8-18-2020

Personality Trends in the Pilot Population

Maria E. Chaparro
Florida Institute of Technology

Meredith Carroll
Florida Institute of Technology

Shem Malmquist
Florida Institute of Technology

Personality has been acknowledged since the 1970's as an influencing factor in pilot performance and training outcomes (King, 2014; Bartram, 1995). Since the late 1940's, pilot selection techniques have included personality related questions (Olson, Walker, & Phillips, 2009; Callister, King, Retzlaff, & Marsh, 1999; Dolgin & Gib, 1988; Fiske, 1947). Unfortunately, despite the large number of different personality indexes used within this line of research, there has not been an aggregation of all aviation studies examining pilot personality and its impact on performance and success. In the current effort, a literature review was conducted to identify research that examined pilot personality traits, and a high-level summary of the findings related to trends in pilot personality traits is provided. The summary includes an examination of personality traits across the differing pilot categories (i.e., commercial, student, and military pilots) and pilot genders. When examining pilots, in general, compared to a general population, consistent with past research, pilots tend to exhibit personality traits lower in neuroticism, higher in extraversion, equivalent in openness, lower in agreeableness, and higher in conscientiousness. However, when different pilot categories are examined, the trends are not as ubiquitous. For instance, commercial pilots research consistently shows pilots to have higher levels of conscientiousness than the general population; however, for military and student pilots the results are not equivocal. We present here the methods and results associated with our review of the literature and provide a discussion of what can be gleaned and future research needed.

Recommended Citation:

Personality has been acknowledged since the 1970's as a factor that influences pilot performance and training outcomes (King, 2014; Bartram, 1995). Since the late 1940's, pilot selection techniques in both military and commercial settings have included personality assessments (Olson, Walker, & Phillips, 2009; Callister, King, Retzlaff, & Marsh, 1999; Dolgin & Gib, 1988; Fiske, 1947). Although there is a large body of work related to pilot personality, given the disparate goals, measures, pilot types, and findings within the works, there is currently not an overarching understanding of how personality influences pilot performance and success, and if there are indeed personality traits that set pilots apart from the general population.

Much of the research related to personality traits in the pilot population aims to identify a pilot-specific personality profile or pilot-specific personality traits (Ragan, 2010; Yeames, 2001). However, the focus and means by which these questions are examined differ, making it challenging to draw overall conclusions. For example, many studies examining pilot personality focus on the military population (Chapelle, Novy, Sowin, and Thompson, 2010; Ragan 2010; Grice & Katz, 2006). However, pilot personality findings related to this population may differ significantly from the commercial pilot population as military culture has been found to have a profound effect on personality (Jackson, Thoemmes, Jonkmann, Lüdtke, & Trautwein, 2012). There are also studies which have examined pilot-in-training personality traits (Fussell, Dattel, and Mullins, 2018; Robins, Fraley, Roberts, & Trzensniewski, 2001). Research has shown significant changes in personality during young adulthood (Caspi, Roberts, & Shiner, 2005). Additionally, typical pilot-in-training environments are extremely different from commercial operations or military environments, and environment has been found to have a marked effect on personality (Ullén et al., 2012). Pilots-in-training in college go through complex challenges and adaptations as this is usually their first time away from home and the period where they are transitioning to preparedness for marriage and the workforce (Robins, Fraley, Roberts, & Trzesniewski, 2001). Some of the literature examined pilot personality trends of a particular gender or differences between genders. Gender differences have been found in the non-aviation personality literature and previous studies in aviation have not found this same trend (Novello & Youseff, 1974). With growing numbers of female pilots, it is important to understand gender differences of pilots for operational and medical consideration (King, McGlohn, & Retzlaff, 1997).

The goal of this paper is to aggregate the pilot personality research that has been conducted to date, draw conclusions regarding key questions and identify research gaps to guide future research. Of particular interest are the following research questions:

(1)   Are pilot's personality traits different from the general population?
(2)   Are there differences in the personality traits of commercial, military and pilots-in-training?
(3)   Are there differences in the personality traits of female and male pilots?

These questions are the focus of the methods and findings discussed in the following sections.

Methodology

First, a literature review was conducted to identify research which used personality inventories to examine pilot personality traits. Literature was searched utilizing the following databases: Florida Tech Summons library database, ProQuest, Wiley Online Library, PsycINFO, and Google Scholar. The following key words were used: pilot, commercial pilot, military pilot, pilot-in-training, aviation, personality, five-factor model (FFM), gender, Neuroticism, Conscientiousness, Extraversion, Agreeableness, and Openness. The personality traits of focus were those associated with the five-factor model (FFM); however, the literature review revealed several other personality indexes not using the FFM, therefore, these were included in the review as well. When an article was identified, the abstracts were reviewed to determine whether the studies were relevant to the scope of the current study. Study relevancy was determined based on two criteria, including that the study either (a) reported pilots' raw personality scores, or (b) compared pilot personality scores to a general or specific population, (e.g., a working population or pilot-in-training population).

Second, papers deemed relevant were thoroughly reviewed and the following information was extracted and input into a database: the research focus of the article, type of research (theoretical, experimental, etc.), target constructs (e.g. personality), pilot type (e.g., commercial, military or pilot-in-training), the population the sample was compared to, summary of findings, individual difference factors examined (e.g., gender, etc.), study methodology, measures (i.e., NEO-PI-R), type of measures, (e.g., physiological, survey, behavioral), results/findings, limitations, and suggested future research.

Third, the FFM was chosen as the benchmark against which to aggregate findings associated with the range of personality measures used to assess pilot personality. This decision was made due to (1) the FFM being the most commonly used personality index within the database of studies reviewed, and (2) the FFM's prominence in the literature assessing general personality, its validity, and its recurrent use in the pilot personality literature (Fussell, Dattel, & Mullins, 2018; Fitzgibbons, Davis, & Schutte, 2004; Callister et al., 1999), The five traits which are represented in the FFM are: Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A), and Conscientiousness (C). Each of the five factors are described in Table 1 per Costa and McCrae (1992).

Table 1
FFM and Descriptions

Facet	Description
Neuroticism	Intensity and frequency of experienced negative emotions, sensitivity to negative aspects of environment
Extraversion	Amount of energy directed outwards to the external environment, and need for external stimulation
Openness	Receptivity to a range of external and internal sources of information and new input
Agreeableness	Role a person adopts in relationships on continuum from compassion to antagonism; likelihood of person taking on board, accepting, and being influenced by perspectives or concerns of others
Conscientiousness	Strength of purpose and drive to goal accomplishment

Fourth, based on the results of studies in the database, a mapping was created for each of the benchmark personality factors (i.e., Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness). Within this mapping, results from each of the studies were classified as indicating that pilots scored higher, lower, or equal to a comparison population. The mapping was also segmented into the type of sample population including whether the sample was pilot-in-training, GA, commercial or military pilots. Initially the mapping only included articles which used a FFM measure. The mapping was then expanded to include findings from studies which utilized measures that have been shown in the literature to correlate with the FFM factors.

Finally, we summarized trends in the data related to the personality traits of: (a) pilots, in general, compared to the general population, (b) commercial vs. military vs. pilots-in-training, and (c) female vs. male pilots. The following sections discuss the resulting findings.

Results

The literature review resulted in 24 publications that met the inclusion criteria. Table 2 summarizes the number of studies with each pilot and comparison populations, and the following paragraphs provide a high level description of the studies various goals and methods.

Table 2
Number of Studies with each Pilot and Comparison Population

Comparison Population	Pilot Samples			
	Military	Commercial	Pilots-in-training	Total
General Population	15	3	1	19
Working Population	1	2	0	3
College Students	0	0	2	2
Total	16	5	3	24

The 16 studies which utilized military populations had a range of different objectives and approaches. Chappelle et al. (2010) administered the NEO PI-R to 10,142 USAF-rated pilots with the purposes of (a) providing normative data for USAF female pilot personality traits, (b) investigating differences between USAF female and male pilots, and (c) investigating differences in personality traits between female pilots with various positions. Ragan (2010) administered the NEO PI-R and Multidimensional Aptitude Battery (MAB-II) to 1,819 USAF-rated fighter pilots to update the current literature base with a more representative sample of current USAF pilots. Campbell, Moore, Poythress, and Kennedy (2009) compared 956 U.S. Naval aviators to both the U.S. Air Force (USAF) population and the general population. Several studies surveyed military pilot personality traits using the FFM to investigate whether there was a typical military pilot personality, if gender differences were present, or if there were differences based on stage in their careers (King, Barto, Ree, & Teachout, 2011; Callister et al., 1999; King, Callister, Retzlaff, & McGlohn, 1997; King, McGlohn, & Retzlaff, 1997). Bucky & Speilberger (1973) and Vaernes et al. (1991) as cited in Castaneda (2007), utilized the State-Trait Anxiety Inventory to measure military pilot's personality and the relationship between stress, psychological factors, and health-related factors among military aviators. Grice and Katz (2006 & 2007) and Carretta, et al. (2014) administered personality tests to new military aviators, comparing them to the general population. Yeames (2001) as cited in Castaneda (2007) examined US Army Aviation

Warrant Officer personality traits to determine if specific personality factors afford aviators a greater probability of being promoted in the United States Army. Using the Eysenck Personality Questionnaire-Revised (EPQ-R), Glicksohn, J., & Naor-Ziv, R. (2016) compared Israeli military pilot personality traits to population norms and to data previously collected from participants in other sections of the military population to examine whether there were distinctive personality differences. Meško, Karpljuk, Videmšek, and Podbregar (2009) examined the personality traits of Slovenian military pilots in relation to stress coping strategies utilizing the Big Five Questionnaire (BFQ).

The four studies that were conducted with commercial aviation pilots compared personality traits of a sample of commercial pilots to a general population using differing methods. Fitzgibbons et al. (2004) examined U.S. commercial pilot personality traits and whether there was a commercial pilot personality profile by comparing personality traits of 93 U.S. commercial pilots to the general U.S. population using the NEO-PI-R. Dickens (2014) compared the personality traits of 165 commercial helicopter pilots to the general U.K. population using the Big Five Inventory to determine whether experienced rotary wing pilots had a typical personality type. Mesarosova et al. (2018) compared personality traits of 591 European airline pilots to the general working population using the NEO-PI-R to determine the personality profile of this population. Wakcher, Cross, and Blackman, (2003) as cited in Castaneda (2007) compared the personality traits of 81 current U.S. airline pilots, 137 U.S. airline pilot applicants, and the U.S. general population using the Sixteen Personality Factor Questionnaire (16PF).

The three studies which examined non-military pilot-in-training personality traits also had a range of methods. Robertson and Putnam (2008) compared the personality of aviation pilot-in-trainings at the Aviation Flight Program at a Midwestern U.S. university to the general U.S. population using the Myers Briggs Type Indicator (MBTI) to determine if there is a typical personality type in collegiate aviation programs. Gao and Kong (2016) compared the personality types of 103 pilots-in-training in an Australian collegiate aviation program to that of psychology students. The data on psychology students was raw data from a prior study at the same University by Murray et al., (2009). The instrument they utilized was the Australian Personality Inventory (API), a 50-item instrument measuring the FFM in order to determine the differences in personality between pilots-in-training and non-pilot students and to determine if there existed a typical pilot-in-training personality type. Fussell et al. (2018) examined MBTI scores of aviation students who had completed their first solo flight in a US collegiate flight program in relation to a learning preference scale to assess if personality was a predictor of learning preference.

The following sections summarize the results of the 24 studies, specifically, the trends identified regarding the personality traits of: (a) pilots, in general, compared to the general population, (b) commercial vs. military vs. pilots-in-training, and (c) female vs. male pilots.

Pilots Compared to the General Population. Table 3 presents the trends found when examining results associated with the entire pilot population, including commercial, military, and pilots-in-training when compared to the general population. The studies either employed a measure of the FFM or personality indexes which included a factor that has been shown in the literature to highly correlate with one of the five factors. Table 3 and Figure 1 provide a

summary of the percentage (and proportion) of studies which have shown that pilots score either higher, equal to, or lower than the general population on each of the five factors. Trends that represent a majority (>50%) are presented in bold print. The sections that follow provide a summary of these trends for each of the five factors.

Table 3
Trends in FFM Scores of Pilots Compared to General Population

FFM Factors	Pilots (Across all Categories)		
	Lower	Equal to	Higher
Neuroticism	**89%** *(17/19)*	11% *(2/19)*	0% *(0/19)*
Extraversion	11% *(2/19)*	11% *(2/19)*	**79%** *(15/19)*
Openness	21% *(4/19)*	**63%** *(12/19)*	16% *(3/19)*
Agreeableness	**63%** *(12/19)*	21% *(4/19)*	16% *(3/19)*
Conscientiousness	5% *(1/18)*	39% *(7/18)*	**56%** *(10/18)*

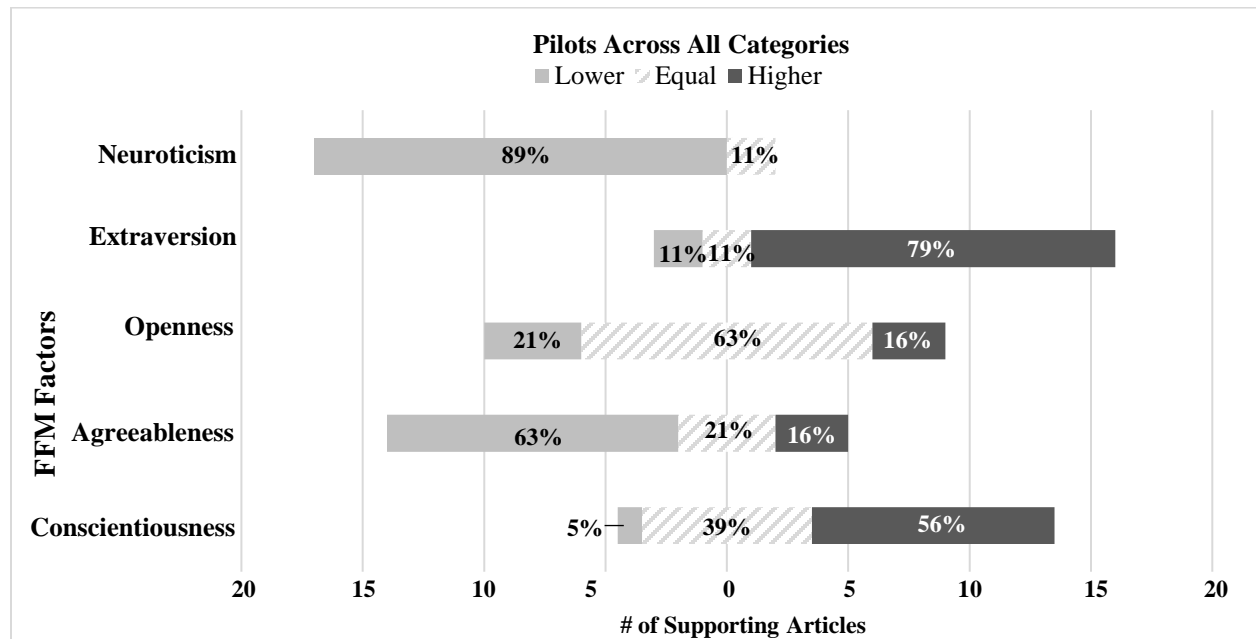*Note:* Bolded numbers indicate majority trends (>50%)

Figure 1. *Trends in FFM Scores of Pilots Compared to General Population*

Neuroticism. The data suggests that pilots typically possess lower levels of Neuroticism than the general population. Seventeen of the 19 studies examining the personality trait of Neuroticism, or a personality trait from a personality index that has shown to be significantly

correlated with Neuroticism, reported pilots scores as lower than that of the general population. Fitzgibbons et al., (2004) found that 60% of commercial pilots scored lower than the general population on the Neuroticism factor within the NEO-PI-R, indicating pilots are more emotionally stable than the general population (Fitzgibbons et al., 2004). Additionally, Mesarova et al., (2018) and Dickens (2014) found that commercial pilots scored lower on Neuroticism, as measured by the NEO-PI-R and Big Five Inventory (BFI), when compared to workers in the U.K. and the general U.K. population, respectively. Fifteen studies using measures which target the five factors of personality, found that military aviators scored lower on Neuroticism than the general U.S. population (Glicksohn & Naor-Ziv, 2016; Carretta et al., 2014; King et al., 2011; Chapelle et al., 2010; Ragan 2010; Campbell et al., 2009; Grice & Katz, 2006; Yeames, 2001; King, Callister, Retzlaff, & McGlohn, 1997; King, McGlohn, & Retzlaff, 1997; Vaernes et al. 1991; Bucky & Speilberger, 1973). Only two of the 19 studies that examined pilot scores on Neuroticism or a related dimension, found pilots to be equivalent to the general population on the Neuroticism dimension, both of which were military pilot populations (Grice & Katz, 2007; Callister et al.,1999) and no studies found that pilots scored higher on Neuroticism than a general population.

Extraversion. With respect to Extraversion, the data suggests that the pilot population typically has higher levels of Extraversion compared to the general population. Higher Extraversion was found for pilots in 15 out of the 19 studies that examined Extraversion or a personality trait from a personality index that has shown to be significantly correlated with Extraversion (Carretta et al., 2014; Chappelle et al., 2010; Ragan, 2010; Callister et al., 1999; Yeames, 2001; King, Callister, Retzlaff, & McGlohn, 1997; King, McGlohn, & Retzlaff, 1997). Twelve of these studies compared various military pilot samples to the general population. Additionally, two studies found pilots to be lower on the Extraversion factor. Mesarosova et al. (2018) found that U.K. commercial pilots had lower Extraversion when compared to the U.K. working population. Fussell et al. (2018) found U.S. pilots-in-training to be lower in Extraversion than the general U.S. student population. Two studies also found the populations were equivalent in Extraversion. Grice and Katz (2006) found that a sample of 75 military aviators (i.e., utility attack, scout, and cargo aviators) scored equivalent to the general population on Extraversion. Gao and Kong (2016) also found that pilots-in-training were equivalent to the general student population in terms of Extraversion.

Openness. The data suggest that the pilot population typically possesses equivalent levels of Openness when compared to the general population. Out of the 19 studies which examined the Openness factor, or a personality trait from a personality index that has shown to be significantly correlated with Openness, 12 studies found pilots to be equivalent to the general population (Gao & Kong, 2016; Carretta et al., 2014; Dickens, 2014; King et al., 2011; Chapelle et al., 2010; Ragan 2010; Meško et al., 2009; Grice & Katz, 2007; Wackcher et al., 2003; Yeames, 2001; Callister et al., 1999; King, Callister, Retzlaff, & McGlohn, 1997), nine of which were conducted with military samples. However, four of the 19 studies found pilots to be lower in Openness, one with the military population, one with the pilot-in-training population, and two of which were with the commercial population (Fussell et al., 2018; Fitzgibbons et al., 2004; Mesarosova et al., 2018; Grice & Katz, 2006). Three studies found pilots to be higher on Openness when compared to the general population (Campbell et al., 2009; Robertson & Putnam, 2008; King et al., 1997).

Agreeableness. With respect to Agreeableness, the data suggests that the pilot population typically possesses lower levels of Agreeableness compared to the general population. Out of the nineteen studies that looked at Agreeableness or a personality trait from a personality index shown to be significantly correlated with Agreeableness, 12 studies found that pilots scored lower in Agreeableness than the general population (Fussell et al., 2018; Carretta et al., 2014; King et al., 2011; Chapelle et al., 2010; Ragan 2010; Robertson & Putnam, 2008; Grice & Katz, 2007; Fitzgibbons et al., 2004; Wackcher et al., 2003; Yeames, 2001; Callister et al., 1999; King, Callister, Retzlaff, & McGlohn, 1997). Three studies found that pilots scored higher on Agreeableness than the general population, two of which examined a commercial pilot sample (Mesarosova et al., 2018; Dickens, 2014), and one of which examined a military sample (King, 1997). Four studies found their sample of pilots to be equivalent to the general population with respect to Agreeableness (Gao & Kong, 2016; Campbell et al., 2009; Meško et al., 2009; Grice and Katz, 2006).

Conscientiousness. For the Conscientiousness factor, the pilot population appears to trend higher in Conscientiousness when compared to the general population; however, this was the factor for which there was the least clear trend. Ten of the 18 studies examined Conscientiousness, or a personality trait from a personality index that has shown to be significantly correlated with Conscientiousness, found pilots to have higher levels of Conscientiousness than the general population (Mesarova et al., 2018; Carretta et al., 2014; Dickens, 2014; King, 2011; Campbell et al., 2009; Meško et al., 2009; Fitzgibbons et al., 2004; Wakcher, 2003; Yeames 2001; King et al., 1997. Seven of the 18 studies found pilots to be equivalent to the general population with respect to Conscientiousness, six of which were conducted with the military populations (Chapelle et al., 2010; Ragan, 2010; Grice & Katz, 2006 & 2007; Callister et al., 1999; King, McGlohn, & Retzlaff, 1997; King, Callister, Retzlaff, & McGlohn, 1997) and one within the pilot-in-training population (Gao & Kong, 2016). There was only one study which found pilots scored lower on Conscientiousness compared to the general population: Robertson and Putnam (2008), who utilized the MBTI to assess a sample of 83 pilots-in-training at a Midwestern U.S. university.

Pilot Population Subtypes. Table 4 and Figures 2-4 present the trends found when examining each of the three pilot categories separately (i.e., commercial, military, and pilots-in-training) compared to the general population. This includes a summary of the percentage (and proportion) of studies which have shown that each category of pilot scores either higher, equal to, or lower than the general population on each of the five factors. Trends that represent a majority (>50%) are presented in bold print. The sections that follow provide a summary of these trends for each of the five factors.

Table 4

Trends in FFM Factor Scores of Commercial, Military and Pilot-in-trainings

FFM Factors	Commercial Pilots			Military Pilots			Pilots-in-training		
	Lower	Equal	Higher	Lower	Equal	Higher	Lower	Equal	Higher
Neuroticism	**100%** *(4/4)*	0%	0%	**86%** *(12/14)*	14% *(2/14)*	0%	**100%** *(1/1)*	0%	0%
Extraversion	25% *(1/4)*	0%	**75%** *(3/4)*	0%	7% *(1/13)*	**92%** *(12/13)*	**50%** *(1/2)*	**50%** *(1/2)*	0%
Openness	**50%** *(2/4)*	**50%** *(2/4)*	0%	8% *(1/12)*	**75%** *(9/12)*	17% *(2/12)*	**33%** *(1/3)*	**33%** *(1/3)*	**33%** *(1/3)*
Agreeableness	**50%** *(2/4)*	0%	**50%** *(2/4)*	**67%** *(8/12)*	25% *(3/12)*	8% *(1/12)*	**67%** *(2/3)*	33% *(1/3)*	0%
Conscientiousness	0%	0%	**100%** *(4/4)*	0%	**50%** *(6/12)*	**50%** *(6/12)*	**50%** *(1/2)*	**50%** *(1/2)*	0%

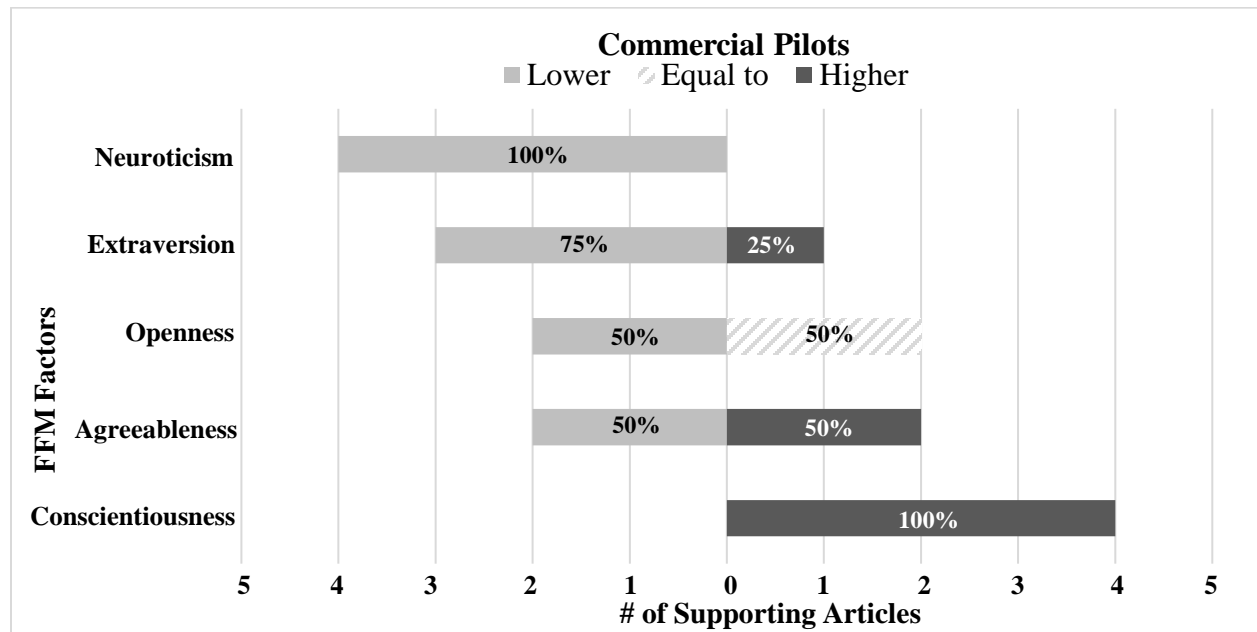*Note:* Bolded numbers indicate majority trends (>50%) and comparison is being made to the general population.

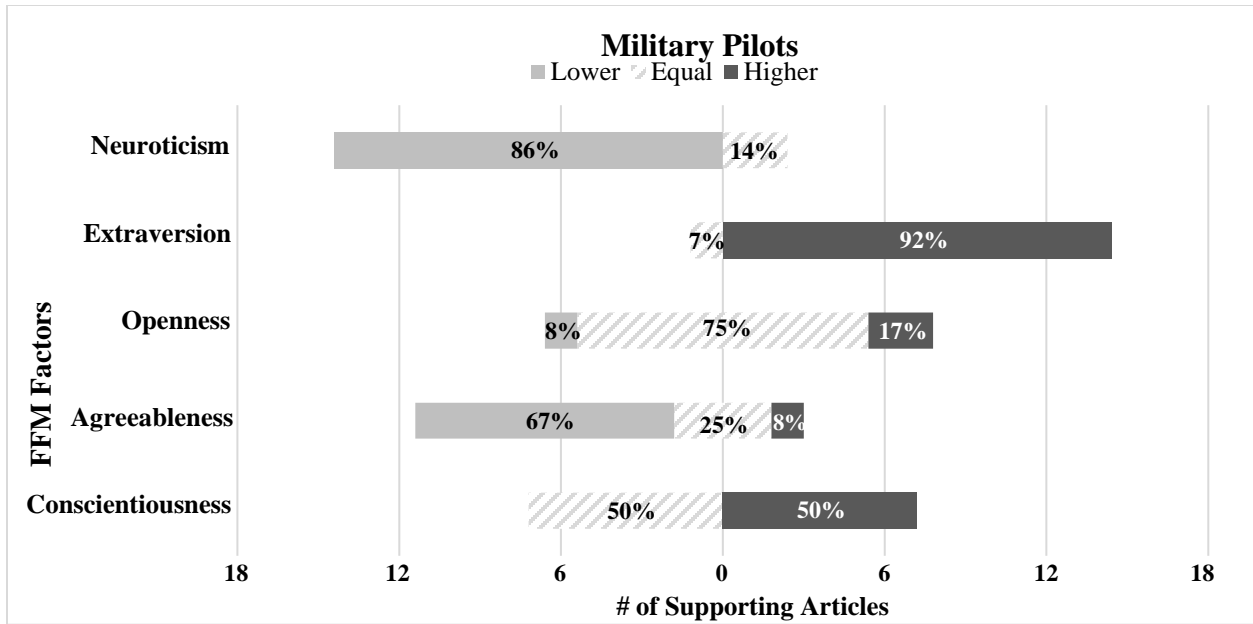Figure 2. *Trends in FFM Scores of Commercial Pilots Compared to General Population*

Military Pilots

■ Lower　▨ Equal　■ Higher

FFM Factors		
Neuroticism	86%	14%
Extraversion	7%	92%
Openness	8%	75%	17%
Agreeableness	67%	25%	8%
Conscientiousness	50%	50%

18　12　6　0　6　12　18

# of Supporting Articles

Figure 3. *Trends in FFM Scores of Military Pilots Compared to General Population*

Pilots-in-Training

■ Lower　▨ Equal　■ Higher

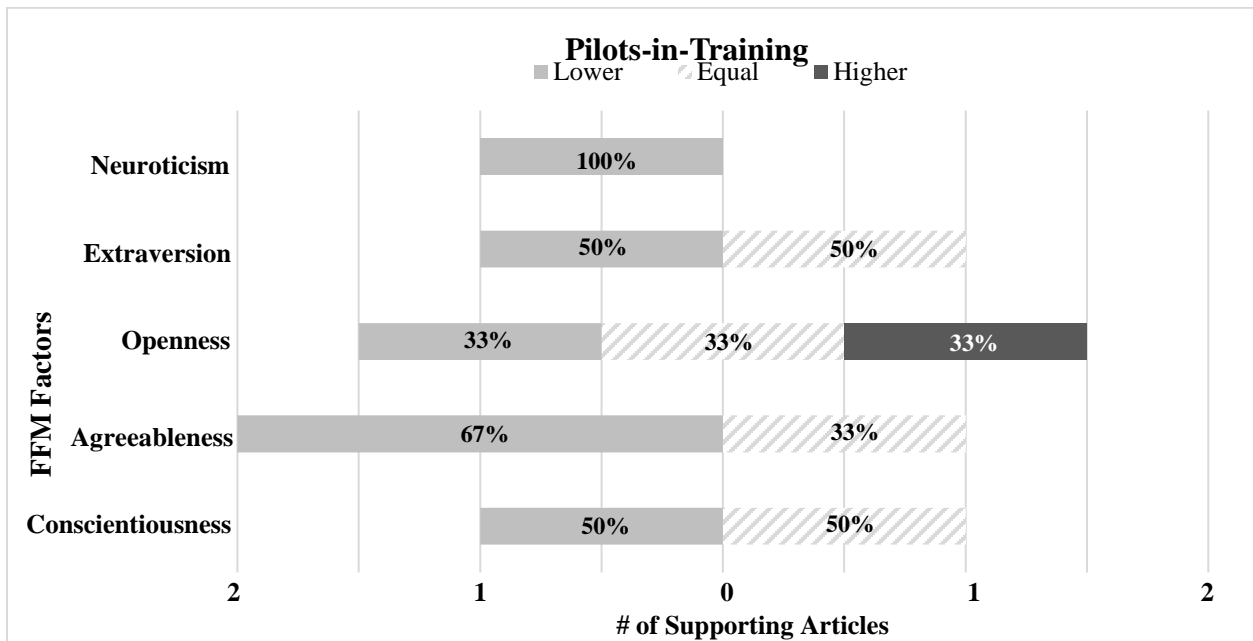| FFM Factors		
Neuroticism	100%
Extraversion	50%	50%
Openness	33%	33%	33%
Agreeableness	67%	33%
Conscientiousness	50%	50%

2　1　0　1　2

# of Supporting Articles

Figure 4. *Trends in FFM Scores of Pilots-in-Training Pilots Compared to General Population*

Neuroticism. With respect to Neuroticism, all three categories of pilots exhibited the same trends with respect to neuroticism. The literature indicated that all categories of pilots typically possess less Neuroticism than the general population.

Extraversion. With respect to Extraversion, while commercial and military pilots typically scored higher in Extraversion, pilots-in-training did not. There were only two studies examining Extraversion within the pilot-in-training population that used measures which correlated to the five factors. One of the studies utilizing the API, showed pilots-in-training as

equivalent to the general population (Gao & Kong, 2016) while the other used the MBTI and showed pilots-in-training scoring lower than the general population (Fussell et al., 2018).

Openness. In terms of Openness to experience, military pilots tended to score equivalent to the general population; however, results associated with commercial and pilots-in-training had mixed results. Only two studies concerning military pilots found them to score higher than the population in Openness (Campbell et al., 2009; King et al., 1997). Only one study by Grice and Katz (2006) found that military pilots scored lower than the population in Openness. Two studies on commercial pilots found them to be lower than the general population in Openness (Mesarosova et al., 2018; Fitzgibbons et al., 2004), while the other two found pilots to be equivalent in Openness (Dickens, 2014; Wakcher et al., 2003). When looking at the pilot-in-training population all three studies yielded different results in the domain of Openness, with Gao and Kong (2016) yielding results wherein pilots-in-training were equivalent, Fussell et al., (2018) found pilots-in-training scored lower than the general population, and Robertson and Putnam (2008) had pilots-in-training scoring higher than the general population. Inferences regarding pilots-in-training population are limited as only three studies could be utilized for the pilot-in-training population (Fussell et al., 2018; Gao & Kong, 2016; Robertson & Putnam, 2008).

Agreeableness. With respect to Agreeableness, military pilots and pilots-in-training trended towards lower than the general population; however, results associated with commercial pilots were mixed. Three studies examining the military pilot population found them to be equivalent to the general population (Campbell et al., 2009; Mesko, et al, 2009; Grice & Katz, 2006). One study by King et al., (1997) found that military pilots were more agreeable than the general population. In regards to commercial pilots, two study's findings yielded pilots as scoring lower in Agreeableness than the general population (Fitzgibbons et al., 2004; Wakcher et al., 2003). Two studies found that commercial pilots scored higher than the general population (Mesarova et al., 2018; Dickens, 2014). Two of the studies utilizing the pilot-in-training population found they were lower in Agreeableness than the general population (Fussell et al., 2018; Robertson & Putnam, 2008). Gao and Kong (2016) found pilots-in-training to be equivalent in the Agreeableness factor. Inferences regarding pilots-in-training population are limited as only three studies could be utilized for the pilot-in-training population (Fussell et al., 2018; Gao & Kong, 2016; Robertson & Putnam, 2008).

Conscientiousness. With respect to Conscientiousness, all commercial pilot studies found commercial pilots to be higher in Conscientiousness than the general population (Fitzgibbons et al., 2004; Mesrosova et al., 2018; Dickens, 2014); however, studies utilizing military pilots had mixed results. Six of the twelve studies using military pilots found them to be higher in Conscientiousness while the other six studies found them to be equal in Conscientiousness to the general population. No studies found military pilots to be lower in Conscientiousness. Inferences regarding pilots-in-training population are limited as only two studies could be utilized for the pilot-in-training population (Gao & Kong, 2016; Robertson & Putnam, 2008). However, they found pilots-in-training to be equivalent in one study and lower than the population in terms of Conscientiousness in the other.

Pilot Population Gender Differences

The trends found when examining pilots across two genders (i.e., female and male) are presented in Table 5. The table provides a summary of the percentage (and proportion) of studies which have shown that female pilots score either higher, equal to, or lower than male pilots on each of the five factors. Trends that represent a majority (>50%) are presented in bold print. The sections that follow provide a summary of these trends for each of the five factors.

Table 5
Trends in FFM Factor Scores of Female Pilots Compared to Male Pilots

FFM Factors	Female Pilots		
	Lower	Equal	Higher
Neuroticism	0%	**80%** *(4/5)*	20% *(1/5)*
Extraversion	0%	**100%** *(5/5)*	0%
Openness	0%	20% *(1/5)*	**80%** *(4/5)*
Agreeableness	0%	**60%** *(3/5)*	40% *(2/5)*
Conscientiousness	0%	**100%** *(5/5)*	0%

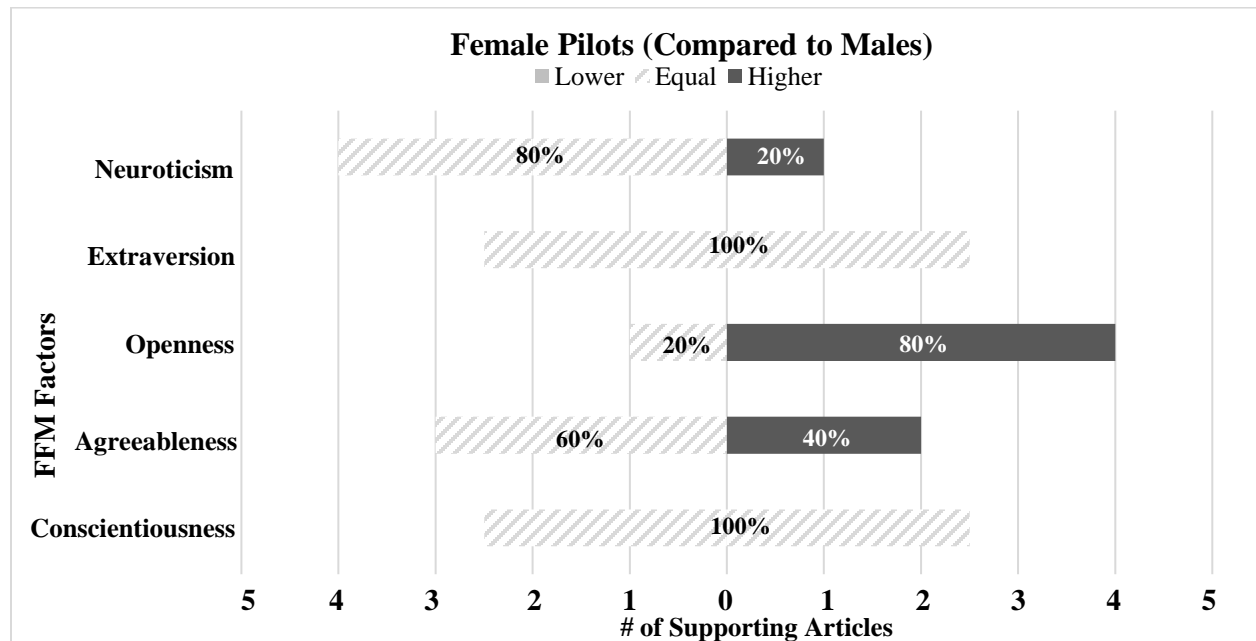Note: Bolded numbers indicate majority trends (>50%)

Figure 5. *Trends in FFM Scores of Female Pilots Compared to Male Pilots*

Gender. The results of the pilot comparison table for gender suggests that female pilots have very similar personality traits to that of their male counterparts. Of the five studies which compared personality traits of male and female pilots, personality traits were typically equivalent for four of the five factors, including Neuroticism, Extraversion, Agreeableness and

Conscientiousness. For Agreeableness, there were studies that found females to be both more and less agreeable than males. For Openness, four of the five studies found female pilots to possess higher levels of Openness than males (King et al., 2011; Chapelle et al., 2010; Musson et al., 2004; Callister, 1999; King et al., 1997).

Discussion

When looking at the pilot population compared to the general population, the trend that emerged is lower Neuroticism, higher Extraversion, equivalent Openness, lower Agreeableness, and higher Conscientiousness. When pilots were separated into commercial, pilot-in-training, and military, the trends were slightly different. The only consistent finding across all pilot categories was with respect to Neuroticism, which trended towards lower than the comparison populations. In terms of Extraversion, commercial and military pilots tended to be higher than their comparison populations while in the student population, the two studies found them to be equal or lower in Extraversion. In terms of the Openness factor, commercial and pilots-in-training yielded mixed results, while military pilots tended towards equivalence with the general population. With respect to the Agreeableness factor, commercial pilots had mixed results with two studies finding them lower than the general population and another two finding them higher than the general population. However, military and pilots-in-training trended towards lower in Agreeableness. Finally, when examining the Conscientiousness factor, commercial pilots scored higher in all studies on Conscientiousness, while mixed results were found for the military and pilot-in-training populations. Half of the military studies found pilots to be higher and the other half equivalent in the factor. Pilots-in-training were found to be lower or equal to their comparison populations in Conscientiousness. When looking at the difference in personality factors among genders, females and males were equivalent in all factors except Openness to experience, for which females trended higher.

Low Neuroticism was the most consistent trend found in the studies, with 17 of 19 studies examining Neuroticism finding pilots were lower in Neuroticism than the general population. Neuroticism is associated with anxiety, sensitivity, anger, irritability, and insecurity, among other emotions (Helton & Street, 1992; Barrick & Mount, 1991). Low levels of Neuroticism are associated with calmness, even-temperedness, and the ability to easily deal with stress (Castaneda, 2007). The finding that pilots tend to be low in Neuroticism could be due to the need to be more emotionally stable and less reactive to stress as aviation is a high stakes/high stress environment (Fitzgibbons et al., 2004). Therefore, individuals with low Neuroticism and high emotional stability may be drawn to the aviation industry and succeed/persist as they are better able to handle the stress (Campbell et al., 2009). Individuals who score high in Neuroticism can become easily anxious and potentially struggle in an environment with high stress and stakes (Cooper, 2015). This finding is consistent with the extant literature and indicates that including Neuroticism in the pilot selection battery may lead to more effective pilot selection (Hormann & Maschke, 1996; Ramachandran, Wadhawan, Kumar, Chandramohan, 1983; Jessup & Jessup, 1971).

With respect to Extraversion, our findings indicate that military and commercial pilots are higher in Extraversion than the general population. High Extraversion, is related to sociability, gregariousness, impulsivity, and an action orientation (Goeters, Timmermann, &

Maschke, 1993). Furthermore, past studies have found that Extraversion is positively related to pilot training success in military aviators (Chang et al., 2018; Campbell, 2009). Given the requirement for military pilots to, at times, be able to depart on a moment's notice, the activeness and impulsivity associated with Extraversion would be beneficial in this career choice. Sociability is of importance to the commercial pilot domain in which pilots are continually performing in a team context (Fitzgibbons et al, 2004). Commercial pilots must communicate effectively over the radio to other individuals, socialize with continually changing co-pilots with whom they may be confined on the flight deck for over 24 hours, and travel to new places where communication is required to operate. When looking at pilot-in-training Extraversion, the trend is different. However, due to the presence of only two pilot-in-training studies this interpretation should be accepted with caution. The current study found mixed results with respect to pilots-in-training extraversion levels, which was typically found to be equivalent to or lower than the general student population. This is not surprising as pilots-in-training are in a very different environment than commercial and military pilots. Pilots-in-training must not only succeed in their flight program, but additionally in their college courses to attain their degree. A study by Schurer, Kassenboehmer, and Leung (2015) found that low levels of Extraversion strongly predicted the probability of obtaining a university degree. This may be due to the need to be more focused on the long-term goals (i.e., degree attainment) rather than impulsivity or action orientation. Additionally, although socializing with peers is an important aspect to success in the university, there is a limit, and too much socialization can be detrimental (Schurer et al., 2015). Therefore, due to their university environment, pilots-in-training Extraversion levels may be different than those of the typical military and commercial pilots. Further, the difference may stem from the period of time in the students life, wherein they are young adults, a time when many changes in personality occur (Lüdtke, Trautwein, & Husemann, 2009; Caspi et al., 2005).

The results related to the Openness domain show no clear pattern in commercial and pilots-in-training; however, in the military domain pilots trended towards equivalence with the general population. These findings suggest that this may not be a facet that differentiates pilots from the general population. This may be due to the highly proceduralized nature of piloting. That is, there are clear checklists and rules that have to be mandatorily followed before, during, and after flight by the crew (Schwaitzberg et al., 2009; Rockliff, 2003). Therefore, there may be less need for a pilot to be adaptive to changes and creative, on a day-to-day basis as the regulators create the terms in which pilots can operate (Rockliff, 2003). Additionally, a common trait associated with Openness is the yearning to move up in position and move around between different job opportunities (Nieß & Zacher, 2015). Given the limited variability in types of jobs available to pilots (e.g., other than flying different types of aircraft), those high in openness may be less drawn to this career.

With respect to agreeableness, when looking at pilots in general, they tended to be less agreeable. This could be due to pilots' need to prioritize performance and goals at hand rather than relationships (Grice and Katz, 2006). However, commercial pilots tended to be more agreeable than the general population in two of the four commercial pilot studies. This trend was not found in military and pilot-in-training categories. Agreeableness is related to traits such as warmth, sympathy, altruism, cooperation, courtesy, flexibility, and having a disposition toward interpersonal trust and consideration of others (Helton & Street, 1992; Barrick & Mount, 1991; McCrae & Costa, 1986). Agreeableness is also an important personality facet in team settings as

more agreeable individuals tend to work cooperatively and are better able to resolve conflict (Morgeson, Reider, & Campion, 2005). Agreeableness is also closely tied to trust (Mooradian, Renzl, & Matzler, 2006). Agreeableness in commercial pilots may be due to the constant change in a commercial pilot's crew requiring commercial pilots to be trusting of their crew and straightforward with their needs (Civil Aviation Authority, 2014). However, in the other two commercial studies, as well as most of the military and pilot-in-training studies, pilots were found to be lower in Agreeableness. Low Agreeableness is associated with less empathetic and co-operative attributes (Driskell, Goodwin, Salas, & O'Shea, 2006). Pilots, specifically military pilots, may be less agreeable due to being more concerned with aspects of mission performance over relationships (Grice & Katz, 2006).

With respect to Conscientiousness, the current study found a mix of studies that report pilots being higher or equal to the general population in Conscientiousness. The Conscientiousness factor is related to purpose, mindfulness and drive to accomplish goals, which is extremely important in the military domain (Siem & Murray, 1997) and may be less so in commercial and pilot-in-training domains. Studies on the Conscientiousness domain have found that much of the variance in Conscientiousness is attributable to environmental influences, such as environments that foster or allow the trait to be expressed (Roberts, Lejuez, Krueger, Richards, & Hill, 2014; Krueger & Johnson, 2008). A great example of this is the military population. The military works to break down civilian identity and mold recruits towards the desired military identity (Jackson et al., 2012; Roberts, Wood, & Caspi, 2008). Differences in the sample's military environment across studies may have led to the equivocal results within the military samples. For example, some military training programs may foster more teamwork whereas other sectors may be less focused on this aspect (i.e., single-pilot vs. multi-pilot operations). Interestingly, Air Force pilots have rated conscientiousness as the most important aspect of personality (Siem & Murray, 1997). Conscientiousness is important for working well and thoroughly. The findings that pilots-in-training are lower in Conscientiousness may be due to their age. Contrary to popular belief, personality can change over time (Corker, Oswald, & Donnellan, 2011; Caspi et al., 2005). One period with emotional intense growth is young adulthood, which aligns with the time period in college. Conscientiousness is relevant to many changes during this time period, such as impulse control, which facilitates task- and goal-directed behavior, such as thinking before acting, delaying gratification, following norms and rules (Corker et al., 2011). College students have recently just left home and are being presented with multiple options and trying to find their own way, and learning to prioritize, test rules, andwork through impulsivity.

When looking at the gender differences in pilots, it appears that the differences typically found between genders in the general population are not present within the aviation domain. When looking at gender in the general population, studies have found that women, across most nations typically have higher levels of Neuroticism, Extraversion, Agreeableness, and Conscientiousness than men (Chapman, Duberstein, Sörensen, & Lyness, 2007). However, the only factor in our analysis which seemed to differentiate female pilots from male pilots, is that female pilots tend to be more open to experience than male pilots. This suggests that female pilots may be more receptive to input from other individuals and sources of information than their male counterparts (Costa & McCrae, 1992). Another facet of those high in Openness to experience is related to adaptability (Escolas, Ray, & Escolas, 2016). Female pilots have been

found to have less accidents than their male counterparts, even those with more experience (Walton & Politano, 2016). This may be due to their ability to adapt to novel situations. Another plausible reason is that women with this personality type may be more attracted to the aviation domain due to it being amore adventurous occupation not typical for most women. Additionally, women tend to be higher in neuroticism, therefore the typical female personality may not be attracted to the high-stakes and potential risks associated with a piloting career while those who are low in neuroticism do not see it as a high-stakes career. Additionally, similarities between male and female pilots may be due to environmental factors. The piloting job requires that the individuals spend a large amount of time with their fellow co-pilots, which is unlike work environments that women typically find themselves, wherein the individual spends eight hours at work and then goes home to their family every weekday (Roberts et al., 2008; Novello & Youssef, 1974). Given this, female pilot personalities are shaped to a larger degree, by their colleagues and work environment, than is typical for most females in the work force (Roberts et al., 2008).

There are several practical implications of this research. First, it provides insight into personality traits that may be necessary to achieve a successful piloting career. There was a clear difference between pilot-in-training and commercial pilot personality, especially with respect to Conscientiousness. Commercial pilots were found to be high in Conscientiousness whereas pilots-in-training were found to be equal or lower than the general population. This finding could elude to the fact that high levels of Conscientiousness are needed to succeed as a commercial pilot, or that conscientiousness is developed as a pilot's career progresses. This is consistent with the literature that has found conscientiousness to correlate with successful job performance (Halim, Zainal, Khairudin, Shahrazad, Nasir, & Fatimah, 2011). Therefore, looking into environmental aspects which promote Conscientiousness in the classroom could be a helpful tool to foster pilots-in-training. As stated earlier, this also may be a facet of age, that is, students entering a collegiate aviation program are in an age where they are just learning how to be self-sufficient and their Conscientiousness is developing (Roberts et al., 2008). Commercial pilots also trended towards more extraverted than the general population compared to pilots-in-training who trended towards equal/lower Extraversion. This may elude to an environmental change occurring between training and commercial, that is as pilots-in-training spend time in a commercial setting they become more extraverted. Interestingly, some studies have pointed to college students who score lower in Extraversion being more likely to have successful program completion (Schurer et al., 2015; Lunderberg, 2013). Therefore, collegiate aviation programs may not need to be concerned with students who are lower in extraversion, however, they should provide opportunities for them to exercise traits associated with extraversion. This could be done by collegiate aviation programs encouraging pilots-in-training to get involved in extracurricular activities such as aviation groups to help cultivate more Extraversion. Given the current study's findings, successful pilots seem to be low in neuroticism. Low neuroticism may therefore be both a good predictor of success and selection parameter for pilots. The literature lends support as low neuroticism has been found to be positively related to performance in jobs involving interpersonal interactions (Mount, Barrick, & Stewart, 1998) and success in commercial and military pilots. Personality may also be a parameter to consider in pilot training to aid in improving pilot success (i.e., training completion). Understanding the personality of pilots in training may provide instructors with a way to adapt their instructional techniques for individual trainees or students. For example, the results of personality assessments could be used to

individualize the learning context, such as in the case that an instructor encounters a pilots-in-training who is very low in extraversion, he can provide problem-based training which encourages the trainee to be assertive, or group work that provides the opportunity for them to take the lead. Finally, diversity in personality could be beneficial in performance (Van Knippenberg & Schippers, 2007; Neuman, Wagner, & Christiansen, 1999; Mount, Barrick, & Stewart, 1998) and used as a tool to improve CRM. A study by Neuman et al. (1999) found that differing levels of extraversion and emotional stability (neuroticism) were positively related to team performance. Additionally, a study by Gorla and Lam (2004) found that differing personality types between leaders and personnel lended itself to better team performance. Therefore, differing personality types may work better than a homogeneous pilot type.

Generalizability & Limitations.

The current review is limited in its generalizations due to the limited publications and unequal amount of publications per category. There was more than three times the number of studies on military personality compared to the student and commercial populations. An understanding of the commercial and student population personality traits will be limited until more research is conducted in this area. Therefore, the results need to be interpreted with caution. Additionally, some of the studies utilized measures that were categorized as proxy measures of the FFM factors given their factor correlations with the FFM factors. This allowed us to include a greater number of studies, but may have introduced slight confounds. Finally, some of the trends were based off of only two studies (e.g., two studies pointing towards high than equivalent), which limits the generalizability of the findings.

Conclusion

The goal of this paper was to amass the pilot personality research that has been conducted to date in order to draw conclusions regarding whether (1) pilot's personality traits are different from the general population; (2) there are differences in the personality traits of commercial, military and pilots-in-training, (3) there are differences in the personality traits of female and male pilots. In regards to the first question there are clear differences in pilot levels of Neuroticism, Extraversion, Agreeableness and Conscientiousness, compared to the general population. With regards to our second question, there appear to be differences in personality traits across military, commercial and pilot-in-training population; however, inferences should be interpreted with caution due to the limited number of studies involving commercial and pilots-in-training. The final, question regarding the differences in gender, points to female and male pilots having equivalent personality in all factors except Openness to experience.

Further research should focus on increasing the number of studies examining pilot personality in student and commercial pilot populations using the FFM. Such research could help build an understanding of personality trends that could aid companies and flight training programs in tailoring their training and operations in a way that supports individual success. Further, examining the environmental factors that differ between military and commercial pilot training and operations may help to shed light on how these differences emerge and whether they are due to environmental factors or whether certain personality types are drawn to the different types of pilot operations. Finally, future research should examine the differences in personality

trends between female pilots and females in the general population, to determine whether females with a certain personality are drawn to the aviation field or whether they are similar to the female population and over time their personality is shaped by the aviation environment.

References

Barrick, M. R., & Mount, M. K. (1991). The big five personality dimensions and job performance: a meta-analysis. *Personnel Psychology*, 44(1), 1-26.

Bartram, D. (1995). The predictive validity of the EPI and 16PF for military flying training. *Journal of Occupational and Organizational Psychology*, 68(3), 219-236.

Bucky, S. F., & Spielberger, C. D. (1973). State and trait anxiety in voluntary withdrawal of student naval aviators from flight training. *Psychological Reports*, 33(2), 351-354.

Callister, J. D., King, R. E., Retzlaff, P. D., & Marsh, R. W. (1999). Revised NEO Personality Inventory profiles of male and female U.S. Air Force pilots. *Military Medicine*,164, 885-890.

Campbell, J. S., Moore, J. L., Poythress, N. G., & Kennedy, C. H. (2009). Personality traits in clinically referred aviators: two clusters related to occupational suitability. *Aviation, Space, and Environmental Medicine*, 80(12), 1049-1054.

Carretta, T. R., Teachout, M. S., Ree, M. J., Barto, E. L., King, R. E., & Michaels, C. F. (2014). Consistency of the relations of cognitive ability and personality traits to pilot training performance. *The International Journal of Aviation Psychology*, 24(4), 247-264.

Caspi, A., Roberts, B. W., & Shiner, R. L. (2005). Personality development: Stability and change. *Annu. Rev. Psychol.*, 56, 453-484.

Castaneda, M. A. (2007). *A Big Five Profile of the Military Pilot: A Meta-analysis* (Doctoral dissertation, University of West Florida).

Chang, M.-C., Lee, T.-H., and Lung, F.-W., 2018. Personality characteristics of fighter pilots and ground personnel. *Military Psychology*, 30, 70–78. doi:10.1080/08995605.2017.1420977

Chapman, B. P., Duberstein, P. R., Sörensen, S., & Lyness, J. M. (2007). Gender differences in Five Factor Model personality traits in an elderly cohort. *Personality and Individual Differences*, 43(6), 1594-1603.

Chappelle, W. L., Novy, M. P. L., Sowin, C. T. W., & Thompson, W. T. (2010). NEO PI-R normative personality data that distinguish US Air Force female pilots. *Military Psychology*, 22(2), 158-175.

Cooper, C. (2015). *Individual differences and personality*. Routledge.

Corker, K. S., Oswald, F. L., & Donnellan, M. B. (2012). Conscientiousness in the classroom: A process explanation. *Journal of Personality*, 80(4), 995-1028.

Costa, P. T., & McCrae, R. R. (1992). Normal personality assessment in clinical practice: The NEO Personality Inventory. *Psychological Assessment*, 4(1), 5.

Civil Aviation Authority. (2014). *Flight-crew human factors handbook*. CAP, 737, 55-70.

Dickens, P. (2014). Big 5 personality profiles of rotary-wing aircrew. In *Proceedings of the 31st Conference of the European Association for Aviation Psychology* (pp. 149-158).

Dolgin, D. L., & Gibb, G. D. (1988). *A Review of Personality Measurement in Aircrew Selection* (No. NAMRL-MONOGRAPH-36). Naval Aerospace Medical Research Lab, Pensacola, Florida.

Driskell, J. E., Goodwin, G. F., Salas, E., & O'Shea, P. G. (2006). What makes a good team player? Personality and team effectiveness. *Group Dynamics: Theory, Research, and Practice*, 10(4), 249.

Escolas, H. D., Ray, L. N., & Escolas, S. M. (2016). Personality traits and family styles of combat medics in training. *Military Medicine*, 181(6), 546-552.

Fiske, D. W. (1947). Validation of naval aviation cadet selection tests against training criteria. *Journal of Applied Psychology*, 31(6), 601.

Fitzgibbons, A., Davis, D., & Schutte, P. C. (2004). *Pilot personality profile using the NEO-PI-R.*

Fussell, S., Dattel, A. R., & Mullins, K. (2018). Personality types and learning styles of collegiate aviation students. *International Journal of Aviation, Aeronautics, and Aerospace*, 5(3), 1.

Gao, Y., & Kong, S. (2016). Personality types of pilot students: A study of an Australian collegiate aviation program. *International Journal of Aviation, Aeronautics, and Aerospace*, *3*(3), 6.

Glicksohn, J., & Naor-Ziv, R. (2016). Personality profiling of pilots: traits and cognitive style. *International Journal of Personality Psychology*, 2(1), 7-14.

Goeters, K. M., Timmermann, B., & Maschke, P. (1993). The construction of personality questionnaires for selection of aviation personnel. *The International Journal of Aviation Psychology*, 3(2), 123-141.

Gorla, N., & Lam, Y. W. (2004). Who should work with whom? Building effective software project teams. *Communications of the ACM*, 47(6), 79-82.

Grice, R. L., & Katz, L. C. (2007). *Personality profiles of US Army initial entry rotary wing students versus career aviators* (No. ARI-TR-1208). Army Research Institute for the Behavioural and Social Sciences, Fort Rucker, AL Rotary-Wing Aviation Research Unit

Grice, R., & Katz, L. C. (2006). *Personality profiles of experienced U.S. Army aviators across mission platforms* (Technical Report 1185). Ft. Rucker, AL: U.S. Army Research Institute for the Behavioral and Social Sciences

Heinstrom, J. (2010). From fear to flow: personality and information interaction. *Elsevier*.

Helton, K. T., & Street Jr, D. R. (1992). *The five-factor personality model and naval aviation candidates* (No. NAMRL-1379). Naval Aerospace Medical Research Lab, Pensacola, Florida.

Halim, F. W., Zainal, A., Khairudin, R., Shahrazad, W. W., Nasir, R., & Fatimah, O. (2011). Emotional stability and conscientiousness as predictors towards job performance. *Pertanika Journal of Social Sciences & Humanities*, 19, 139-146.

Hormann, H. J., & Maschke, P. (1996). On the relation between personality and job performance of airline pilots. *The International Journal of Aviation Psychology*, 6(2), 171-178.

Jackson, J. J., Thoemmes, F., Jonkmann, K., Lüdtke, O., & Trautwein, U. (2012). Military training and personality trait development: Does the military make the man, or does the man make the military?. *Psychological Science*, 23(3), 270-277.

Jessup, G., & Jessup, H. (1971). Validity of the Eysenck Personality Inventory in pilot selection. *Occupational Psychology*.

King, R. E. (2014). Personality (and psychopathology) assessment in the selection of pilots. The *International Journal of Aviation Psychology*, 24(1), 61-73.

King, R. E., Barto, E., Ree, M. J., & Teachout, M. S. (2011). *Compilation of pilot personality norms* (No. AFRL-SA-WP-TR-2011-0008). School of Aerospace Medicine, Wright-Patterson AFB, Ohio.

King, R. E., Callister, J. D., Retzlaff, P. D., & McGlohn, S. (1997). *Pilot personality: Gender and career-level differences* (AL/AO-TR-1997-0065). Brooks Air Force Base, TX: Armstrong Laboratory

King, R. E., McGlohn, S. E., & Retzlaff, P. D. (1997). Female United States Air Force pilot personality: The new right stuff. *Military Medicine*, 162, 695-697.

Krueger, R. F., & Johnson, W. (2008). *Behavioral genetics and personality: A new look at the integration of nature and nurture*.

Lüdtke, O., Trautwein, U., & Husemann, N. (2009). Goal and personality trait development in a transitional period: Assessing change and stability in personality development. *Personality and Social Psychology Bulletin*, 35, 428–441.

Lundberg, S. (2013). The college type: Personality and educational inequality. *Journal of Labour Economics*, 31(3), 421-441.

McCrae, R. R., & Costa Jr, P. T. (1986). Personality, coping, and coping effectiveness in an adult sample. *Journal of personality*, 54(2), 385-404.

Mesarosova, K., Siegling, A. B., Plouffe, R. A., Saklofske, D. H., Smith, M. M., & Tremblay, P. F. (2018). Personality Measurement and Profile in a European Sample of Civil Airline Pilots. *European Journal of Psychological Assessment*. Advance online publication. http://dx.doi.org/10.1027/1015-5759/a000466

Meško, M., Karpljuk, D., Videmšek, M., & Podbregar, I. (2009). Personality profiles and stress-coping strategies of Slovenian military pilots. *Horizons of Psychology*, 18(2), 23-38.

Mooradian, T., Renzl, B., & Matzler, K. (2006). Who trusts? Personality, trust and knowledge sharing. *Management Learning*, 37(4), 523-540.

Morgeson, F. P., Reider, M. H., & Campion, M. A. (2005). Selecting individuals in team settings: The importance of social skills, personality characteristics, and teamwork knowledge. *Personnel Psychology*, 58(3), 583-611.

Mount, M. K., Barrick, M. R., & Stewart, G. L. (1998). Five-factor model of personality and performance in jobs involving interpersonal interactions. *Human Performance*, 11(2-3), 145-165.

Murray, G., Judd, F., Jackson, H., Fraser, C., Komiti, A., Pattison, P., & Robins, G. (2009). Personality for free: Psychometric properties of a public domain Australian measure of the five-factor model. *Australian Journal of Psychology*, 61(3), 167-174.

Musson, D. M., Sandal, G., & Helmreich, R. L. (2004). Personality characteristics and trait clusters in final stage astronaut selection. *Aviation, Space, and Environmental Medicine*, 75(4), 342-349.

Neuman, G. A., Wagner, S. H., & Christiansen, N. D. (1999). The relationship between work-team personality composition and the job performance of teams. *Group & Organization Management*, 24(1), 28-45.

Nieß, C., & Zacher, H. (2015). Openness to experience as a predictor and outcome of upward job changes into managerial and professional positions. *PloS one*, 10(6).

Novello, J. R., & Youssef, Z. I. (1974). Psycho-social studies in general aviation: II. Personality profile of female pilots. *Aviation, Space, and Environmental Medicine*.

Olson, T. M., Walker, P. B., & Phillips IV, H. L. (2009). Assessment and selection of aviators in the US military. *Human Performance Enhancement in High-Risk Environments: Insights, Developments, and Future Directions from Military Research*, 37-57.

Ragan, K. M. (2010). *The Warfighters of Today: Personality and Cognitive Characteristics of Rated Fighter Pilots in the United States Air Force* (Doctoral dissertation, Florida State University).

Ramachandran, N; Wadhawan, JM; Kumar, V; Chandramohan, V,. (1983). Rao PLN. Personality profile of an IAF pilot: its usefulness in pilot selection. *Av Med*; 21 (2): 131-39.

Roberts, B. W., Lejuez, C., Krueger, R. F., Richards, J. M., & Hill, P. L. (2014). What is conscientiousness and how can it be assessed? *Developmental Psychology*, 50(5), 1315-1330. doi:http://dx.doi.org.portal.lib.fit.edu/10.1037/a0031109

Roberts, B. W., Wood, D., & Caspi, A. (2008). The development of personality traits in adulthood. *Handbook of personality: Theory and Research*, 3, 375-398.

Robertson, M. F., & Putnam, A. R. (2008). Personality types of student pilots admitted to the aviation flight program at Southern Illinois University Carbondale. *Collegiate Aviation Review*, 26(1), 111.

Robins, R. W., Fraley, R. C., Roberts, B. W., & Trzesniewski, K. H. (2001). A longitudinal study of personality change in young adulthood. *Journal of Personality*, 69(4), 617-640.

Rockliff, L. (2003). Contemporary Large Aircraft Flight Training Practices. In *AIAA International Air and Space Symposium and Exposition: The Next 100 Years* (p. 2662).

Schurer, S., Kassenboehmer, S. C., & Leung, F. (2015). *Do universities shape their students' personality?*

Schwaitzberg, S. D., Godinez, C., Kavic, S. M., Sutton, E., Worthington, R. B., Colburn, B., & Park, A. (2009). Training and working in high-stakes environments: lessons learned and problems shared by aviators and surgeons. *Surgical Innovation,* 16(2), 187-195.

Siem, F. M., & Murray, M. W. (1997). *Personality factors affecting pilot combat performance: A preliminary investigation* (No. AL/HR-TP-1997-0012). Armstrong Lab, Brooks AFB, Texas Human Resources Directorate.

Ullén F, de Manzano Ö, Almeida R, Magnusson PK, Pedersen NL, Nakamura J, Csíkszentmihályi M, Madison G. (2012). Proneness for psychological flow in everyday life: Associations with personality and intelligence. *Personality and Individual Differences*, 1;52(2):167-72

Van Knippenberg, D., & Schippers, M. C. (2007). Work group diversity. *Annu. Rev. Psychol.*, 58, 515-541.

Værnes, R. J., Myhre, G., Aas, H., Homnes, T., Hansen, I., & Tonder, O. (1991). Relationships between stress, psychological factors, health, and immune levels among military aviators. *Work & Stress*, 5(1), 5-16.

Wakcher, S., Cross, K. & Blackman, M. (2003). Personality comparison of airline pilot incumbents, applicants, and the general population norms on the 16PF. *Psychological Reports*, 92, 773-780.

Walton, R. O., & Politano, P. M. (2016). Characteristics of general aviation accidents involving male and female pilots. *Aviation Psychology and Applied Human Factors*, 6(1), 39-44. doi:http://dx.doi.org.portal.lib.fit.edu/10.1027/2192-0923/a000085

Yeames, A. O. I. (2001). *An examination of US Army Aviation Warrant Officers' personality and promotability.*