Big 5 Personality Profiles of Rotary-Wing Aircrew

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Abstract. This study explored the Big 5 personality profiles of a substantial sample of commercial rotary-wing pilots and engineers using the Big Five Inventory. Both groups were shown to differ significantly from the general population in being higher on the factors of Extraversion, Agreeableness, and Conscientiousness, and lower on the factor of Neuroticism. No significant differences were seen for Open-mindedness in either group. Findings were similar to those seen in earlier studies. The study is unique in defining the personality characteristics of a group of aeronautical engineers using the Big 5 model. Potential limitations of this study, and direction for further research and validation were suggested.

Keywords: personality, helicopters, pilots, engineers, selection

Introduction

There is a long history of the search for specific personality factors found in aircrew, dating back to the earliest days of aviation (Ganesh and Joseph, 2005). Much of the impetus for this has come from the need to select aircrew for military duties (Paulin et.al., 2006), and more recently from the need to ensure that aircrew – pilots in particular – are psychologically fit to work in the civil aviation sector. The earliest studies were mainly anecdotal, but since the advent of more objective measures of personality, some systematic research has been carried out and published, again mainly dealing with military selection situations (Campbell, Castaneda and Pulos 2010). It is now common to include personality measures in the assessment and selection processes of both commercial and military aircrew. (King 2014)

Most published studies do not discriminate aircrew by aircraft type, and so give generic results potentially including fixed and rotary wing aircrew. This is not surprising as many papers describe personality assessments carried out prior to initial flight training when selection of aircraft type is not yet made. As a result there are few specific published studies of personality characteristics of rotary-wing aircrew, and almost all of the existing studies are of military rather than commercial crew. A similar lack of studies occurs when differentiation is made between types of rotary wing aircraft operations (for example types of military operational scenarios), and between categories of aircrew, notably pilots, engineers or rear crew. This study aims to describe unique personality factors that might differentiate rotary wing pilots and engineers specifically from the normal population, focussing on a commercial aviation situation.

Within the psychology of personality much recent attention has been focussed on the “Big 5” personality factors made popular by Costa and McCrae (1989) with their development of the NEO Personality Inventory – Revised (NEO-PI-R) which has become the most widely-used measure of the Big 5. The Big 5 factors are:

- Extraversion (E) – an energetic and outgoing focus towards the social world
- Agreeableness (A) – a prosocial and communal orientation towards others
- Conscientiousness (C) – socially prescribed impulse control
- Neuroticism (N) – contrasts emotional stability with negative emotionality
- Open-Mindedness (O) – the breadth, depth and complexity of mental life

There have been a number of meta-analytic studies of the usefulness of the model in predicting job performance, most notably by Barrick and Mount (1991), whose meta-analytic study showed the value of high levels of C and A in predicting success in specific careers.

The Big 5 dimensions have been used to define specific personality parameters in aviation situations. Callister et.al. (1997) used the NEO-PI-R to explore the personality characteristics of a group of 1301 USAF student pilots compared to the general personality norms, and found higher levels of E and lower levels of A. Female student pilots in the sample also had higher levels of O. King et al (2011) produced a set of aviator-specific norms for the NEO-PI-R, but only for military pilots. Fitzgibbons, Schutte and Davis (2004) used the NEO-PI-R to define a general personality profile for commercial aviation pilots, finding a group of 93 experienced fixed-wing pilots to have significantly low scores on N and high scores on C, with a strong trend towards higher scores on E and A. King et.al. (2012) found small but significant relationships between Big 5 factors and training outcomes in USAF trainee pilots, whilst King, Retzlaff and Orme (2001) focussed on the Conscientiousness factor and linked it to safety-related incidents in USAF pilots who had experienced such incidents, showing that higher levels of the factor were positively correlated with an increased incidence of flying mishaps.

Most of the quoted research studies either do not differentiate between fixed and rotary wing pilots, or include both groups in an undifferentiated sample. Grice and Katz (2006) used the NEO-PI-R to explore the Big 5 profiles of experienced US Army rotary-wing aviators across a number of mission platform types. In the full sample of 75 pilots they found average levels of E, A and C together with low levels of N and O. In differentiating between platform types, they found higher levels of E in attack pilots, and higher levels of C in cargo and utility pilots (possibly the closest comparison group to commercial rotary-wing pilots).

The application of the Big 5 model to the description of unique personality characteristics of aeronautical engineers – or indeed engineers of any variety – for once justifies the use of the cliché of there being a dearth of research. An extensive literature search of the psychology and engineering literature produced only two studies. Kaur (2013) found that high scores on C and E differentiated high and low achievers amongst a group of 559 undifferentiated engineering students, whilst Van der Molen, Schmidt and Kruisman (2007) found that a group of engineers showed high levels of E, C and O and low levels of A and N. This study included an undifferentiated sample of engineers, with a bias towards software engineers. No specific research using the Big 5 factors with aeronautical engineers was found, so the current study is unique in its use of the Big 5 factors to define the characteristics of this group.

The present study is therefore unique in a number of ways in that it focusses solely on experienced rotary-wing pilots and has a substantial sample size, and it focusses solely on aeronautical engineers, again with a substantial sample size.

Method

The Big Five Inventory

We chose to use the Big Five Inventory (BFI) (John, Donahue and Kentle (1991); John, Naumann and Soto (2008)). The reasons for this were that the BFI possesses robust statistical properties and is quick to complete and score, allowing questioning of answers during the interview process. The BFI has been shown to have high internal consistency, retest reliability, a clear factor structure and a strong correlation with longer Big Five measures such as the NEO-PI –R. The BFI is a 44 item self-report inventory designed to measure directly the Big 5 dimensions. It consists of short phrases with a relatively accessible vocabulary. Items are rated on a 5 point Likert-type scale of agreement with the statement "I see myself as some who..", ranging from strongly disagree (1) to strongly agree (5). A number of items are reverse scored. Average scores on that scale for each of the 5 factors are computed and there is a table of age-related general population norms for comparison. There are some parallel versions in different languages. In this study, where possible, we used the English, Dutch, Spanish and Italian versions with native speakers of each language.

The BFI was administered as part of a larger test battery that also included a measure of intelligence, a measure of mental wellbeing, an in-depth structured interview including critical incident analysis and a strengths-based inquiry. The interview questions were developed using an evidence-based approach based on research into the characteristics of safe and unsafe pilots, and also offered an opportunity to validate the BFI scores. For pilots only a test of situational awareness was administered, and for engineers only a test of understanding of mechanical concepts.

Subjects

The subjects in this study were all qualified pilots and engineers that were being considered for hire to work with a commercial helicopter operator, mainly in the North Sea, between May 2012 and October 2014. No prior selection of either group was possible, and the psychological assessment process was part of a wider hiring process. All pilots tested were post-training and all held current CPL (H) and ATPL licenses

Table 1 below shows the number and gender of pilots in the study. Comparison is made to the most recent statistical account available of the number of pilots holding the basic qualification required by the company – Commercial Pilot's License (Helicopter) (CPL (H)) – as listed by the UK Civil Aviation Authority (CAA 2008).

Table 1.

Totals and Gender Balance of the Pilots

	Sample	%	2008 CAA	%
Female	9	5.7%	23	4%
Male	156	94.3%	617	96%

Total	165	100%	640	100%

Table 2. shows the average age and flying hours of the sample, again with a comparison to the 2008 CAA summary statistics.

Table 2.

Average Age and Flying Hours of the Pilots.

	Average	Range	2008 CAA	Range
Age	39	21 - 63	35	20 - 61
Hours	2250	140 - 12800		

Both B1 and B2 licenced engineers were included in the study and Table 3 below shows the number and gender of the sample. The age range for the total sample of engineers was 40.7 years, with a range of 22 to 67. All were experienced engineers holding current B1, B2 or a combination of both licences.

Table 3.

Gender of the Engineers.

	Sample	%
Female	2	2.4%
Male	83	97.6%
Total	85	100%

Results

The results are presented separately for the sample of pilots and for the sample of engineers. Tables 4 and 5 below show the descriptive statistics for each of the BFI factors for the total sample of pilots and engineers respectively.

E – Extraversion
A – Agreeableness
C – Conscientiousness
N – Neuroticism

O – Open-mindedness

Note that for the Neuroticism dimension the directionality is that a low score indicates increased emotional stability.

Table 4.

BFI Descriptive statistics for the pilots sample

	E	**A**	**C**	**N**	**O**
Mean	3.88	4.32	4.57	1.73	3.67
Standard Error	0.04	0.03	0.03	0.03	0.03
Median	3.88	4.34	4.67	1.75	3.6
Mode	4.25	4.34	5	1.75	3.4
Standard Deviation	0.571	0.397	0.395	0.511	0.503
Sample Variance	0.326	0.158	0.156	0.261	0.253
Kurtosis	- 0.675	0.036	0.62	0.079	0.97
Skewness	-0.119	-0.481	-1.011	0.639	-0.3
Range	2.4	1.88	1.8	2.5	3.2
Minimum	2.6	3.12	3.2	1	1.6
Maximum	5	5	5	3.5	4.8
Sum	641.6	713.34	755.31	286.3	606.31
Count	165	165	165	165	165
Confidence Level (95.0%)	0.087	0.061	0.06	0.078	0.077

Table 4 indicates that the rotary-wing pilots included in this study showed:

- slightly high levels of E,
- higher levels of A,
- very high levels of C,
- very low levels of N
- average levels of O

These findings are generally in keeping with previously-quoted research, particularly those of Grice and Katz (2006), although the current larger civil aviation sample has higher levels of A and of O than their military sample, specifically the cargo and utility pilot group. However the current sample is much larger than theirs, so direct comparison might be misleading.

Table 5 shows that the aeronautical engineers showed:

- slightly higher levels of E
- higher levels of A
- very high levels of C
- lower levels of N
- slightly lower levels of O

Table 5.

BFI Descriptive statistics for the engineers sample

	E	**A**	**C**	**N**	**O**
Mean	3.731529	4.390824	4.661882	1.746118	3.694118
Standard Error	0.060253	0.050715	0.038991	0.062038	0.044006
Median	3.75	4.56	4.78	1.75	3.6
Mode	4	4.67	5	1.13	3.5
Standard Deviation	0.555502	0.46757	0.359475	0.571962	0.405719
Sample Variance	0.308582	0.218622	0.129223	0.327141	0.164608
Kurtosis	-0.48034	0.898389	2.403477	-0.14688	-0.00158
Skewness	0.085628	-1.07729	-1.41779	0.622513	0.127973
Range	2.5	2.11	1.8	2.38	2.1
Minimum	2.5	2.89	3.2	1	2.6
Maximum	5	5	5	3.38	4.7
Sum	317.18	373.22	396.26	148.42	314
Count	85	85	85	85	85
Confidence Level (95.0%)	0.119819	0.100853	0.077537	0.123369	0.087512

Using Welch's unpaired t test for unequal samples (Welch 1947), an independent comparison for the pilot and engineer groups was made with a general population sample as described by John, Naumann and Soto (2008) to test if the differences evident were statistically significant. This has some drawbacks, given the grossly unequal nature of the sample sizes (132,515 for the general populations, 165 for pilots and 85 for engineers). Tables 6 and 7 below show the results using Welch's test for both groups, including the confidence levels of the difference.

Table 6.

Significance of pilots sample compared to the general population.

	General Population		Rotary-wing pilots					
	Mean	S.D	Mean	S.D.	t	df	SED	p
E	3.2	0.8	3.9	0.6	14.97	164	0.047	<0.0001
A	3.8	0.6	4.3	0.4	16.03	164	0.031	<0.0001
C	3.6	0.7	4.6	0.4	32.05	164	0.031	<0.0001
N	3.0	0.8	1.7	0.5	33.34	164	0.039	<0.0001
O	3.7	0.6	3.7	0.5				N.S.

Table 7

Significance of aeronautical engineers sample compared to the general population.

	General Population		Aero engineers					
	Mean	S.D	Mean	S.D.	t	df	SED	p
E	3.2	0.8	3.7	0.6	7.67	84	0.065	<0.0001
A	3.8	0.6	4.4	0.5	11.05	84	0.05	<0.0001
C	3.6	0.7	4.7	0.4	25.33	84	0.04	<0.0001
N	3.0	0.8	1.8	0.6	18.42	84	0.065	<0.0001
O	3.7	0.6	3.7	0.4				N.S.

The results show consistently significant differences for both groups and the general population on E, A, C and O, but no significant difference for O.

Discussion/Conclusions

The above results show a clear pattern of Big 5 personality characteristics for both pilot and engineer samples. For the pilots this can be summarised as:

Significantly higher levels of Extraversion: pilots tend to be more outgoing, assertive and energetic than the general population.
Significantly higher levels of Agreeableness: pilots tend to be much more co-operative, empathic and warm than the general population.
Significantly higher levels of Conscientiousness: pilots tend to be much more organised, methodical and self-disciplined than the general population.
Significantly lower levels of Neuroticism: pilots tend to be very much more relaxed, calm and emotionally stable than the general population.
Average levels of Open-mindedness: pilots tend to be as flexible, reflective and creative as the general population.

These results are broadly consistent with both general findings for pilots and specifically for rotary-wing pilots. Compared to Grice and Katz's (2006) smaller military sample, this sample of experienced commercial pilots showed higher levels of A than theirs, and higher (although still average) levels of O. The implications of theses finding are that commercial pilots are more likely to get on with colleagues and passengers in the line, and be as relaxed and calm under pressure as their military counterparts. A future analysis of the current data could examine these differences in more detail, as a significant proportion (47%) of the commercial pilots had received their initial training in a military situation and a number had operational experience, albeit usually in cargo and utility operational roles rather than attack or SAR helicopter roles.

For the engineers the findings can be summarised as:

Significantly higher levels of Extraversion: engineers tend to be slightly more outgoing, assertive and energetic than the general population.
Significantly higher levels of Agreeableness: engineers tend to be much more co-operative, empathic and warm than the general population.
Significantly higher levels of Conscientiousness: engineers tend to be very much more organised, methodical and self-disciplined than the general population.

Significantly lower levels of Neuroticism: engineers tend to be very much more relaxed, calm and emotionally stable than the general population.
Average levels of Open-mindedness: pilots energetic to be as flexible, reflective and creative as the general population.

Compared to the only available generic study of engineers by Van der Molen, Schmidt and Kruisman (2007), this specific sample of aeronautical engineers show a number of significant differences. They are more Agreeable but less Open-minded than their sample – they tend to be more practical and pragmatic and less conceptual and creative. Further differentiation may be made in future analysis of this data by distinguishing between those engineers holding B1 (mechanical) and B2 (avionic) licenses – the latter might be closer to the published sample which includes software engineers.

There are some limitations or drawbacks to this study, however, that apply equally to both pilot and engineer groups. Firstly the sample was pre-selected, having been presented for pre-hire assessment. It is possible that an initial sift had been made of candidates by the company recruitment staff, and that only those who fitted an informal company profile made it through. Both pilots and engineers who might have been suitable qualified, but not fitting an informal personality or cultural fit profile may well not have been included and the sample may be positively biased to produce such an outcome. However a proportion of the pilots and engineers seen for assessment (anecdotally close to 5%) were rejected for hire, so there may be evidence that the sample is more generally representative of both wider populations. Secondly there is consistent evidence that most people "fake good" and show positive response bias on recruitment assessments. Joseph, Thomas and Roopa (2005) and Galić, Jernieć and Kovačić (2012) showed specific evidence that this occurs in pilots, although both papers emphasise that the general directionality of personality test scores is reliable, whilst the absolute scores might be exaggerated. Besides the in-built reliability of the BFI, including the use of reverse-scoring, two ways of mitigating this were employed during the present study. The first was an indication that the scores were generally correct because of the lack of positive response bias on the O factor. Differentially biasing scores on the other four factors would have required a degree of psychological knowledge and sophistication not generally seen in either pilots or engineers! The second was through the use of the structured clinical interview to explore and validate an individual's scores with questions around each of the 5 factors, to check extreme scores in either a positive or negative direction and to make clinical observation of behavioural markers of personality.

This study is really only the first part of a much bigger study, as the sample size of both groups grows monthly. Further analysis of the current data can be made to look at scores at the facet level (see Soto and John 2009) as each of the five factors in the BFI is made up of two facets, giving a more detailed analysis of personality characteristics. Similarly differentiation of both samples can be made to include looking at potential differences between military trained and civil trained pilots, mechanical and avionic engineers and between male and females in both samples (although the number of females in both samples is significantly low). However the most important requirement is for the validation of the use of the Big 5 factors as a way of differentiating between performance levels of both groups. For the pilots this requires establishing correlations between the five factors and data such as training and simulator performance, or potentially, FDM data. For the engineers it requires establishing correlations between the five factors and subsequent job performance on a number of measures. I hope to undertake this over the next year and publish the data when complete.

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