 4.0 |
| Gregariousness | (E2) | 19.01 | 5.01 | 16.0 | 4.9 |
| Assertiveness | (E3) | 20.21 | 4.37 | 16.3 | 4.7 |
| Activity | (E4) | 20.69 | 3.67 | 17.3 | 4.3 |
| Excitement-Seeking | (E5) | 23.19 | 3.66 | 17.2 | 4.7 |
| Positive Emotions | (E6) | 21.46 | 4.36 | 19.5 | 4.3 |
| OPENNESS | (O) | 112.94 | 18.10 | 110.1 | 17.5 |
| Fantasy | (O1) | 18.23 | 4.97 | 17.0 | 4.7 |
| Aesthetics | (O2) | 16.14 | 5.68 | 16.7 | 5.4 |
| Feelings | (O3) | 20.66 | 4.23 | 19.7 | 3.8 |
| Actions | (O4) | 16.77 | 3.97 | 16.1 | 3.8 |
| Ideas | (O5) | 21.94 | 5.22 | 19.8 | 5.0 |
| Values | (O6) | 19.20 | 4.49 | 20.8 | 4.5 |
| AGREEABLENESS | (A) | 114.78 | 16.61 | 120.1 | 16.1 |
| Trust | (A1) | 20.39 | 4.42 | 20.9 | 4.3 |
| Straightforwardness | (A2) | 19.10 | 4.41 | 20.3 | 4.3 |
| Altruism | (A3) | 23.72 | 3.54 | 22.8 | 3.6 |
| Compliance | (A4) | 16.18 | 4.17 | 18.1 | 3.7 |
| Modesty | (A5) | 16.84 | 4.69 | 18.1 | 4.4 |
| Tender-Mindedness | (A6) | 18.55 | 3.72 | 19.9 | 3.8 |
| CONSCIENTIOUSNESS | (C) | 131.40 | 17.55 | 123.6 | 17.4 |
| Competence | (C1) | 24.48 | 3.28 | 22.5 | 3.5 |
| Order | (C2) | 19.08 | 4.30 | 18.9 | 4.1 |
| Dutifulness | (C3) | 24.19 | 3.56 | 23.2 | 3.9 |
| Achievement Striving | (C4) | 23.07 | 3.85 | 19.3 | 4.1 |
| Self-Discipline | (C5) | 22.69 | 4.13 | 21.8 | 4.2 |
| Deliberation | (C6) | 17.89 | 4.17 | 17.8 | 4.0 |

Table 14. NEO PI-R Descriptive Information for the USAF Female and Female Normative Sample Groups

| Domains/Facets | | USAF Female Pilots (N = 900) | | Female Normative Sample (N = 500) | |
|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD |
| NEUROTICISM | (N) | 74.01 | 20.81 | 83.1 | 21.7 |
| Anxiety | (N1) | 14.06 | 4.85 | 15.4 | 5.4 |
| Angry Hostility | (N2) | 11.93 | 4.63 | 12.6 | 4.8 |
| Depression | (N3) | 10.86 | 4.99 | 12.9 | 5.6 |
| Self-consciousness | (N4) | 13.38 | 4.65 | 15.0 | 4.5 |
| Impulsiveness | (N5) | 15.78 | 4.84 | 16.3 | 4.6 |
| Vulnerability | (N6) | 7.99 | 3.43 | 10.9 | 4.0 |
| EXTRAVERSION | (E) | 132.69 | 17.19 | 110.3 | 18.4 |
| Warmth | (E1) | 24.44 | 3.96 | 23.6 | 3.8 |
| Gregariousness | (E2) | 19.69 | 5.20 | 17.0 | 4.7 |
| Assertiveness | (E3) | 20.10 | 4.35 | 15.4 | 4.8 |
| Activity | (E4) | 21.78 | 3.54 | 17.8 | 4.4 |
| Excitement-Seeking | (E5) | 22.69 | 3.86 | 15.7 | 5.1 |
| Positive Emotions | (E6) | 23.99 | 4.18 | 20.8 | 4.5 |
| OPENNESS | (O) | 123.58 | 17.04 | 111.0 | 17.2 |
| Fantasy | (O1) | 19.12 | 5.00 | 16.2 | 5.0 |
| Aesthetics | (O2) | 19.58 | 5.46 | 18.5 | 5.1 |
| Feelings | (O3) | 22.77 | 3.87 | 20.8 | 4.1 |
| Actions | (O4) | 18.55 | 3.76 | 16.8 | 3.6 |
| Ideas | (O5) | 21.98 | 4.80 | 18.2 | 5.0 |
| Values | (O6) | 21.57 | 3.99 | 20.5 | 3.8 |
| AGREEABLENESS | (A) | 121.25 | 15.90 | 128.5 | 14.4 |
| Trust | (A1) | 21.49 | 4.59 | 21.7 | 4.0 |
| Straightforwardness | (A2) | 20.69 | 4.32 | 22.2 | 4.3 |
| Altruism | (A3) | 24.73 | 3.43 | 24.3 | 3.2 |
| Compliance | (A4) | 16.68 | 4.29 | 19.6 | 4.1 |
| Modesty | (A5) | 18.33 | 4.45 | 19.7 | 3.8 |
| Tender-Mindedness | (A6) | 19.31 | 3.34 | 21.0 | 3.1 |
| CONSCIENTIOUSNESS | (C) | 129.86 | 18.65 | 122.7 | 17.8 |
| Competence | (C1) | 23.75 | 3.40 | 21.8 | 3.5 |
| Order | (C2) | 19.25 | 4.66 | 19.1 | 4.2 |
| Dutifulness | (C3) | 23.51 | 3.79 | 23.2 | 3.8 |
| Achievement Striving | (C4) | 23.33 | 3.94 | 19.6 | 3.9 |
| Self-Discipline | (C5) | 22.49 | 4.44 | 21.7 | 4.4 |
| Deliberation | (C6) | 17.54 | 4.19 | 17.3 | 4.3 |

Table 15. NEO PI-R Descriptive Information for USAF Total Sample and Total Normative Sample Groups

| Domains/Facets | | USAF Pilots (N = 12,072) Mean | USAF Pilots (N = 12,072) SD | Normative Sample (N = 1000) Mean | Normative Sample (N = 1000) SD |
|---|---|---|---|---|---|
| NEUROTICISM | (N) | 68.34 | 18.65 | 79.1 | 21.2 |
| Anxiety | (N1) | 12.33 | 4.56 | 14.3 | 5.3 |
| Angry Hostility | (N2) | 11.80 | 4.46 | 12.4 | 4.6 |
| Depression | (N3) | 10.04 | 4.36 | 12.3 | 5.4 |
| Self-consciousness | (N4) | 12.64 | 4.28 | 14.3 | 4.4 |
| Impulsiveness | (N5) | 14.78 | 4.47 | 15.8 | 4.4 |
| Vulnerability | (N6) | 6.76 | 3.28 | 10.0 | 3.9 |
| EXTRAVERSION | (E) | 128.01 | 17.20 | 109.4 | 18.4 |
| Warmth | (E1) | 23.20 | 3.90 | 22.9 | 4.0 |
| Gregariousness | (E2) | 19.06 | 5.03 | 16.5 | 4.8 |
| Assertiveness | (E3) | 20.20 | 4.37 | 15.8 | 4.7 |
| Activity | (E4) | 20.76 | 3.67 | 17.6 | 4.4 |
| Excitement-Seeking | (E5) | 21.15 | 3.68 | 16.4 | 4.9 |
| Positive Emotions | (E6) | 21.64 | 4.39 | 20.2 | 4.5 |
| OPENNESS | (O) | 114.70 | 18.23 | 110.6 | 17.3 |
| Fantasy | (O1) | 18.30 | 4.98 | 16.6 | 4.9 |
| Aesthetics | (O2) | 16.39 | 5.73 | 17.6 | 5.3 |
| Feelings | (O3) | 20.81 | 4.24 | 20.3 | 4.0 |
| Actions | (O4) | 16.89 | 3.98 | 16.4 | 3.7 |
| Ideas | (O5) | 21.94 | 5.19 | 19.0 | 5.0 |
| Values | (O6) | 19.37 | 4.49 | 20.7 | 4.1 |
| AGREEABLENESS | (A) | 115.23 | 16.64 | 124.3 | 15.8 |
| Trust | (A1) | 20.47 | 4.44 | 21.3 | 4.2 |
| Straightforwardness | (A2) | 19.21 | 4.42 | 21.2 | 4.4 |
| Altruism | (A3) | 23.78 | 3.54 | 23.6 | 3.5 |
| Compliance | (A4) | 16.21 | 4.18 | 18.9 | 4.0 |
| Modesty | (A5) | 16.95 | 4.68 | 18.9 | 4.2 |
| Tender-Mindedness | (A6) | 18.60 | 3.70 | 20.5 | 3.5 |
| CONSCIENTIOUSNESS | (C) | 131.26 | 17.65 | 123.1 | 17.6 |
| Competence | (C1) | 24.42 | 3.30 | 22.2 | 3.5 |
| Order | (C2) | 19.09 | 4.33 | 19.0 | 4.2 |
| Dutifulness | (C3) | 24.14 | 3.58 | 23.2 | 3.9 |
| Achievement Striving | (C4) | .23.08 | 3.86 | 19.5 | 4.0 |
| Self-Discipline | (C5) | 22.67 | 4.15 | 21.8 | 4.3 |
| Deliberation | (C6) | 17.87 | 4.17 | 17.5 | 4.1 |

These studies of personality in the USAF further solidify the concept that significant personality differences can be noted, not only across occupations, but also across aspects such as aircraft assignment, gender, and career. These studies also stress

that highly selected and trained aviators should be clinically assessed against other aviators, rather than the adult norm (King, 1994).

*United states army.*

Grice and Katz (2007) conducted a quantitative study examining the NEO PI-R profiles of U.S. Army student aviators awaiting Initial Entry Rotary Wing Training, and compared them to a sample of U.S. Army aviators. With the purpose of identifying personality differences and similarities between the groups, the authors planned to use this data as the foundation for longitudinal research. Male U.S. Army student aviators (N = 196) and U.S. Army career pilots (N = 75) were compared to one another as well as normative personality scales.

Regarding the personality profiles of the male U.S. Army student aviators, it was found that this group was higher than average in the extraversion (E) factor, average in the neuroticism (N), openness (O), and conscientiousness (C) factors, and lower than average in the agreeableness (A) factor as compared to the normative sample. This profile, "… suggests that these student aviators, although outgoing and assertive, are more concerned with individualism and improving individual competence than maintaining social relationships that consume their time and energy" (Grice & Katz, 2007, p. 18).

At the facet level, the male U.S. Army student aviator group scored in the average range of the normative sample on all but three facets. In the extraversion (E) factor, the group scored high in the assertiveness (E3), activity (E4), and excitement-seeking (E5) facets. When compared to the U.S. Army career pilots, the student pilot group was found to score higher in neuroticism (N), extraversion (E), and openness (O), but lower in

agreeableness (A) at the factor level. With respect to facet scores, the student pilot group scored higher in vulnerability (N6), excitement-seeking (E5), aesthetics (O2), and compliance (A4), but lower in the facets of competence (C1) and achievement striving (C4).

Three possible reasons are offered accounting for the differences between the U.S. Army pilots at the student and career level (Grice & Katz, 2007). First, there is a possibility that a sorting effect has caused aviators with personalities not conductive to Army aviation to be eliminated from military service. Second, the personality of contemporary students may be different than those of the mid-1980s. Several changes in Army aviation such as the requiring of a college degree might attract or require different types of personalities. Finally, these changes may be due to some adaptation effect brought on by the organizational environment of Army aviation.

While relatively short as compared to research in other branches of the U.S. military, this study offers support for the idea that individual traits have a tendency to vary throughout adult life as a result of maturation and social factors (Conley, 1984).

**Aviation selection methods.**

Pilot selection methods in the military can be traced as far back as World War I (Carretta & Ree, 2003). The paragraphs that follow will review the results of several studies related to pilot selection methods primarily within the USAF, however exploratory research on the pilot selection in the United States Navy has been included as well.

Meta analytic research conducted by Martinussen (1996) reviewed validity evidence for the psychological measures used in pilot selection. Sixty-six independent

samples from fifty studies were analyzed, and predictors of pilot performance were identified according to mean validity (Martinussen, 1996). Ranking highest was previous training experience (.30) followed by a combination of indices categorized as cognitive and psychomotor tests (.37). Personality, intelligence, and academic tests yielded mean validities of (.14), (.16), and (.15) respectively (Martinussen, 1996). Other meta analytic research investigated studies using personality constructs to predict military training outcomes (Campbell, Castaneda, & Pulos, 2010). Focusing on the constructs appearing most frequently, results revealed the largest mean effect in neuroticism (N) ($r = -.15$), extroversion (E) ($r = .13$), and anxiety (N1) ($r = -.11$), meaning that the (N), (E), and (N1) constructs had the greatest magnitude of effect on training outcomes. Correction for predictor reliability and range restriction further increased the validity coefficient of neuroticism (N) to ($r = -.25$), indicating that more psychometrically reliable and sensitive instruments could allow substantial improvements in such selection methods (Campbell, Castaneda, & Pulos, 2010). A final meta-analysis revealed a mean sample-weighted correlation of ($r = .10$) for personality as a predictor in aircraft pilot selection studies published from 1940-1990 (Hunter & Burke, 1994).

Studies specific to the USAF were found reaching back to 1994 (Carretta & Ree, 1994). Analysis of USAF pilot training candidates (N= 678) revealed that measures of flying experience, psychomotor skills, and attitude toward risk increased the prediction criteria (i.e. pass-fail fight training, and class rank at the end of flight training) above that of a USAF aptitude battery by 23% (Carretta & Ree, 1994). Longitudinal research by Retzlaff, King, and Callister (1995), analyzed pilot training completion and length of service for USAF officers (N= 350) ten years after completing the MAB, Personality

Research Form, and Millon Clinical Multiaxial Inventory (MCMI). While no differences were found among the training completions groups, a number of consistent personality variables were found to be correlated with length of service (Retzlaff, King, & Callister, 1995). Those individuals scoring least playful on the Personality Research Form, and highest in compulsiveness on the MCMI were found to remain on active duty the longest, while the most dysthymic of the MCMI spent the least amount of time in the service (Retzlaff, King, & Callister, 1995). Those of particular applicability to this proposed research, the factors measured by the NEO PI-R have been determined to possess "great utility (savings in costs and man-hours) as part of a battery of tools for screening potential pilots" (Anesgart & Callister, 2001, p. 10). Analysis of individuals graduated from Air Force reserve Officer Training, and accepted into the USAF enhanced flight screening program (N = 1031) indicated that candidates with high scores in the factors of neuroticism (N) and low on extraversion (E) are 10 times more likely to self-eliminate from flight training than the average candidate. Furthermore, results showed that candidates scoring "very high on neuroticism (N), very low on extraversion (E), and low on openness (O) are 50 times more likely to self-eliminate then is the average candidate" (Anesgart & Callister, 2001, p. 10).

More contemporary quantitative research (Carretta, 2011) has examined the predictive validity of the contemporary Pilot Candidate Selection Method (PCSM) against aspects of training performance in students attending Specialized Undergraduate Pilot Training (SUPT). The USAF has utilized the PCSM since 1993, and composite scores have been shown to relate to pilot training elimination and graduation (Carretta & Ree, 2003). The study examined the composite scores of USAF officers (N = 883)

accepted for SUPT and compared these to training criteria such as graduation/elimination, academic grades, daily flying grades, and check flight grades. As in previous work with the PCSM (Carretta & Ree, 1994), results indicated significant correlations in each training aspect. Of note is that the experimental inclusion of an experimental personality measure, the Self-Description Inventory (SDI+). The SDI+ composite scores, which measure the FFM personality traits, contributed small, but statistically significant increments in validity when combined with the PCSM. Despite its low predictive validity in initial pilot training, Carretta notes that personality should not be ignored in the selection process, as it has been shown to be predictive of occupational criteria such as aircraft mishaps and accidents. Furthermore, when discussing the optimization of the PCSM, Carretta notes that "… Identify[ing] content areas not currently covered by the AFOQT or TBAS … could account for additional reliable variance in training performance." (Carretta, 2011, p. 7) It is further noted that Interpersonal/Personality (e.g. integrity, assuming responsibility, cooperativeness, and decisiveness) is among the highest rated constructs not currently measured by the AFOQT or TBAS selection tests.

Concerning the U.S. Navy, multiple-linear discriminant-function analysis indicated that measures of competitiveness were able to distinguish between individuals passing and failing U.S. navy pilot training (Street, Helton, & Dolgin, 1992). This study further revealed that combining these competitive measures with aptitude scores produced an even stronger discriminant function (Street, Helton, & Dolgin, 1992).

These studies collectively offer that the measurement of personality, particularly instruments measuring FFM traits such as the NEO PI-R, has had a small but valid place

in the composition of pilot selection methods for the United States military. Furthermore, very contemporary works (Carretta, 2011) vouch for its importance as these same pilot selection methods are refined in the future.

**Assumptions**

The design of the research described below relies on the following assumptions:

(1) All assumptions associated with the BFI Personality Inventory

(2) Submission of a single response set from each participant in the UAS student group. Response independence must be assumed, as no identifying information was collected to ensure participant confidentiality

# CHAPTER II

# METHODOLOGY

This quantitative study examines the FFM personality profiles of students enrolled with either a Pre UAS Operations or UAS Operations major at the University of North Dakota in the fall semester of 2013. Using the BFI general personality index, the responses of this group were compared against a normative sample of college students collected previously (Petros, 2013). This comparison will allow for the identification of differences and similarities between those students interested in pursuing studies in UAS and the general population. The following methodology sections outline and reflect designs and practices found in other published work related to the NEO PI-R and BFI personality inventories.

Carretta and Ree (2003) caution against several methodological issues associated with studies of personnel measurement and selection. As the results of this study may serve as the foundation for future research in pilot selection, the issues most applicable are of construct and statistical power. While the alpha reliabilities of the BFI scales are well established (John & Srivastava, 1999), concern for statistical power, or the ability of their tests to detect an effect of a particular size (Field, 2009), in this area of study is well placed. Many of the quantitative studies reviewed in the previous section failed to report the power of their test statistics, if inferential statistics were used to draw conclusions at all. As a remedy to this, the present study aimed for a statistical power of at least .8, and setting significance at $p < 0.05$. With these variables set, a sample of 85 subjects should

be sufficient to detect differences with a medium effect size (r =.3), and a sample of 28 subjects should detect differences with a large effect size (r=.5) (Cohen, 1992).

**Population**

The subject population for this study consisted of students enrolled as either Pre UAS Operations, or UAS Operations majors at the University of North Dakota. According to official enrollment reports, this population contained 123 students for the fall semester of 2013. Of this population, 42 students (41 males) are Pre UAS Operations, and 81 (75 males) have declared UAS Operations as either their first or second major (Office of Institutional Research, 2013). Subjects were not be separated by race, or gender in this study.

**Sample**

Of the 123 students with either Pre UAS Operations, or UAS Operations declared as a first or second major, 65 responses were gathered into the UAS Student sample group for a 52.84% response rate. The average age of respondents was 22.14, and no responses to the BFI were excluded from analysis. As no identifying information was collected on respondents to ensure subjects could not be individually identified, it is possible a student enrolled in more than one of the classes, or attending both of the one hour sessions outlined above, could have submitted multiple responses. However, it was requested by the principle investigator prior to distribution of the instrument that students participate only once. The analysis and results below are based on the assumption that this request was respected.

A second sample, collected previously (Petros, 2013), was used as a control group and consisted of BFI responses from 248 individuals. Unlike the UAS sample, scores for

several FFM factors were excluded from analysis in this group due to incompleteness. Specifically, 237 responses were included in the Normative sample's neuroticism (N) score, 234 were included in the extraversion (E) factor score, 235 were included in the openness (O) factor score, 234 were included in the agreeableness (A) factor score, and 233 were included in the conscientiousness (C) factor score.

**Instrument**

The BFI is a brief questionnaire, shown in Appendix C, which asses the Big Five personality domains and is freely available for use in research. This particular measure of the five factor model of personality was chosen for several reasons. First and foremost, the BFI, as opposed to the NEO PI-R, has been made freely available. Second, its brevity allows for efficient assessment of the FFM which the author believed would increase response rate as well as allow for distribution of the instrument within class time for the participants. Lastly, the scales of the BFI have shown strong correlations with the NEO PI-R which permeates the majority of applicable previous works.

As explained above, the BFI is a general personality inventory which focuses on identifying five factor model personality traits, as opposed to an aviation specific test or an inventory designed to identify pathology. The BFI is a 44 item self-report personality battery, which allows subjects to respond to each statement on a five point Likert scale ranging from "strongly disagree" to "strongly agree." Each subject's scores are divided into five domains (i.e. Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness). The test is self-paced, and was administered under the supervision of the principal investigator. Following completion, the raw BFI scores were aggregated and

analyzed to identify differences in personality that may exist between the two sample groups.

**Data Collection and Analysis**

This study was reviewed and approved by the University of North Dakota's Institutional Review Board on August 20th, 2013 as IRB Project IRB-201308-047. Subjects were informed of this study during short presentations to the Avit 226 Introduction to UAS, Avit 331 Systems of Unmanned Aircraft, Avit 332 UAS Ground Control Systems, Avit 333 UAS Sensor Systems, Avit 334 UAS Communication and Telemetry Systems, and Avit 338 UAS Operations classes. Advertisements (i.e. Appendix B) were also posted throughout the on campus aerospace facilities targeting students enrolled as either a Pre UAS Operations, or UAS Operations major. Subjects were briefed on the purpose and nature of the study both in the classroom presentations and prior to receiving the survey. The Big Five Inventory (BFI) was made available for completion during each class visited as well as two one hour time slots in Odegard Hall, Rm. 114, supervised by the principal investigator. The instrument was distributed to and collected from subjects by the principal investigator and subject responses were kept anonymous. The duration of subject participation did not extend beyond completion of the BFI, and no compensation was provided. Following collection, respondents' scores were aggregated and stored for analysis on a password protected drive, encrypted using Advanced Encryption Standard (AES) algorithms.

Using SPSS 21 statistics software, descriptive and inferential statistics were collected from the data. The means, standard deviations, minimum, maximum, range, and measures of skewness and kurtosis indices were calculated using the raw scores from

each of the groups. A one-way Analysis of Variance (ANOVA) assessed potential relationships between the independent variables (sample group) and the dependent variables (BFI factor scores). Significance in all statistical tests were set at a minimum of $p < 0.05$, though significance above $p < 0.01$ and $p < 0.001$ were denoted when necessary.

# CHAPTER III

# RESULTS

Following data collection, the raw BFI scores were subjected to a preliminary basic descriptive analysis in SPSS 21 statistics software. Means, standard deviations, minimum and maximum ranges, skewness and kurtosis indices were calculated for each FFM factor in both the UAS Student and Normative sample groups. Following descriptive analysis, a one way ANOVA was used to compare mean scores for each factor between the independent variables. Of the 123 students with either Pre UAS Operations, or UAS Operations declared as a first or second major, 65 responses were gathered into the UAS Student sample group for a 54.62% response rate. The responses of 248 individuals comprised the Normative sample group.

## Comparison of Descriptive Statistics

As illustrated in Table 16, descriptive statistics for the UAS Student sample show mean scores of 2.2385 for neuroticism (N), 3.3462 for extraversion (E), 3.5723 for openness (O), 3.9402 for agreeableness (A), and 4.0239 for conscientiousness (C). Standard deviations for the same sample were 0.60504 for neuroticism (N), 0.75802 for extraversion (E), 0.51342 for openness (O), 0.60127 for agreeableness (A), and 0.45622 for conscientiousness (C). Minimum and maximum ranges for factors in this sample were from 1.00 to 3.63 in neuroticism (N), 1.88 to 4.63 in extraversion (E), 2.50 to 4.70 in openness (O), 2.44 to 5.00 in agreeableness (A), and 3.00 to 4.89 in conscientiousness (C).

Also included in Table 16 are z-scores for both the skewness and kurtosis of each factor's score distribution. These scores were calculated by dividing skewness and kurtosis scores by their respective standard errors. Following this conversion, absolute values greater than 1.96 indicate significantly non-normal distributions at $p<0.05$, scores greater than 2.58 are significantly non-normal at $p<0.01$, and absolute values above 3.29 are significantly non-normal at $p<0.001$ (Field, 2009). All factor score distributions for the UAS Student sample failed to differ significantly from a normal distribution in either skewness or kurtosis.

Table 16. BFI Descriptive Statistics

| Domains/Sample Group | | N | Mean | SD | Minimum | Maximum | Z skewness | Z kurtosis |
|---|---|---|---|---|---|---|---|---|
| NEUROTICISM | (N) | | | | | | | |
| UAS Student Sample | | 65 | 2.2385 | 0.60504 | 1.00 | 3.63 | 0.1346 | -0.7850 |
| Normative Sample | | 237 | 2.8877 | 0.55495 | 1.38 | 4.25 | -1.2089 | -1.2508 |
| EXTRAVERSION | (E) | | | | | | | |
| UAS Student Sample | | 65 | 3.3462 | 0.75802 | 1.88 | 4.63 | -0.8754 | -1.5614 |
| Normative Sample | | 234 | 3.3446 | 0.70697 | 1.25 | 5.00 | 1.2893 | -0.1009 |
| OPENNESS | (O) | | | | | | | |
| UAS Student Sample | | 65 | 3.5723 | 0.51342 | 2.50 | 4.70 | -0.8081 | -1.1860 |
| Normative Sample | | 235 | 3.3557 | 0.53413 | 2.10 | 4.90 | 2.4214* | -0.5601 |
| AGREEABLENESS | (A) | | | | | | | |
| UAS Student Sample | | 65 | 3.9402 | 0.60127 | 2.44 | 5.00 | -1.3939 | -0.7150 |
| Normative Sample | | 234 | 3.7953 | 0.60479 | 2.22 | 5.00 | -1.6352 | -1.6246 |
| CONSCIENTIOUSNESS | (C) | | | | | | | |
| UAS Student Sample | | 65 | 4.0239 | 0.45622 | 3.00 | 4.89 | 0.5219 | -1.2730 |
| Normative Sample | | 233 | 3.6476 | 0.55225 | 2.33 | 5.00 | 0.1887 | -2.2044* |

* Indicates significant at the 0.05 level

Descriptive statistics for the Normative sample, also illustrated in Table 16, show mean scores of 2.8877 for neuroticism (N), 3.3446 for extraversion (E), 3.3557 for openness (O), 3.7953 for agreeableness (A), and 3.6476 for conscientiousness (C). Standard deviations for the same sample were 0.55495 for neuroticism (N), 0.70697 for extraversion (E), 0.53413 for openness (O), 0.60479 for agreeableness (A), and 0.55225

for conscientiousness (C). Minimum and maximum ranges for factors in this sample were from 1.38 to 4.25 in neuroticism (N), 1.25 to 5.00 in extraversion (E), 2.10 to 4.90 in openness (O), 2.22 to 5.00 in agreeableness (A), and 2.33 to 5.00 in conscientiousness (C).

As with the UAS Student sample, z-scores were calculated for the skewness and kurtosis of factor score distributions in the Normative sample. While scores in the openness (O) factor were significantly non-normal with respect to skew at $p<0.05$, it should be noted that large samples (e.g. 200 or more) will often give rise to small standard errors, resulting in significantly non-normal values from even small deviations in normality (Field, 2009). In such cases, a maximum threshold of 3.29 and visual examination of the distribution are considered better criterion (Field, 2009). This consideration should also be extended to the significantly ($p<0.05$) non-normal kurtosis score of the conscientiousness (C) factor in the same sample.

In ordinal rank, the UAS Student sample scored highest in conscientiousness (C), followed closely by agreeableness (A). The factors of openness (O) and extraversion (E) followed respectively in decreasing order, with the factor neuroticism (N) holding the lowest mean score for the sample. Rankings of the normative sample were similar, with the agreeableness (A) factor holding the highest score, followed by conscientiousness (C). Following these factors, in the same decreasing order, were the scores for openness (O), extraversion (E), and neuroticism (N).

**Comparison of Means**

Results of the one way ANOVA comparing the scores of both groups for each factor are illustrated in Table 17. Significant differences were found in three of the FFM

factors analyzed, neuroticism (N), openness (O) and conscientiousness (C). The UAS Student sample group was found to have scored significantly lower in neuroticism (N), significantly higher in openness (O), and significantly higher in conscientiousness (C) than the Normative sample.

Table 17. BFI One Way ANOVA

| | | UAS Student Sample | | Normative Sample | | |
|---|---|---|---|---|---|---|
| Domains | | Mean | SD | Mean | SD | P |
| NEUROTICISM | (N) | 2.2385 | 0.60504 | 2.8877 | 0.55495 | .000*** |
| EXTRAVERSION | (E) | 3.3462 | 0.75802 | 3.3446 | 0.70697 | .987 |
| OPENNESS | (O) | 3.5723 | 0.51342 | 3.3557 | 0.53413 | .004** |
| AGREEABLENESS | (A) | 3.9402 | 0.60127 | 3.7953 | 0.60479 | .088 |
| CONSCIENTIOUSNESS | (C) | 4.0239 | 0.45622 | 3.6476 | 0.55225 | .000*** |

* The mean difference is significant at the 0.05 level
** The mean difference is significant at the 0.01 level
*** The mean difference is significant at the 0.001 level

Overall, the descriptive and inferential statistics above indicate normal distributions of BFI factor scores in both the UAS Student and Normative sample groups. Apart from the two highest scoring factors in each group, ordinal rank of mean factor scores showed similarity between samples. While contentiousness (C) was the highest mean score for the UAS Student group, agreeableness (A) was the highest mean factor score for the Normative sample. From highest to lowest, the remaining mean factor scores in both samples were openness (O), extraversion (E), and neuroticism (N). Finally, significant differences between the independent variables of neuroticism (N), openness (O) and conscientiousness (C) were indicated at $p<0.001$, $p<0.01$, and $p<0.001$ levels respectively. The UAS Student sample group was found to have scored significantly lower in neuroticism (N), significantly higher in openness (O), and significantly higher in conscientiousness (C) than the Normative sample.

# CHAPTER IV

# DISCUSSION

Interpretation of personality results necessitates a familiarity with the basics of psychological testing, what aspects of personality the instrument measures, and the ability to integrate scale score information into a meaningful profile (Costa & McCrae, 1992). The tendency to think in terms of types or categories should be avoided. While it is convenient to think of introverts and extroverts, the FFM extraversion (E) scale represents a continuous dimension and "… most individuals would be best described as 'ambiverts,' that is, showing a combination of introverted and extraverted tendencies" (Costa & McCrae, 1992, p. 13). With these considerations in mind, there is no single cutoff point designating between individuals who have and do not have a given trait. Scoring average on a factor scale can be just as informative as scoring high or low. When cutoff points are needed for a particular application, they should be established empirically and only applied to the specific purpose for which they were intended (Costa & McCrae, 1992).

Building on the concept of a continuous scale for each personality trait and lack of strict dichotomy, it logically follows that raw score responses carry limited meaning (Costa & McCrae, 1992). Only when compared to the responses of others do scale score responses take on meaning. This comparison of personality profiles is what enables meaningful comparisons between groups. Acknowledging these considerations, the personality traits of the UAS Student sample are expounded below.

## Personality Traits of UND UAS Students

The personality traits and tendencies of those individuals pursuing UAS studies at the University of North Dakota are outlined in the paragraphs that follow. While primary interest is with respect to the Normative sample (Petros, 2013), these traits are also informally compared with many of the FFM scores of professional aviation groups outlined in Chapter 1. Each of the FFM traits is examined, beginning with neuroticism (N).

### Neuroticism.

In neuroticism (N), the most pervasive domain of the FFM scales, the UAS Student sample scored significantly lower than individuals in the Normative sample. Recalling that this factor contrasts emotional stability against maladjustment or the tendency toward negative affects, this score indicates that students pursuing UAS studies are usually calm, even-tempered, and relaxed. They are able to face stressful situations without becoming upset or rattled, and are generally more emotionally stable than members of the Normative sample (Costa & McCrae, 1992).

The UAS Students' relatively low score in neuroticism parallels the majority of findings for that trait among other aviation students and professionals. Schutte, Fitzgibbons, and Davis (2004), found that 60% of the commercial pilots in their study scored low or very low in this factor. ATC students in Luuk, K, Luuk, A, and Aluoja (2009) also exhibit significantly lower mean scores for this trait than the general population. In military aviators, model-based cluster analysis discovered two personality profiles among clinically referred aviators. The group scoring significantly lower in neuroticism was found to contain significantly more members deemed Aeronautically

Adaptable (Campbell, Moore, Poythress, & Kennedy, 2009). A second study on naval aviators found that Aeronautically Adaptable individuals scored significantly lower in every facet of neuroticism than individuals deemed Non-Aeronautically Adaptable (Campbell, Ruiz, & Moore, 2010). In King, Callister, Retzlaff, and McGlohn (1997) USAF student pilots were found to be significantly less neurotic than a sample of female college students. Again in 2010, USAF female pilots were found to be significantly less neurotic than a normative female sample (Chappelle, Novy, Sowin, & Thompson, 2010).

Overall, the personality traits of the UAS Sample display a high degree of congruency with traits documented among other aviation students and professionals. This tendency to be calm, even-tempered, and relaxed, as well as the ability to face stress without becoming upset is also well aligned with the attributes composure and resilience identified by Chappelle, McDonald, and King (2010) as traits affecting duty performance and adaptation to the unique nature of UAS operations.

**Extraversion.**

With respect to extraversion (E), there was a lack of significant difference between individuals of the UAS Student and Normative sample groups. This would indicate that members of the UAS Student group display similar tendencies toward assertiveness, activity, and sociability as the Normative sample. As noted above, however, average scores on a factor scale can be just as informative as scoring high or low. This is especially true as this result is considered alongside extraversion scores documented among the majority of aviation students and professionals. While many studies (Schutte, Fitzgibbons, & Davis, 2004), (Luuk, Luuk, & Aluoja, 2009), (Campbell, Moore, Poythress, & Kennedy, 2009), (Campbell, Ruiz, & Moore, 2010), (Callister,

King, Retzlaff, & Marsh, 1999), (Chappelle, Novy, Sowin, & Thompson, 2010), (Barto, Chappelle, King, Ree, & Teachout, 2011), and (Grice & Katz, 2007) found their respective aviation samples exhibiting higher degrees of extraversion than their normative or Non-Aeronautically Adaptable samples, the UAS Student results indicate an aviation population exhibiting the same degree of extraversion. Similar results were also noted in both parts of King, Callister, Retzlaff, and & McGlohn (1997) where no significant differences were found in the extraversion (E) trait between a normative sample, USAF student pilots, or USAF career pilots.

A lack of significant difference between the UAS Student group and the Normative sample is a noteworthy break from many of the personalities documented among other aviation students and professionals. Though an informal comparison in this study, this tendency to display more introverted traits may distinguish individuals interested in UAS from their manned aviation peers. Future research is encouraged to explore direct comparisons between the personality traits of manned and unmanned pilots.

**Openness.**

Within the openness (O) scale, the UAS student sample showed significantly higher scores than the Normative sample. Indicating that, as a group, these individuals display a relatively more active imagination, aesthetic sensitivity, attentiveness to inner feelings, preference for variety, and intellectual curiosity (Costa & McCrae, 1992). Open individuals are willing to entertain novel ideas and unconventional values, and display a willingness to question authority. Openness (O) scores are modestly associated with both educational and measured intelligence, and are especially related to aspects of

intelligence which contribute to creativity. The scores of the UAS Student group in this trait relative to a normative sample again depart from the relative scores of many other aviation students and professionals. The openness (O) trait of many of the students and professionals examined above do not differ from their respective normative or Non-Aeronautically Adaptable samples (Schutte, Fitzgibbons, & Davis, 2004), (Luuk, Luuk, & Aluoja, 2009), (Campbell, Moore, Poythress, & Kennedy, 2009), (Grice & Katz, 2007). Interestingly, Campbell, Ruiz, and Moore (2010) found scores of their Non-Aeronautically Adaptable sample to be significantly higher in openness (O) than members of their Aeronautically Adaptable group, while several USAF studies discovered higher openness (O) scores in USAF samples than the normative sample (King, Callister, Retzlaff, & McGlohn, 1997), (Callister, King, Retzlaff, & Marsh, 1999), (Chappelle, Novy, Sowin, & Thompson, 2010) (Barto, Chappelle, King, Ree, & Teachout, 2011). Clearly, responses for the openness (O) trait vary throughout the aviation industry and even military branches. Explanation for this variety may be revealed within the higher resolution facet scores not examined by the BFI or this study.

The increased tendency of the UAS Student sample toward openness (O) is perhaps not surprising given the incubative nature of the UAS industry. Students pursuing this degree program would be entering into profession teeming not only with novel concepts of aircraft and their capabilities, but also of unconventional modes of compliance with existing regulations both before and after these aircraft are integrated into the National Airspace System (NAS).

**Agreeableness.**

In agreeableness (A), the UAS student sample did not differ significantly from members of the normative sample. This indicates that members of the UAS Student sample share similar interpersonal tendencies with individuals of the Normative sample group. Both are equally altruistic, sympathetic to others, and equally willing to assist with the belief that assistance will be offered in return (Costa & McCrae, 1992). This similarity with the normative sample was shared in the traits of many aviation students and professionals (Schutte, Fitzgibbons, & Davis, 2004), (Luuk, Luuk, & Aluoja, 2009), (King, Callister, Retzlaff, & McGlohn, 1997). However, Aeronautically Adaptable Navy aviators were found to display higher agreeableness (A) than their NAA counterparts (Campbell, Moore, Poythress, & Kennedy, 2009) (Campbell, Castaneda, & Pulos, 2010), and many USAF and US Army pilots were found to be less agreeable than their normative counterparts (Callister, King, Retzlaff, & Marsh, 1999), (Chappelle, Novy, Sowin, & Thompson, 2010), (Barto, Chappelle, King, Ree, & Teachout, 2011) (Grice & Katz, 2007).

While responses of aviation students and professionals in agreeableness (A), like openness (O) scores, display a wide variance compared to normative samples, a dichotomy between civil and military operations seems to be present. Indeed, it is noted that while, "It is tempting to see the agreeable side of this domain as both socially preferable and psychologically healthier … [it] is not a virtue on the battlefield or in the courtroom" (Costa & McCrae, 1992, p. 15). Low degrees of agreeableness (A) may be advantageous in single pilot military operations, while more normative degrees may be better suited for the interactions and resource management found in crewed and civil

operations. The cohesiveness and humility traits identified as critical to the operational performance of MQ-1 and MQ-9 sensor operators (Chappelle, McDonald, & King, 2010), lends support to this concept that higher relative scores in agreeableness (A) may be desirable in crewed UAS environments, even when that environment exists within military operations.

**Conscientiousness.**

The UAS Student sample exhibited significantly higher scores in conscientiousness (C), indicating individuals who are purposeful, strong-willed, and determined. These characteristics, coupled with high scores in openness (O) in particular, implicate a tendency toward higher academic and occupational achievement (Costa & McCrae, 1992). Several of the traits found among Chappelle, McDonald, and King's (2010) critical traits for operational performance of MQ-1 and MQ-9 sensor operators, such as self-certainty, consciousness, and success orientated, seem to encourage high degrees of consciousness (C). Furthermore, high degrees of this trait are commonplace among other aviation students and professionals relative to their respective normative samples or NAA samples (Schutte, Fitzgibbons, & Davis, 2004), (Luuk, Luuk, & Aluoja, 2009), (Campbell, Moore, Poythress, & Kennedy, 2009), (Campbell, Ruiz, & Moore, 2010), (King, Callister, Retzlaff, & McGlohn, 1997), (Barto, Chappelle, King, Ree, & Teachout, 2011). The personality traits of the UAS Sample display a high degree of congruency, in the factor of consciousness (C), with traits documented among other aviation students and professionals.

## Limitations

The design of this research carries the following limitations:

(1) Sample size of the UND UAS Student group will be limited to the number of students enrolled as either a Pre UAS Operations, or UAS Operations major at the University of North Dakota for the fall semester of 2013.

(2) Population homogeneity, as is often found in populations of highly selected individuals, may lessen potential personality differences between research groups.

(3) Research results will have limited generalizability beyond UND students.

**Conclusion and Future Studies**

The performance of pilots has been construed as "… a product of skill, attitude and personality factors" (Chidester, Helmreich, Gregorich, & Geis, 1991, p. 25), personnel specialists in both military and commercial aviation have worked for decades to identify means to accurately measure the characteristics needed to be a well performing pilot (Carretta & Ree, Pilot Selection Methods, 2003). A great deal of effort has been made to quantify personality characteristics in the pilots of manned aircraft. However, analysis of similar characteristics of individuals interested in piloting Unmanned Aircraft (UA) remains relatively unexplored. Above, research into the personality traits of commercial pilots, Air Traffic Controllers, and astronauts have been presented alongside similar efforts made within the United States Navy, Air Force, and Army. Generally speaking, these studies offer that individuals scoring relatively low in neuroticism (N) and high in the factors of extraversion (E), and conscientiousness (C) appear to be better suited to aeronautical duties.

The purpose of this study has been to examine these same FFM personality traits within a contemporary sample of UND UAS students. Using the Big Five Inventory (BFI) general personality index, responses of a UAS student sample group (N=65) were

juxtaposed against a normative sample group (N=248) collected previously (Petros, 2013). Comparison allowed for the identification of differences and similarities between the personality profiles of those students interested in pursuing studies in UAS and the general population.

Apart from the two highest scoring factors in each group, ordinal rank of mean factor scores showed similarity between the two samples. While contentiousness (C) was the highest mean score for the UAS Student group, agreeableness (A) was the highest mean factor score in the normative sample. From highest to lowest, the remaining mean factor scores in both samples were openness (O), extraversion (E), and neuroticism (N). The sample group comprised of students with either Pre UAS Operations, or UAS Operations declared as a first or second major was found to have scored significantly lower in neuroticism (N) ($p<0.001$), significantly higher in openness (O) ($p<0.01$), and significantly higher in conscientiousness (C) ($p<0.001$) as compared to individuals in the normative sample. This UAS student personality profile of relatively low scores in neuroticism (N), and relatively high openness (O) and conscientiousness (C) scores is similar to the relatively low neuroticism (N) and relatively high extraversion (E), and conscientiousness (C) profile of individuals previously identified as better suited for aeronautical duties. Differences distinguishing between these generalized profiles are found in the extraversion (E) and openness (O) factors. Based on these differences, one might hypothesize that relative to their manned counterparts, those students pursuing careers in UAS are similar in their neurotic, interpersonal, and achievement-oriented tendencies, but are distinguishable by their tendency toward introversion and openness to experience.

Recommendations for future research encourage the inclusion of the BFI facet scores offered by Soto and John (2008), or application of the Revised NEO Personality Inventory for assessment of more specific traits within the domains of the FFM. Greater resolution within FFM factor scores may better illuminate commonalities and differences among unique traits like the facet scores of openness (O) which displays mixed results when aggregated at the factor level. As highly selected and trained aviators should be clinically assessed against one another or other aviators (King, 1994), the exploration of FFM personality traits within individuals, both civil and military, who have completed training for the operation of UAS, as well as between those individuals and a contemporary sample of their manned aviation peers, is recommended.. The construction of percentile tables, such as those included in Appendix A, would allow an individual interested in pursuing UAS studies to be more readily compared to the larger population of UAS students, and would enable a higher quality of academic and career advising.

The measurement of personality, particularly instruments measuring FFM traits, has had a small but valid place in the composition of pilot selection methods in the United States military. Contemporary works (Carretta, 2011) even vouch for its importance as these selection methods are refined for future use. As subtle differences between the personality profiles of manned and unmanned pilots are explored and mapped, a foundation will be provided on which these personnel selection methods can be developed. Furthermore, it will allow for the assessment of relationships between personality and areas such as training success, career persistence, or crew performance within the new and exciting industry of UAS.

## APPENDIX A

Table 18. USAF Male Percentile Table for NEO PI-R Score Comparison

| Domains/Facets | | USAF Male Percentile Equivalent Scores | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1% | 5% | 15% | 50% | 85% | 95% | 99% |
| NEUROTICISM | (N) | 26 | 40 | 51 | 69 | 91 | 104 | 120 |
| Anxiety | (N1) | 2 | 5 | 7 | 12 | 17 | 20 | 23 |
| Angry Hostility | (N2) | 2 | 5 | 7 | 11 | 17 | 21 | 24 |
| Depression | (N3) | 1 | 3 | 6 | 10 | 15 | 19 | 24 |
| Self-consciousness | (N4) | 2 | 5 | 8 | 12 | 17 | 20 | 24 |
| Impulsiveness | (N5) | 4 | 7 | 10 | 14 | 20 | 22 | 25 |
| Vulnerability | (N6) | 0 | 1 | 3 | 6 | 10 | 13 | 16 |
| EXTRAVERSION | (E) | 85 | 95 | 107 | 126 | 144 | 156 | 168 |
| Warmth | (E1) | 11 | 15 | 18 | 23 | 26 | 29 | 31 |
| Gregariousness | (E2) | 4 | 9 | 12 | 18 | 23 | 26 | 29 |
| Assertiveness | (E3) | 9 | 12 | 15 | 19 | 24 | 26 | 29 |
| Activity | (E4) | 10 | 14 | 16 | 20 | 24 | 27 | 29 |
| Excitement-Seeking | (E5) | 13 | 16 | 19 | 22 | 27 | 29 | 31 |
| Positive Emotions | (E6) | 9 | 13 | 16 | 21 | 26 | 28 | 31 |
| OPENNESS | (O) | 68 | 84 | 95 | 114 | 134 | 146 | 158 |
| Fantasy | (O1) | 7 | 10 | 13 | 19 | 24 | 27 | 30 |
| Aesthetics | (O2) | 3 | 7 | 10 | 17 | 23 | 26 | 30 |
| Feelings | (O3) | 9 | 13 | 16 | 21 | 25 | 28 | 30 |
| Actions | (O4) | 5 | 10 | 12 | 16 | 20 | 23 | 25 |
| Ideas | (O5) | 6 | 12 | 16 | 22 | 27 | 30 | 31 |
| Values | (O6) | 5 | 9 | 13 | 19 | 23 | 26 | 28 |
| AGREEABLENESS | (A) | 64 | 79 | 95 | 113 | 131 | 141 | 153 |
| Trust | (A1) | 6 | 10 | 15 | 20 | 24 | 26 | 30 |
| Straightforwardness | (A2) | 7 | 10 | 13 | 19 | 23 | 26 | 28 |
| Altruism | (A3) | 12 | 16 | 19 | 23 | 27 | 29 | 31 |
| Compliance | (A4) | 5 | 8 | 11 | 16 | 20 | 23 | 26 |
| Modesty | (A5) | 5 | 8 | 11 | 17 | 21 | 24 | 27 |
| Tender-Mindedness | (A6) | 7 | 10 | 13 | 18 | 22 | 24 | 27 |
| CONSCIENTIOUSNESS | (C) | 74 | 95 | 109 | 128 | 147 | 158 | 168 |
| Competence | (C1) | 14 | 18 | 20 | 24 | 27 | 29 | 31 |
| Order | (C2) | 6 | 10 | 14 | 18 | 23 | 26 | 28 |
| Dutifulness | (C3) | 13 | 17 | 20 | 23 | 27 | 29 | 31 |
| Achievement Striving | (C4) | 9 | 14 | 18 | 22 | 26 | 28 | 30 |
| Self-Discipline | (C5) | 9 | 13 | 17 | 22 | 26 | 28 | 31 |
| Deliberation | (C6) | 6 | 10 | 12 | 17 | 21 | 24 | 27 |

Table 19. USAF Female Percentile Table for NEO PI-R Score Comparison

| Domains/Facets | | USAF Female Percentile Equivalent Scores | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1% | 5% | 15% | 50% | 85% | 95% | 99% |
| NEUROTICISM | (N) | 34 | 46 | 56 | 80 | 107 | 127 | 140 |
| Anxiety | (N1) | 5 | 8 | 10 | 16 | 21 | 24 | 27 |
| Angry Hostility | (N2) | 1 | 6 | 8 | 12 | 18 | 22 | 27 |
| Depression | (N3) | 1 | 4 | 7 | 12 | 20 | 24 | 25 |
| Self-consciousness | (N4) | 5 | 7 | 9 | 13 | 19 | 24 | 27 |
| Impulsiveness | (N5) | 2 | 8 | 12 | 16 | 22 | 25 | 27 |
| Vulnerability | (N6) | 2 | 3 | 5 | 8 | 12 | 16 | 18 |
| EXTRAVERSION | (E) | 83 | 93 | 104 | 129 | 150 | 157 | 164 |
| Warmth | (E1) | 9 | 13 | 19 | 24 | 28 | 29 | 31 |
| Gregariousness | (E2) | 5 | 8 | 12 | 19 | 25 | 28 | 30 |
| Assertiveness | (E3) | 6 | 10 | 14 | 19 | 24 | 26 | 29 |
| Activity | (E4) | 13 | 14 | 17 | 21 | 24 | 26 | 28 |
| Excitement-Seeking | (E5) | 13 | 14 | 17 | 22 | 26 | 28 | 30 |
| Positive Emotions | (E6) | 13 | 15 | 17 | 23 | 28 | 30 | 31 |
| OPENNESS | (O) | 75 | 93 | 105 | 124 | 140 | 156 | 166 |
| Fantasy | (O1) | 7 | 11 | 13 | 20 | 25 | 28 | 30 |
| Aesthetics | (O2) | 4 | 10 | 13 | 20 | 25 | 28 | 30 |
| Feelings | (O3) | 12 | 15 | 18 | 23 | 26 | 30 | 31 |
| Actions | (O4) | 11 | 12 | 14 | 18 | 22 | 24 | 28 |
| Ideas | (O5) | 10 | 13 | 16 | 21 | 25 | 28 | 30 |
| Values | (O6) | 10 | 15 | 17 | 21 | 24 | 26 | 28 |
| AGREEABLENESS | (A) | 78 | 83 | 97 | 118 | 136 | 144 | 159 |
| Trust | (A1) | 5 | 9 | 15 | 21 | 25 | 27 | 31 |
| Straightforwardness | (A2) | 7 | 11 | 14 | 20 | 25 | 27 | 29 |
| Altruism | (A3) | 15 | 17 | 19 | 24 | 27 | 30 | 31 |
| Compliance | (A4) | 4 | 9 | 11 | 16 | 20 | 23 | 25 |
| Modesty | (A5) | 5 | 10 | 13 | 18 | 23 | 25 | 27 |
| Tender-Mindedness | (A6) | 12 | 13 | 15 | 19 | 22 | 25 | 27 |
| CONSCIENTIOUSNESS | (C) | 63 | 87 | 102 | 128 | 144 | 149 | 164 |
| Competence | (C1) | 11 | 15 | 18 | 23 | 26 | 28 | 30 |
| Order | (C2) | 7 | 9 | 12 | 19 | 23 | 25 | 28 |
| Dutifulness | (C3) | 9 | 13 | 17 | 23 | 26 | 29 | 31 |
| Achievement Striving | (C4) | 11 | 14 | 18 | 22 | 26 | 27 | 28 |
| Self-Discipline | (C5) | 6 | 12 | 16 | 22 | 25 | 27 | 29 |
| Deliberation | (C6) | 7 | 9 | 12 | 17 | 21 | 23 | 25 |

Table 20. USAF Female Percentile Equivalent Table for NEO PI-R Score Comparison

| | | Percentile Equivalent Scores | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Domains/Facets | | 5% | 10% | 25% | 50% | 75% | 90% | 95% |
| NEUROTICISM | (N) | 43.00 | 49.00 | 59.00 | 72.50 | 88.00 | 102.00 | 111.00 |
| Anxiety | (N1) | 7.00 | 8.00 | 11.00 | 14.00 | 18.00 | 21.00 | 22.35 |
| Angry Hostility | (N2) | 5.00 | 7.00 | 9.00 | 11.00 | 15.00 | 18.70 | 22.00 |
| Depression | (N3) | 4.00 | 6.00 | 8.00 | 10.00 | 13.00 | 17.00 | 20.00 |
| Self-consciousness | (N4) | 6.65 | 8.00 | 10.00 | 13.00 | 16.00 | 20.00 | 22.00 |
| Impulsiveness | (N5) | 8.00 | 10.00 | 12.00 | 16.00 | 19.00 | 22.00 | 24.00 |
| Vulnerability | (N6) | 2.00 | 3.00 | 6.00 | 8.00 | 10.00 | 12.00 | 14.00 |
| EXTRAVERSION | (E) | 100.65 | 109.00 | 122.00 | 133.00 | 144.00 | 155.00 | 162.00 |
| Warmth | (E1) | 17.00 | 19.00 | 22.25 | 25.00 | 27.00 | 29.00 | 30.00 |
| Gregariousness | (E2) | 10.00 | 13.00 | 16.00 | 20.00 | 23.00 | 26.00 | 28.00 |
| Assertiveness | (E3) | 13.00 | 15.00 | 17.00 | 21.00 | 23.00 | 26.00 | 27.00 |
| Activity | (E4) | 16.00 | 18.00 | 20.00 | 22.00 | 24.00 | 26.00 | 28.00 |
| Excitement-Seeking | (E5) | 16.00 | 17.00 | 20.00 | 23.00 | 26.00 | 27.00 | 29.00 |
| Positive Emotions | (E6) | 16.00 | 18.00 | 21.00 | 24.00 | 27.00 | 29.00 | 31.00 |
| OPENNESS | (O) | 95.65 | 102.00 | 112.00 | 124.00 | 135.00 | 145.00 | 154.70 |
| Fantasy | (O1) | 10.00 | 13.00 | 16.00 | 20.00 | 23.00 | 26.00 | 27.00 |
| Aesthetics | (O2) | 10.00 | 12.00 | 16.00 | 20.00 | 23.00 | 26.00 | 28.00 |
| Feelings | (O3) | 16.00 | 18.00 | 20.00 | 23.00 | 25.00 | 28.00 | 29.00 |
| Actions | (O4) | 12.00 | 13.00 | 16.00 | 19.00 | 21.00 | 23.00 | 25.00 |
| Ideas | (O5) | 13.00 | 16.00 | 19.00 | 22.00 | 25.00 | 28.00 | 30.25 |
| Values | (O6) | 14.00 | 17.00 | 20.00 | 22.00 | 24.00 | 26.00 | 28.00 |
| AGREEABLENESS | (A) | 92.00 | 99.00 | 112.00 | 121.00 | 130.00 | 139.70 | 144.35 |
| Trust | (A1) | 12.00 | 16.00 | 19.00 | 22.00 | 24.00 | 26.00 | 27.35 |
| Straightforwardness | (A2) | 13.00 | 14.00 | 17.00 | 21.00 | 23.00 | 26.00 | 27.00 |
| Altruism | (A3) | 18.00 | 20.00 | 23.00 | 24.00 | 27.00 | 29.00 | 30.00 |
| Compliance | (A4) | 9.00 | 11.00 | 14.00 | 17.00 | 19.00 | 22.00 | 23.00 |
| Modesty | (A5) | 10.00 | 12.00 | 15.00 | 18.00 | 21.00 | 24.00 | 25.00 |
| Tender-Mindedness | (A6) | 14.00 | 15.00 | 17.00 | 19.00 | 21.00 | 23.00 | 24.00 |
| CONSCIENTIOUSNESS | (C) | 98.00 | 105.00 | 118.00 | 131.00 | 142.00 | 152.00 | 159.00 |
| Competence | (C1) | 18.00 | 19.00 | 22.00 | 24.00 | 26.00 | 28.00 | 29.00 |
| Order | (C2) | 11.65 | 13.00 | 16.00 | 20.00 | 22.00 | 25.00 | 26.00 |
| Dutifulness | (C3) | 17.00 | 19.00 | 21.00 | 24.00 | 26.00 | 28.00 | 29.00 |
| Achievement Striving | (C4) | 16.65 | 18.00 | 21.00 | 24.00 | 26.00 | 28.00 | 29.00 |
| Self-Discipline | (C5) | 14.00 | 17.00 | 20.00 | 23.00 | 25.00 | 28.00 | 29.00 |
| Deliberation | (C6) | 10.00 | 12.00 | 15.00 | 18.00 | 20.00 | 23.00 | 24.00 |

*Note*. The table above provides a psychologist with the capability of comparing an individual female pilot's (or pilot applicant's) NEO PI-R Domain and Facet scores with the distribution of rated USAF female pilot scores as a group to assess for significant differences

**APPENDIX B**

# Pre-UAS Operations
# &
# UAS Operations Students

You are invited to participate in a research study involving the personality traits of students enrolled in the Unmanned Aircraft Systems (UAS) Operations major at UND.

The purpose of this study is to define the personality characteristics of students pursuing UAS studies and compare them to the personalities of the general public. This research will help future studies determine whether personality characteristics affect areas such as training success, career persistence, and crew performance for UAS pilots.

A short personality inventory will be administered to interested individuals **Tuesday Sept. 3rd** and **Wednesday Sept. 4th** in **Odegard Hall, Rm 114** from **4:00-5:00 PM.** The inventory will take approximately 10 minutes to compete. If interested but unable to attend the above time slots, please contact Zach Waller to arrange an alternative time.

Zach Waller
(218) 205-0722 (C)
zachary.waller@my.und.edu

## APPENDIX C

**Age ____ Credits Completed ____**

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who *likes to spend time with others*? Please write a number next to each statement to indicate the extent to which **you agree or disagree with that statement.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Disagree Strongly | Disagree a little | Neither agree nor disagree | Agree a little | Agree strongly |

### I am someone who…

1. _____ Is talkative
2. _____ Tends to find fault with others
3. _____ Does a thorough job
4. _____ Is depressed, blue
5. _____ Is original, comes up with new ideas
6. _____ Is reserved
7. _____ Is helpful and unselfish with others
8. _____ Can be somewhat careless
9. _____ Is relaxed, handles stress well.
10. _____ Is curious about many different things
11. _____ Is full of energy
12. _____ Starts quarrels with others
13. _____ Is a reliable worker
14. _____ Can be tense
15. _____ Is ingenious, a deep thinker
16. _____ Generates a lot of enthusiasm
17. _____ Has a forgiving nature
18. _____ Tends to be disorganized
19. _____ Worries a lot
20. _____ Has an active imagination
21. _____ Tends to be quiet
22. _____ Is generally trusting
23. _____ Tends to be lazy
24. _____ Is emotionally stable, not easily upset
25. _____ Is inventive
26. _____ Has an assertive personality
27. _____ Can be cold and aloof
28. _____ Perseveres until the task is finished
29. _____ Can be moody
30. _____ Values artistic, aesthetic experiences
31. _____ Is sometimes shy, inhibited
32. _____ Is considerate and kind to almost everyone
33. _____ Does things efficiently
34. _____ Remains calm in tense situations
35. _____ Prefers work that is routine
36. _____ Is outgoing, sociable
37. _____ Is sometimes rude to others
38. _____ Makes plans and follows through with them
39. _____ Gets nervous easily
40. _____ Likes to reflect, play with ideas
41. _____ Has few artistic interests
42. _____ Likes to cooperate with others
43. _____ Is easily distracted
44. _____ Is sophisticated in art, music, or literature

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