Revised NEO Personality Inventory Profiles of Male and Female U.S. Air Force Pilots

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The study of pilot personality characteristics has a long and controversial history. Personality characteristics seem to be fairly poor predictors of training outcome; however, valid personality assessment is essential to clinical psychological evaluations. Therefore, the personality characteristics of pilots must be studied to ensure valid clinical assessment. This paper describes normative personality characteristics of U.S. Air Force pilots based on the Revised NEO Personality Inventory profiles of 1,301 U.S. Air Force student pilots. Compared with male adult norms, male student pilots had higher levels of extraversion and lower levels of agreeableness. Compared with female adult norms, female student pilots had higher levels of extraversion and openness and lower levels of agreeableness. Descriptive statistics and percentile tables for the five domain scores and 30 facet scores are provided for clinical use, and a case vignette is provided as an example of the clinical utility of these U.S. Air Force norms.

Introduction

Psychologists first measured pilot personality characteristics during World War I, and even at that time there were starkly divergent ideas about which personality characteristics were most important. For example, Rippon and Manuel[1] described the ideal pilot as high-spirited and happy-go-lucky, whereas Dockeray and Isaacs[2] described the ideal pilot as quiet and methodical. The controversy over pilot personality continues today, driven primarily by strong evidence that personality measures are poor predictors of completion of initial training.[3] On the other hand, personality measures may have more utility in predicting performance beyond initial training completion. For example, Houston[4] found that personality measures were the best predictors of the ratings given to first officers by captains in commercial airlines. Similarly, personality characteristics appear to significantly affect training in crew resource management.[5] Moreover, personality measures taken during initial training appear to predict retention characteristics in U.S. Air Force pilots.[6]

Beyond the selection, training, and retention issues, the assessment of personality is an essential part of the clinical evaluation of pilots. Despite the controversy over the relationship between "normal" personality characteristics and pilot performance, there is little argument that there are "abnormal" personality characteristics that are undesirable. Highly anxious, hostile, or impulsive people probably should not control aircraft. In the U.S. Air Force, personality disorders are not medically disqualifying; however, administrative separation can occur when personality characteristics are judged to significantly impair the performance of military duties (Air Force Instruction 48-123). Also, U.S. Air Force flight surgeons are required to judge aircrew suitability for flying duty during selection physical examinations through a process known as the Adaptability Rating for Military Aeronautics (ARMA). The ARMA typically involves assessment of motivation, insight, social poise, and past accomplishments.[7] Identified problems in these areas warrant further psychological evaluation. Verdone et al.[8] describe a number of limitations in the ARMA as a screening tool and report that flight surgeons would like better training, guidance, and more objective methods of evaluating potential pilots.

Currently, U.S. Air Force psychologists often use standard personality measures such as the Minnesota Multiphasic Personality Inventory[9] and the Millon Clinical Multiaxial Inventory[10] when evaluating pilots. These tests have been normed on the general population but not on military pilots, and for this reason experienced aviation psychologists use pilot-based normative data whenever possible.[11,12] However, appropriate pilot norms are difficult to establish because psychological tests are rarely given to large representative samples of pilots.

Many authors have suggested that pilots are more extroverted and independent than the general population. However, large studies using reliable, valid, and relevant tests are rare. This is particularly true with regard to female pilots, with the exception of studies by Novello and Youssef[13] and more recently King et al.[14]

There are several distinct types of personality inventories that differ according to the purpose for which they were developed. For example, tests such as the Minnesota Multiphasic Personality Inventory and the Millon Clinical Multiaxial Inventory were designed to identify psychopathology, whereas measures such as the Revised NEO Personality Inventory (NEO-PI-R),[15] the Personality Research Form,[16] and the Eysenck Personality Inventory[17] were designed to describe normal personality characteristics. Both types of test overlap to some degree, but the distinction is important because testing for psychopathology has been shown to be of limited value in the assessment of the high-functioning pilot population.[18] On the other hand, measures of normal personality characteristics have been shown to be useful in a variety of settings and populations.[19] In 1994, the U.S. Air Force began using the NEO-PI-R to assess normal personality characteristics of new pilots because of this test's

widespread use in both research and clinical applications.[20] The purpose of this paper is to describe these data and illustrate their potential clinical utility.

Methods

A sample of 1,301 U.S. Air Force student pilots participated in this study. This sample included 1,198 male and 103 female student pilots. The mean age was 22.6 years (SD = 2.9). Approximately 56% of the sample were college graduates who had received or would receive a commission through Officer Training School, the Reserve Officer Training Corps, the Air National Guard, or the Air Force Reserve. The others were in their third year at the Air Force Academy.

The NEO-PI-R is a test designed to measure normal personality characteristics. It consists of 240 statements to which the evaluee responds on a scale from 1 to 5 which represents "strongly disagree," "disagree," "neutral," "agree," or "strongly agree." The NEO-PI-R provides five domain scores (Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness) and six facet scores for each domain. Reliabilities for facet scores range from 0.56 to 0.92, and reliabilities for domain scores range from 0.86 to 0.95. The validity of the NEO-PI-R has been evaluated extensively and is summarized in the test manual.[15] For this study, the computer-administered version of the NEO-PI-R was used. This version produces a standardized set of instructions and scores the test automatically. Participant responses were scored using adult same-sex norms.

Before entering the enhanced flight screening programs at Hondo, Texas, and the U.S. Air Force Academy in Colorado Springs, Colorado, student pilots participate in baseline psychological testing. Tests of intelligence, cognitive abilities, and personality characteristics are given to each student. Students are required to take the intelligence and cognitive abilities tests to continue through the screening process.[21] Tests of personality characteristics, including the Armstrong Laboratory Aviation Personality Survey[22] and the NEO-PI-R,[23] are optional. Approximately 81% of students, however, agreed to take these personality tests. During the testing process, student pilots were asked to consent to allow their test data to be used for research, and approximately 96% agreed to allow their data to be used.

Results

Table I shows the means, standard deviations, and percentiles for the total sample of student pilots. The percentiles were derived by applying the mean scale score to the NEO manual percentile conversion tables. As such, the percentiles represent the mean student pilot scores in the context of general population norms. For example, the mean Extraversion score of 126.31 corresponds with the 83rd percentile of general population norms.

As a group, student pilots scored high on Extraversion (83rd percentile) and Openness (60th percentile) and scored low on Agreeableness (20th percentile). Neuroticism and Conscientiousness scores were average (42nd and 58th percentiles). Most facet scores corresponded with their domain score; for example, five of six Extraversion facet scores were elevated (62nd to 92nd percentiles). However, there were some facet scores that did not correspond to their domain score as expected. Although the

TABLE I

TOTAL SAMPLE NEO-PI-R DESCRIPTIVE STATISTICS (N = 1,301)

Scale	Mean	SD	Percentile
Neuroticism	71.92	19.92	42
Anxiety	13.01	4.72	46
Angry Hostility	12.44	4.85	54
Depression	11.00	4.79	48
Self-Consciousness	13.11	4.57	45
Impulsiveness	15.25	4.69	48
Vulnerability	7.09	3.54	21[a]
Extraversion	126.31	18.15	83[a]
Warmth	22.85	4.17	50
Gregariousness	18.37	5.30	62[a]
Assertiveness	19.75	4.48	84[a]
Activity	20.84	3.82	80[a]
Excitement-Seeking	22.87	3.83	92[a]
Positive Emotions	21.61	4.54	70[a]
Openness	115.18	18.87	60[a]
Fantasy	19.20	5.18	72[a]
Aesthetics	17.24	5.98	48
Feelings	21.09	4.49	62[a]
Actions	16.70	4.02	61[a]
Ideas	21.82	5.27	74[a]
Values	19.09	4.71	38[a]
Agreeableness	113.32	18.49	20[a]
Trust	20.09	4.88	35[a]
Straightforwardness	18.81	4.72	30[a]
Altruism	23.32	3.86	48
Compliance	16.19	4.42	26[a]
Modesty	16.89	4.85	33[a]
Tender-Mindedness	17.99	4.10	25[a]
Conscientiousness	127.96	19.23	58
Competence	23.95	3.50	76[a]
Order	18.76	4.69	54
Dutifulness	23.64	3.80	61[a]
Achievement Striving	22.49	4.34	77[a]
Self-Discipline	21.69	4.57	52
Deliberation	17.40	4.28	47

[a] Percentile 10% above or below general population norms.

Agreeableness domain score and five of six facet scores were low (20th to 35th percentiles), the Altruism facet was in the average range (48th percentile); likewise, although the Conscientiousness domain score was average (58th percentile), the facet scores for Competence, Dutifulness, and Achievement Striving were high (76th, 61st, and 77th percentiles, respectively). Also, whereas the Neuroticism domain score and five of six facet scores were average, the Vulnerability facet score was very low (21st percentile). Finally, the Openness domain score and four of six Openness facet scores were high (60th to 72nd percentiles), but the Aesthetics facet score was average (48th percentile) and the Values facet score was low (38th percentile).

Table II shows the means, standard deviations, and percentiles for the sample of 1,198 male student pilots. The Extraversion domain score was high (85th percentile) and the Agreeableness domain score was low (28th percentile). Facet scores were very similar to the facet scores described above for the entire sample. This result is not unexpected because men make up such a large portion of the entire sample.

Table III shows the means, standard deviations, and percentiles for the sample of 103 female student pilots. As with the

TABLE II

MALE NEO-PI-R DESCRIPTIVE STATISTICS (N = 1,198)

Scale	Mean	SD	Percentile
Neuroticism	71.00	19.60	43
Anxiety	12.75	4.69	53
Angry Hostility	12.39	4.84	55
Depression	10.82	4.70	53
Self-Consciousness	12.99	4.54	51
Impulsiveness	15.11	4.65	51
Vulnerability	6.91	3.53	27[a]
Extraversion	126.13	18.01	85[a]
Warmth	22.77	4.13	55
Gregariousness	18.32	5.25	67[a]
Assertiveness	19.80	4.47	81[a]
Activity	20.81	3.85	82[a]
Excitement-Seeking	22.92	3.82	91[a]
Positive Emotions	21.48	4.54	66[a]
Openness	114.39	18.96	59
Fantasy	19.15	5.17	69[a]
Aesthetics	17.00	6.04	54
Feelings	20.93	4.51	67[a]
Actions	16.52	4.02	63[a]
Ideas	21.88	5.33	68[a]
Values	18.89	4.79	35[a]
Agreeableness	112.89	18.51	28[a]
Trust	20.05	4.83	39[a]
Straightforwardness	18.71	4.71	38[a]
Altruism	23.26	3.87	57
Compliance	16.19	4.42	30[a]
Modesty	16.78	4.88	43
Tender-Mindedness	17.88	4.15	33[a]
Conscientiousness	128.24	19.15	57
Competence	24.06	3.48	72[a]
Order	18.76	4.67	54
Dutifulness	23.72	3.74	61[a]
Achievement Striving	22.52	4.37	84[a]
Self-Discipline	21.71	4.56	51
Deliberation	17.44	4.30	44

[a] Percentile 10% above or below general population norms.

TABLE III

FEMALE NEO-PI-R DESCRIPTIVE STATISTICS (N = 103)

Scale	Mean	SD	Percentile
Neuroticism	82.52	23.33	51
Anxiety	16.00	5.05	57
Angry Hostility	12.98	5.03	60[a]
Depression	13.00	5.75	58
Self-Consciousness	14.42	4.95	39[a]
Impulsiveness	16.94	5.17	62[a]
Vulnerability	9.16	3.69	37[a]
Extraversion	128.35	19.79	81[a]
Warmth	23.70	4.64	59
Gregariousness	18.95	5.82	68[a]
Assertiveness	19.18	4.65	80[a]
Activity	21.12	3.40	78[a]
Excitement-Seeking	22.29	3.92	91[a]
Positive Emotions	23.09	4.57	73[a]
Openness	124.32	17.81	79[a]
Fantasy	19.85	5.29	81[a]
Aesthetics	20.08	5.26	63[a]
Feelings	22.97	4.19	74[a]
Actions	18.73	3.98	75[a]
Ideas	21.19	4.46	74[a]
Values	21.47	3.54	62[a]
Agreeableness	118.39	18.36	23[a]
Trust	20.59	5.34	40
Straightforwardness	19.97	4.80	31[a]
Altruism	24.00	3.80	57
Compliance	16.25	4.32	21[a]
Modesty	18.28	4.52	35[a]
Tender-Mindedness	19.30	3.44	31[a]
Conscientiousness	124.70	20.17	52
Competence	22.68	3.79	68[a]
Order	18.82	4.95	53
Dutifulness	22.72	4.44	53
Achievement Striving	22.12	4.05	77[a]
Self-Discipline	21.38	4.69	42
Deliberation	16.95	4.08	50

[a] Percentile 10% above or below general population norms.

male student pilots, the Extraversion domain score was high (81st percentile) and the Agreeableness domain score was low (23rd percentile). Unlike the male student pilots, for females the Openness domain score was high compared with that of the general female population (79th percentile). Also, the Self-Consciousness and Modesty facet scores were low compared with scores in the general population (39th and 35th percentiles), which is not true for male student pilots.

Table IV shows the percentile levels of specific NEO-PI-R scores for male student pilots. Table V shows the percentile levels for female student pilots. Both tables list actual percentile levels, not percentiles derived from means and standard deviations. These tables can be used to make specific comparisons with the current samples. For example, a male student pilot with a Conscientiousness score of 158 would be at the 95th percentile of the current male sample, and a female student pilot with a Neuroticism score of 40 would be at the 5th percentile of the current female sample.

Discussion

The current data suggest that the average male student pilot is more extroverted than men in the general population. Al-

though not particularly warm interpersonally, he is much more assertive and physically active, and he seeks excitement and stimulation. The average pilot appears to be altruistic, but at the same time he is highly competitive, skeptical, and tough-minded. He describes himself as achievement oriented, highly competent, responsible, and capable of handling high levels of stress.

The average female student pilot shows very similar characteristics. She is outgoing, active, and assertive. She is highly competitive, tough-minded, and achievement oriented. However, she is also more open to new experiences, such as new ideas, emotions, actions, and creative thought. Such a finding is not surprising considering that flying a military aircraft is counter to traditional female roles. The average female student pilot also seems to be willing to experience emotions, but she may feel less self-conscious and less vulnerable than women from the general population.

It is important to remember that these are only average characteristics. Individual characteristics vary widely. To understand how an individual's scores compare, such as for clinical evaluations, the percentile tables in this study are key. In clin-

TABLE IV

MALE PILOT PERCENTILE LEVELS (N = 1,198)

	1%	5%	15%	50%	85%	95%	99%
Neuroticism	26	40	51	69	91	104	120
Anxiety	2	5	7	12	17	20	23
Angry Hostility	2	5	7	11	17	21	24
Depression	1	3	6	10	15	19	24
Self-Consciousness	2	5	8	12	17	20	24
Impulsiveness	4	7	10	14	20	22	25
Vulnerability	0	1	3	6	10	13	16
Extraversion	85	95	107	126	144	156	168
Warmth	11	15	18	23	26	29	31
Gregariousness	4	9	12	18	23	26	29
Assertiveness	9	12	15	19	24	26	29
Activity	10	14	16	20	24	27	29
Excitement-Seeking	13	16	19	22	27	29	31
Positive Emotions	9	13	16	21	26	28	31
Openness	68	84	95	114	134	146	158
Fantasy	7	10	13	19	24	27	30
Aesthetics	3	7	10	17	23	26	30
Feelings	9	13	16	21	25	28	30
Actions	5	10	12	16	20	23	25
Ideas	6	12	16	22	27	30	31
Values	5	9	13	19	23	26	28
Agreeableness	64	79	95	113	131	141	153
Trust	6	10	15	20	24	26	30
Straightforwardness	7	10	13	19	23	26	28
Altruism	12	16	19	23	27	29	31
Compliance	5	8	11	16	20	23	26
Modesty	5	8	11	17	21	24	27
Tender-Mindedness	7	10	13	18	22	24	27
Conscientiousness	74	95	109	128	147	158	168
Competence	14	18	20	24	27	29	31
Order	6	10	14	18	23	26	28
Dutifulness	13	17	20	23	27	29	31
Achievement Striving	9	14	18	22	26	28	30
Self-Discipline	9	13	17	22	26	28	31
Deliberation	6	10	12	17	21	24	27

ical cases, premorbid data, such as data available from screening programs like the enhanced flight screening program, are extremely useful;[24] however, data from large data sets such as this study may be used to put an individual's NEO-PI-R scores into the context of scores from U.S. Air Force student pilots. The percentile tables give specific percentiles for specific scores. Scores that fall above the 95th or below the 5th percentile can be viewed as significantly different from this U.S. Air Force sample.

The utility of these data is illustrated by the case of a student pilot who was referred to an Air Force flying training wing's aviation clinical psychologist for an evaluation to rule out manifestations of apprehension, which is student pilot equivalent of fear of flying in a trained pilot. In other words, it is a nonphobic fear associated with flying that significantly impairs a flyer's ability to perform effectively. This student was described as performing below average in general, and particularly so when under pressure in the cockpit. In cases such as this one, it is important to distinguish between lack of ability and lack of motivation and to identify the presence of a medically disqualifying condition, such as an anxiety disorder. In this case, the student had taken the NEO-PI-R during the medical screening phase of the enhanced flight screening program. A review of his

pretraining NEO-PI-R data showed that he had an average Neuroticism domain score, with average Anxiety, Depression, and Vulnerability facet scores. These data did not support a premorbid anxiety or mood disorder. Furthermore, he had an average Achievement Striving facet score compared with men his age. However, this "average" score was very low compared with that of other student pilots. This left open the possibility of inadequate motivation. The student's primary instructor pilot (IP) stated that he believed the student was capable of completing training but seemed to "quickly get behind under stressful situations." The IP also described the student as a "nice guy," but he went on to say that the student did not seem to fit in well with others in the flight. Lack of capability was not likely given the IP's appraisal and the student's Full-Scale IQ score of 125 as measured by a computerized version of the Multidimensional Aptitude Battery, which is above average compared with other student pilots.[25] A clinical interview revealed a self-description that was not consistent with flying-related anxiety symptoms, such as increased physiological arousal or specific avoidance behavior. However, the student had been considering alternative career options. After two brief visits over 2 days, the student elected to self-initiate elimination from training and subse-

TABLE V

FEMALE PILOT PERCENTILE LEVELS ($N = 103$)

	1%	5%	15%	50%	85%	95%	99%
Neuroticism	34	46	56	80	107	127	140
Anxiety	5	8	10	16	21	24	27
Angry Hostility	1	6	8	12	18	22	27
Depression	1	4	7	12	20	24	25
Self-Consciousness	5	7	9	13	19	24	27
Impulsiveness	2	8	12	16	22	25	27
Vulnerability	2	3	5	8	12	16	18
Extraversion	83	93	104	129	150	157	164
Warmth	9	13	19	24	28	29	31
Gregariousness	5	8	12	19	25	28	30
Assertiveness	6	10	14	19	24	26	29
Activity	13	14	17	21	24	26	28
Excitement-Seeking	13	14	17	22	26	28	30
Positive Emotions	13	15	17	23	28	30	31
Openness	75	93	105	124	140	156	166
Fantasy	7	11	13	20	25	28	30
Aesthetics	4	10	13	20	25	28	30
Feelings	12	15	18	23	26	30	31
Actions	11	12	14	18	22	24	28
Ideas	10	13	16	21	25	28	30
Values	10	15	17	21	24	26	28
Agreeableness	78	83	97	118	136	144	159
Trust	5	9	15	21	25	27	31
Straightforwardness	7	11	14	20	25	27	29
Altruism	15	17	19	24	27	30	31
Compliance	4	9	11	16	20	23	25
Modesty	5	10	13	18	23	25	27
Tender-Mindedness	12	13	15	19	22	25	27
Conscientiousness	63	87	102	128	144	149	164
Competence	11	15	18	23	26	28	30
Order	7	9	12	19	23	25	28
Dutifulness	9	13	17	23	26	29	31
Achievement Striving	11	14	18	22	26	27	28
Self-Discipline	6	12	16	22	25	27	29
Deliberation	7	9	12	17	21	23	25

quently cross-trained into another, probably more appropriate, career field. In this case, NEO-PI-R data were used to compare this student with men from the general population and to specific male student pilot norms. These comparisons contributed to the psychologist's accurate diagnosis (or nondiagnosis) and brief, problem-focused intervention.

This study used a fairly large sample and a reliable and valid measure of personality for this population; however, there are limitations to the generalizability of these data. First, the subjects in this study were all student pilots, and a small percentage will not become rated pilots (approximately 15%). Second, the subjects were all U.S. Air Force officers or officer candidates, so generalizing to other populations should be done with caution. Generalizing to student pilots in general aviation settings is discouraged because education levels, age, socioeconomic status, and many other variables differ considerably. Although further study of these other groups is critical, until data from these additional studies become available, use of these data for clinical purposes may be more appropriate than use of norms from the general population.

In summary, pilots are valuable personnel assets that must be provided the highest level of psychological services. Valid

psychological assessment is a critical step in this process. Previous work in the area of psychological assessment of pilots has focused mainly on personnel selection and not on clinical evaluation. The present study demonstrates how large studies using reliable, valid, and clinically relevant tests can yield the type of data necessary to improve the psychological services available to the flying community.
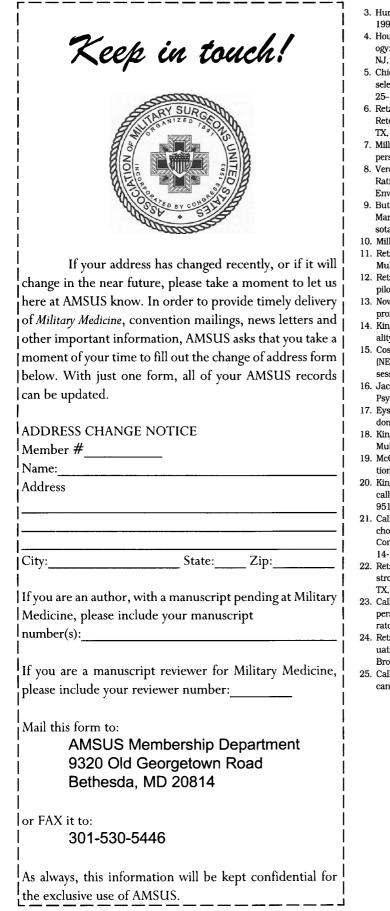
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