2014

Development and Enhancement to a Pilot Selection Battery for a University Aviation Program

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By

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A Thesis Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Arts

In

Industrial/Organizational Psychology

Minnesota State University, Mankato

Mankato, Minnesota

May 2014

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DEVELOPMENT AND ENHANCEMENT TO A PILOT SELECTION BATTERY FOR A UNIVERSITY AVIATION PROGRAM

Hanna, Ryan, M.A., Industrial/Organizational Psychology, Minnesota State University, Mankato, 2014

Abstract

There exists an imbalance between the number of pilots trained to practice in the field of aviation and the amount of those individuals who are qualified to fly airplanes. By putting a systematic selection system in place, it helps to ensure that the best possible candidates fill open positions in the field. Specifically developing a selection system to train and acclimate future pilots while they are in a university setting will not only help select top-tier candidates into the aviation program, but also prepare them for what to expect when they enter the job market. This research study built upon two iterations of a pilot selection battery for a Midwestern university aviation program. Participants completed a battery that was then used for research purposes to obtain information about the potential predictors of pilot performance. The measures include the IPIP Five Factor Scale, Assertive Interpersonal Schema Questionnaire, Cockpit Management Attitudes Questionnaire, Proactive Personality Scale – Short Version, Block Counting Measure, and Rotated Blocks Measure. Additionally, flight instructors evaluated their students based on several aspects of effective performance. Data from 30 student pilots were examined with bivariate correlations and linear regression and the results from the current sample indicated that a pilot personality profile, assertiveness, proactivity, cockpit management skills, and spatial reasoning did not consistently predict flight performance. Further research is warranted to accumulate a larger sample size in order to determine if these characteristics do, indeed, predict performance in the field.

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CHAPTER I

Development and Enhancement to a Pilot Selection Battery for a University Aviation Program

Since 1985, the number of pilots hired at major commercial airlines ranged from around 500 to 5,500 per year (Lovelace & Higgins, 2010). However, the amount of new pilots created and trained to enter the aviation field ranged from around 8,000 to 17,000 per year during that same time frame (Lovelace & Higgins, 2010). When the number of pilots are in abundance and there are far fewer positions available, a pilot selection system needs to be in place to help ensure that the best candidates from the applicant pool are provided with an offer of employment. Damos (1996) stated that there are three basic criteria for a pilot selection system: “First the fundamental purpose is to select individuals for the job of flying an airplane. Second, the scores obtained from the battery must be reliable. Third, the battery must be valid” (p. 199). Given that the combined product of skill, attitude, and personality factors required to fly airplanes construe the performance of pilots, they must be assessed by a selection battery (Chidester, Helmreich, Gregorich, & Geis, 1991). The remaining two points suggest that the battery should measure consistently and accurately. Thus, organizations should focus on having a well-formulated and structured selection process for pilots.

A general pilot selection process involves written and computer-based tests of aptitude, intelligence, and personality; an elimination step where unqualified candidates are removed from consideration based on their performance on the aforementioned selection measures; decisions that involve relating test scores to pilot selection criteria; and a feedback loop that predicts the validity of the selection process (APG International Aviation Academy Inc., 2013). In addition, these more casual selection systems often incorporate unstructured interviews, which may be hindered by unqualified interviewers (Damos, 2003). In other words, interviewers in these settings tend not to have a systematic method for combining interview information, flight skills tests, or the application form. Therefore, a hiring decision is usually based on judgmental and subjective factors rather than on structured and explicit hiring standards (Damos, 2003). Whether for military, private or commercial purposes, pilot selection processes are costly and there exists a continuous concern for passenger, pilot, and personnel safety. A selection system that relies on identifying specific knowledge, skills, abilities, and other characteristics (KSAOs) tends to be more cost-effective and efficient than using a single-hurdle model (Damos, 2003). To become a pilot in general, the cost of training is typically around $35, 000 (Parry, 2013). This price factors in the training materials (i.e. the aircraft, gas, etc.), licensure to fly a multi-engine aircraft, and instrument ratings that are paid for using the pilot's personal expenses. Once minimum qualifications are met and the pilot is ready to enter the workforce, it is important that hiring organizations have a structured and effective selection system is in place in order to evaluate the pilot's expertise.

Effectively relating the structured and planned processes of a pilot selection system to a University Aviation program can help ensure that potential pilots understand the requirements and rigor involved in becoming a pilot. In addition, it can help students prepare for what they can expect in the real world and work on matching their skills with the requirements of becoming a pilot.

In order for the selection system to achieve the goals of measuring KSAOs, it is important to analyze which KSAOs are required to operate an aircraft (Damos, 2003). Although there tends to be disagreement among individuals involved in what constitutes a successful pilot, a consistency in assumptions can help bring structure to the system and produce a systematic process. Using statistical processes is the next logical step in that it reduces the subjectivity involved in the hiring process, allows for decisions to still be made, and predicts how well the applicant will perform. In addition, the selection system can be revised as data on measure validity is accumulated. Given the continuing research involved in this topic, revisions are being made yearly in order to ensure the system is accurately and consistently predicting performance. As a result, several important variables have dependably predicted aviation student performance.

This paper intends to identify the existing components of a university aviation selection program and use data from previous theses that spanned from 2011-2013 to build on and enhance the current selection process. The ultimate goal is to use preexisting behavioral and predictive measures and incorporate additional measures in order to accurately predict aviation student performance. It is the purpose of this research to create a selection system that is similar to what a student may encounter when he or she enters the real world of aviation. In addition, the overarching purpose of identifying behaviors and predictors consistent with performance is a major objective so problem behaviors can be identified. Specifically, research has suggested a number of constructs that are important to pilot performance.

Cognitive Ability

Schmidt and Hunter (1998) asserted that the most valid predictor of employee performance is general cognitive ability. Cognitive ability tends to have key features that vary across several underlying definitions: potential for problem solving, ability to learn from experience and adapt to the environment, and ability to achieve desired ends (Hunter, 1986). Not only are cognitive ability tests one of the most predictive selection measures, they also can be used for all jobs, whether entry-level or complex. In addition, research evidence for the validity of cognitive ability measures for predicting future job performance is stronger than any other selection method (Hunter, 1986; Ree & Earles, 1992). Cognitive ability has even been shown to be the best predictor of acquiring knowledge on the job and job-based learning (Schmidt & Hunter, 1998).

A study conducted for the US Department of Labor assessed 32,000 employees in 515 jobs and found that the validity of cognitive ability for predicting performance was .56 for high-level complex jobs and .58 for managerial jobs (Hunter, 1980; Hunter & Hunter, 1984). In the Air Force, aptitude tests such as the Air Force Officer Qualifying Test (AFOQT) and the Basic Attributes Test (BAT) are used for air crew selection and include cognitive ability components that assess pilot intelligence. Although cognitive ability is a strong predictor of performance, other measures demonstrate incremental validity above and beyond cognitive ability alone. In the current study, students should have adequate comprehension skills, mechanical and spatial skills, and relevant personality characteristics in order to be selected for the Aviation Program.

Personality

The combination of tests with the highest predictors of job performance are cognitive ability and personality measures (mean validity of .65) (Carretta, 2000). For instance, McHenry and colleagues (1990) found that measures of personality added to the predictive validity of selecting military officers when coupled with cognitive ability measures. Selecting military officers closely resembles pilot selection methods given the fact pilot applicants must first be appointed for officer commissioning (Weeks & Zelenski, 1998).

Personality characteristics have been found to be important predictors of performance and have the ability to differentiate between successful and unsuccessful pilots. Shahrokh, Hales, Phillips & Yudofsky (2011) defined personality as “the characteristic way in which a person thinks, feels and behaves; the ingrained pattern of behavior that each person evolves, both consciously and unconsciously, as the style of life or way of being in adapting to the environment" (p.189). Roberts and Mroczek (2008) took on a different meaning of personality: "the relatively enduring patterns of thoughts, feelings, and behaviors that distinguish individuals from one another" (p. 31). One commonality that both definitions offer is the enduring and constant nature of an individual's personality (McCrae & Costa, 1994).

In general, once on the job, the amount and quality of job performance is determined largely by cognitive ability and certain personality constructs (Schmidt & Hunter, 1998). In fact, there are desirable personality characteristics that certain airlines value. British Airways looks for pilots that are leaders, determined, reliable, motivated, flexible, and sociable (Damos, 2003). Research has also indicated that aircraft operators tend to have strong opinions about the personality traits required of pilots they wish to hire. Homing in on personality variables allows aircraft operators to identify problem areas they have experienced with pilots or help determine what constitutes a successful pilot (i.e. conscientiousness) (Damos, 2003). Therefore, personality constructs can be assessed as part of a selection battery. Along with the inclusion of personality variables, selection measures should assess predictors of performance and the KSAOs needed for the position.

For example, The Five Factor Model of personality developed by Costa and McCrae (1985) is a common metric used to assess personality. It divides personality into five facets: Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. Openness to experience is defined as the appreciation and seeking out of new experiences; conscientiousness considers how persistent, organized, and motivated individuals are when considering goal-directed behaviors; extraversion reflects the magnitude and degree of interpersonal interactions; agreeableness is measured on a continuum ranging from compassion to hostility; and neuroticism is defined by an individual's tendency to experience negative affect such as depression and anxious behavior (Piedmont & Weinstein, 1994).

A recent study by the National Aeronautics and Space Administration (NASA) set an objective to determine if pilot personality emerged from available qualitative research using the NEO-PI-R (Fitzgibbons et al., 2004). In more detail, this assessment was used to evaluate 93 commercial pilots from 14 different airlines ranging from small to very large with an average of 12 years of experience. As indicated by Hormann and Maschke (1996), using a suitable personality questionnaire is one such method used to predict job performance. These researchers found that the scores on openness to experience were mostly normally distributed with 29% scoring high and 37% scoring low on the dimension. High levels of conscientiousness was a noticeable trend with 58% of pilots scoring high or very high on this scale, indicating that most pilots are highly conscientious. 42% of pilots reported high levels of extraversion and 23% reported low scores. Agreeableness scores were similar to openness to experience scales in that they were close to normally distributed with 27% scoring high and 32% scoring low. Neuroticism scores favored the majority in which 60% of the pilots scored low or very low (Fitzgibbons et al., 2004).This trend indicates that pilots tend to be emotionally stable.

These results show that pilots tend to be stable, expressive, motivated and organized. Fitzgibbon et al.'s (2004) research compiled the above information to develop a "pilot profile" in which a pilot should be emotionally stable with low levels of anxiety, vulnerability, anger, impulsivity, and depression. In addition, a pilot should be achievement-oriented, competent, trustworthy, and straightforward. Lastly, a pilot should be assertive. Overall, this pilot profile matches the characteristics of a successful pilot according to Hormann and Maschke's (1996) model and parallels Picano's (1991) first personality type, which both showed that pilots tend to be outgoing, conscientious, and emotionally controlled. Fitzgibbon et al.'s (2004) results showed that these related studies may be used as convergent validation of other models of pilot personality. More specifically, Picano (1991) research focused on experienced military pilots which shows that there may be a general pilot personality profile that generalizes across experiences and positions (Fitzgibbons et al., 2004).

The utilization of personality measures to assess pilots continues to flourish. A study by Hormann and Maschke (1996) tested the validity of a personality questionnaire for predicting job success. A sample of 274 licensed pilots to be employed by an airline in Europe were evaluated using the Temperament Structure Scale (TSS), which assesses extraversion, dominance, emotional instability, aggressiveness, empathy, achievement motivation, rigidity, and vitality; the Cockpit Management Attitudes Questionnaire (CMAQ); an interview; a simulator check flight (i.e. demonstrate proficiency in following flight operations); and relevant bio data. The results indicated that 84% of the hired pilots were appropriately selected, as indicated by them meeting or exceeding organizational standards with few problems. A multiple regression model was used in which 74% of the variance in job performance was explained by the simulator check flight and previous flying experience. However, when the TSS personality measure was added to the model, the amount of variance explained in job performance jumped to 79.3%. More specifically, results showed that pilots who are sociable, assertive, and action-oriented tend to be more successful airline pilots.

Given that pilots tend to share specific personality traits, researchers have also been interested in whether there exists a difference between pilots and the average individual. A study by Wakcher, Cross, and Blackman (2003) sampled 218 participants to gauge whether pilots possess different personality characteristics than the general population. Participants were categorized into the four following groups: Civilian Pilot Incumbents (i.e. employed by commercial airlines and no military training), Military Pilot Incumbents (i.e. employed by commercial airlines but had served in the military), Civilian Pilot Applicants (i.e. no flight training or fewer than 10 hours and employed in some sort of civilian occupation), and Military Pilot Applicants (i.e. served in the military and held a civilian occupation; however, most were commissioned officers). Each participant was instructed to complete Form A of the 16PF, which is a measure developed by Cattell and his colleagues (1988) based on basic human personality. The 16 personality factors resulted from the factor analysis of hundreds of measures of fundamental traits in which the results demonstrate scores on second order global traits and more precise primary traits (Cattell, et al., 1988).

Results indicated Pilot Applicants and Pilot Incumbents significantly differed from the general population on 13 out of the 16 personality factors. This seems to show that people who are either flying airplanes or are interested in aviation have different personality profile compared to general population norms (Wakcher, et al., 2003). In addition, results showed that all four groups have similar personality traits, even when considering their military background. Bartram (1995) found similar results and indicated that the similarity between the four groups can be attributed to the fact that they were involved in self-selection processes. In sum, these results relate to the fact that pilots or pilots-to-be tend to possess similar characteristics that can be assessed using personality measures during the selection process.

Wakcher, et al. (2003) compiled the results even further and indicated that the type of people who are drawn to being an airline pilot are those who are more “reserved, intelligent, emotionally stable, dominant, enthusiastic, conscientious, bold, trusting, self-assured, conservative, socially precise, and relaxed than the general population” (p. 779). These results are consistent with Catell’s, et al. (1970) interpretation of pilots in which he found they have higher intelligence, emotional stability, conscientiousness, and are more socially precise than the general population. In can be inferred that a selection system can effectively differentiate between those who are best suited for the field of aviation based on specific personality traits. Again, pilot personalities are adequately identified using a personality assessment that helps determine whether they are fit for the job.

Researchers have also delved deeper into the characteristics of pilots by assessing whether there exists difference between male and female pilots. A study conducted by Callister, et al. (1999) identified the personality characteristics of male and female student pilots in the United States Air Force. In total, 1301 participants completed the NEO-PI-R, which as addressed previously, measures normal personality characteristics. Male student pilots were found to have higher levels of extraversion and lower levels of agreeableness when compared to male adult norms. Female student pilots tended to have higher levels of openness to experience and extraversion and lower levels of agreeableness when compared to female adult norms.

Callister, et al. (1999) characterized the average male student pilot to be highly extraverted, assertive, physically active, and seeks active stimulation. Male student pilots are also considered to be goal-directed, competent, responsible, and have the ability to deal well with stress. The average female student pilot possesses similar characteristics to their male counterparts in that they tend to be assertive, active, outgoing, competitive, and tough-minded. One interesting finding is that female pilots tend to have higher levels of openness to experience, given that female pilots break away from traditional female occupations and roles (Callister, et al., 1999). Collectively, U.S. Air Force Student Pilots tend to score high on extraversion, low on agreeableness, and average for conscientiousness and neuroticism (Callister et al., 1999).

Chappelle, Novy, Sowin, and Thompson (2010) recorded similar findings in that female U.S. Air Force pilots possess very similar personality characteristics to male U.S. Air Force pilots when compared to the normative female sample, and that female USAF pilots tend to be more open and receptive to their emotional experiences (Chappelle, et al., 2010). Even more specifically, Bartram and Dale (1982) found that successful military pilots, regardless of gender, are less neurotic and more extraverted than the general population. Therefore, specific personality characteristics appear to be important contributors to successful pilot performance. However, it is also important to consider the cohesive performance of all aircrew members when considering determinants of performance.

Crew Coordination

A compilation of 10 years of air transport accidents conducted by Cooper, White, and Lauber (1979) indicated that a lack of knowledge or technical skills was rarely the cause of accidents. Rather, lapses in communication and delegating work tasks were found to be the major contributors of air transport accidents. Chidester and his colleagues (1991) ventured that dissimilarities in crew performance may be better predicted by attitudes and personality variables regarding what constitutes correct flight-crew behavior rather than knowledge or skills.

In order to determine what researchers look for in terms of traits that help with communication improvements, Helmreich (1986) assessed the personality structures of males and females in several performance-related situations. Helmreich's (1986) review indicated that there are two core dimensions critical to pilot performance:

1. Instrumental traits relating to goal seeking and achievement
2. Expressive traits relating to interpersonal behaviors, orientation, and sensitivity

Both dimensions were found to be predictive of team performance in aerospace environments. Chidester et al. (1991) noted that high scores on positive, instrumental traits (i.e. mastery orientation) and low scores on negative instrumental attributes (i.e. arrogance and hostility) were indicative of superior pilot performance with multi-person crews. In addition, high scores on expressive traits were also related to superior pilot performance. This specifies that operating an aircraft requires coordination and cooperation of crewmembers in order to achieve effective performance.

Similarly, Chidester, Helmreich, Gregorich, and Geis (1991) gathered data and documented limits on the impact of crew coordination training between groups of pilots. In this study, flight-crew effectiveness was defined as a product of technical skills, attitudes and personality characteristics (Chidester, et al., 1991). Two samples of pilots were assessed in the context of crew coordination training. Relying on a cluster analysis, the results indicated the emergence of three distinct pilot personality profiles. A positive instrumental/interpersonal cluster composed the first grouping, and was characterized by high levels of instrumental and expressive traits. The second cluster, negative instrumentality, was composed of elevated levels of positive and negative instrumental traits along with low levels of positive expressive traits. Lastly, a low motivation cluster emerged and was characterized by below average scores on positive instrumental and expressive traits. This third cluster also showed elevated levels of verbal aggressiveness (Chidester, et al., 1991). These researchers suggested that superior coordination is associated with high levels of instrumental and expressive traits. In addition, the researchers displayed that pilots who fit the positive instrumental/expressive profile appeared to benefit the most from training. Pilots in the low motivation group seemed to benefit the least from training. In some cases, the low motivation group may have even rejected the attitudes of the program. This research provides support for the idea that clustering personality traits lend support to the positive implications for pilot training performance (Chidester, et al., 1991).

In a related study by Helmreich (1984), the differences between the stable nature of personality and the malleability of attitudes in the context of crew coordination were addressed. Results indicated that there is a high agreement that the pilot flying should verbalize his plans for maneuvers and make sure his actions are understood by the other crew members (Helmreich, 1984). There is also agreement that the captain should delegate responsibilities, such as during emergency and nonstandard situations, to better manage their flying operation. Although these results show a general consensus regarding appropriate cockpit management functions, there still exists a divergence in attitudes. Training in crew coordination can result in behavior changes and create a frame of reference for what constitutes appropriate cockpit management functions (Helmreich, 1984). Therefore, it is important to assess both personality variables and predicted crew management when considering pilot performance.

The benefit of assessing personality to predict crew management is that personality is a stable construct. Rose (2001) found that pilots are one of the most consistent and unchanging occupational groups and that it may be surprising when pilot behaviors seem contradictory or unpredictable. In more detail, Rose (2001) noted that pilots tend to have good reasoning skills and are generally social, make decisions, deal with people, and handle complex information. He also observed that although pilots seem to act very quickly, they actually tend to be very slow and procedural when confronted with crisis situations or when they have to make well-informed decisions. This makes sense in that pilots have good stamina – they act rapidly in carrying out complex flying procedures because these situations are highly practiced. However, they are also trained not to rush and may have problems when encountering non-routine situations (Rose, 2001). Rose (2001) concluded that pilots continue to act positive but only because they question anything negative that could occur. They are industrious and diligent but do not like to be rushed. Lastly, they are cooperative but affirm their assertiveness when it comes to safety. In sum, these results indicate that it communication and cooperation almost always improve when we understand why people act the way they do.

As a way to improve communication and cooperation, airline companies have been implementing Cockpit Resource Management (CRM) programs that report the "people skills" associated with, and needed for, flying an aircraft. CRM programs are all encompassing and involve the training of pilots, flight attendants, mechanics, dispatchers and anyone else involved in the flight process (Baron, 1997) in areas such as interpersonal communication, leadership, and decision making, and proactivity (Helmreich & Wilhelm, 1991).

Proactivity

Safety is of extreme importance in the field of aviation. Pilots that are proactive tend to exhibit more organizational citizenship behaviors and are better individual performers (Baba, Touringny, Wang, & Liu, 2009). When operating an aircraft, high performance and going above and beyond what is expected on the job certainly ensures that safety is maintained as a top priority.

Training in such areas will ensure the safety of all those involved. Abeyratne (1998) argues that the aviation industry must move towards a proactive, rather than reactive, approach to ensuring safety. In other words, relying on data about accidents and errors is only a reaction to what has already been done. Airlines are now adopting a new framework that focuses more on proactive organizational support (Helmreich & Merritt, 2000).

Likewise, Baba, Tourigny, Wang, and Liu (2009) conducted a study that involved 485 airline employees including pilots, engineers, flight attendants, and service employees and found that proactive personalities are more apt to shape the safety climate toward the facilitation of superior performance. Further, Baba et al. (2009) found that proactive personality positively predicted individual performance and organizational citizenship behavior. The results also indicated that perceived safety climate moderates the relationship between proactive personality and individual performance. Therefore, it is important that organizations foster a proactive perspective to ensure safety and that pilots and staff engage in proactive behaviors because it leads to better overall performance. Chung-Yan and Butler (2011) studied proactive personality and found that individuals with a high proactive personality, moderate to high job complexity was positively related with demands-abilities fit. Given that flying airplanes is a fairly complex task, proactive individuals tend to better handle particular demands given their ability to perform the task.

Assertiveness

Research has indicated that one way to reduce the potential for mishaps in flight, effectively manage information, voice important concerns, and confidently make decisions is to train pilots to be assertive (Butcher, 2002).

In 1977, two Boeing 747 aircrafts collided causing 583 fatalities in which low assertiveness, leadership, fatigue, and communication were all deemed causal factors of the accident (Weick, 1990). In addition, emerging research findings continuously conclude that failures of interpersonal communication, decision making, leadership, and crew coordination are the main causes of air crashes (Flin, O’Connor, & Meams, 2002). There is now more widespread recognition of the need for a type of training which can enhance these technical skills. One such way is ensuring that pilots are assertive in their actions. For example, Flin and O'Connor (2001) created a taxonomy of non-technical skills for crew resource management. Six categories emerged including situational awareness, decision making, communication, team working, personal resources, and supervision/leadership. Assertiveness falls into the Communication, Team Working, and Supervision/Leadership categories, which indicates the importance of being assertive in helping to avoid issues in the sky. Effectively assessing and training aspects of assertiveness are important in ensuring these qualities are being utilized.

For instance, a study by Smith-Jentsch, Jentsch, Payne, and Salas (1996) examined 32 private pilots who participated in an assertiveness training study. The purpose of the training program was to enhance the ability of pilots to avoid accidents by being assertive in their ideas, opinions and observations. Smith-Jentsch et al. (1996) suggested that assertiveness is a complex skill and also an important team-related attitude. Thus, performance-related assertiveness training used as a way to ensure effective team performance in flight situations. The performance measure in the study consisted of a flight simulation that was used to evaluate gains due to training in the participants' ability to be assertive. Participants were instructed to be assertive to the best of their ability during a 35-minute flight scenario in which they interacted with two confederates. Results indicated that those in the assertive training program outperformed their counterparts in the control group in terms of being assertive and enhancing team performance. In sum, assertiveness is a desired quality of pilots when considering how they perform on the job and when considering the safety of their passengers. In addition, pilot assertiveness is partly a function of how they interact and involve their crew.

A compilation of studies by Salas, Burke, Bowers, and Wilson (2001) indicated that more crew resource management training programs are emphasizing the importance of assertiveness.

For instance, several studies identified positive participant reactions to role play assertiveness exercises and that assertiveness measures are viewed as applicable and job-relevant to pilots (Geis, 1987; Baker, Bauman, & Zalesny, 1991; Salas et al., 1999). In sum, the importance of being assertive is emerging as a major contributor to reducing human error in aviation situations. Voicing concerns with confidence and without threatening the rights of others lends itself as an important piece to the promotion of crew resource management.

The Current Study

Based on the relevant literature, the current research study proposes that individuals with high levels of extraversion and conscientiousness and low levels of neuroticism are projected to be more successful in the university's aviation program than those without the aforementioned pilot profile personality traits. Analyses will be conducted by observing relationships between the results of the self-report assessment and instructor ratings of students. Instructor ratings were obtained half way through the first semester and again half way through the second semester of the academic year. Results of the previous studies from 2012-2013 and 2011-2012 will be used to increase the sample size and contribute longitudinal data on students to the overall analyses. The current selection system will be edited to emphasize the selection of pilots based on personality traits that have been shown to be shared by successful pilots. Concurrently, aspects of mechanical and spatial knowledge will be used as supportive data. Measures that demonstrated low validity coefficients in previous research studies will be removed from the study in order to incorporate other important measures.

Although other studies have found support for a pilot personality profile, this study is intended to test this profile as one piece of the overall pilot selection system. If students in this aviation program display any differences, there may be underlying confounds that influenced the data since past research has indicated that the general pilot population display a similar set of characteristics. However, if the results of this study reflect previous findings, convergent validity for existing research into pilot profiles will be displayed. Lastly, after the establishment of validity for the current study, it will be used alongside measures of spatial and mechanical knowledge to identify whether a candidate for the aviation program will provide a good fit. Specifically, it is hypothesized that students who more closely resemble the pilot personality profile (i.e. high conscientiousness and extraversion and low neuroticism) will perform better overall than those who do not fit it; students with high assertiveness and high proactivity will perform better overall than those with low scores on these qualities; crew coordination will be positively correlated with performance; and lastly, spatial reasoning will be positively correlated with performance.

CHAPTER II

Method

Participants

Forty-seven students in the Aviation Department of a Midwestern university participated in the study throughout the academic school year from September 2013 to May 2014. In the current study, participants ranged in age from 17 to 48 with an average age of 20.6 years. The majority of the students were male (n=39), with the remaining eight students being female. The majority were also native English speakers with a few international students. The students' previous flight experience ranged from 0-170 hours. Four respondents with 25, 30, 59, and 170 hours were outliers, while the average among the other respondents was just over 1 previous flight hour.

Measures

The measures in the present study were chosen based on previous research, a comprehensive analyses of preceding pilot selection tools, interviews with individuals in the Aviation Department, and recommendations for continuing research on this topic. The subsequent measures were divided into a two-part pencil and paper assessment. Part I was timed and consists of a block counting measure and a rotated blocks measure. Part II was untimed and consists of the IPIP Five Factor Scale, the Cockpit Management Attitudes Questionnaire (CMAQ), the Assertive Interpersonal Schema Questionnaire (AISQ), and the Proactive Personality Scale. Demographic measures, past flying experience, flight time (in hours), type of flight lessons completed, and relevant past performance data were additionally collected.

Block Counting and Rotated Blocks. In order to assess spatial reasoning, a 20-item Block Counting scale and 12-item Rotated Block scale adapted from Peterson's Military Practice Tests (Wiener, 2005) were included in Part I of the battery. The Block Counting scale and the Rotated Block scale were capped with a 3 minute time limit and a 6 minute time limit, respectively.

IPIP Five Factor Scale. A 50-item scale with items from the International Personality Item Pool (IPIP) was used to measure where applicants fall on the scales of the original Five Factor Model (Costa & McCrae, 1985): openness to experience(α=.82), conscientiousness (α=.81), extraversion (α=.86), agreeableness (α=.77) and neuroticism (α=.86). The ratings are on a 5-point Likert-type scale in which participants rate their agreement from *Strongly Disagree* (1) to *Strongly Agree* (5). Sample items include the items below and are characterized by the personality characteristic in brackets:

1. I often feel blue [neuroticism]
2. I pay attention to details [conscientiousness]
3. I know how to captivate people [extraversion]
4. I have a vivid imagination [openness to experience]
5. I believe that others have good intentions [agreeableness]

CMAQ. The 8-item Cockpit Management Attitudes Questionnaire was developed by Gregorich, Helmreich, and Wilhelm (1990) and was used to assess cockpit resource management and crew coordination in an aircraft (α=.65). The ratings are on a 5-point Likert-type scale ranging from *Strongly Disagree* (1) to *Strongly Agree* (5). Sample items include:

1. My decision-making ability is as good in emergencies as it is in any other situation.
2. I can still perform effectively even when I have to work with someone who is less experienced than me.
3. Each crew member should monitor others for signs of stress or fatigue.

AISQ. The Assertive Interpersonal Schema Questionnaire (AISQ) developed by Vagos and Pereira (2010) is a 21-item scale developed for evaluating cognitive components in assertiveness (α=.89). In addition, it encompasses emotional and behavioral aspects in which the goal is to differentiate individuals on the basis of their level of assertiveness. A Likert-type scale with 5 points ranging from *Completely False About Me (1)* to *Completely True About Me (5)* was used. Sample items include:

1. I usually know what I want and am able to make my own choices.
2. When someone I like pulls away from me, I try to understand why and solve the situation.

3. I am usually capable of making my own decisions, but when I don't know what to do I have someone to go to for counsel and guidance.

Proactive Personality Scale – Short Version. The Proactive Personality Scale – Short Version is based on Bateman and Crant's (1993) 17-item Proactive Personality Scale. The shortened assessment was developed by Seibert, Crant, and Kraimer (1999) in which items with the highest factor loadings across three different samples were retained to create the 10-item measure (α=.89). It is designed to measure dimensions of work-related proactivity within the framework of goal-regulation. Participants rate their agreement using a Likert-type scale with points ranging from *Strongly Disagree (1)* to *Strongly Agree (7)*. Sample items include:

1. If I see something I don't like, I try to fix it.
2. I excel at identifying opportunities.
3. I am always looking for better ways to do things.

Instructor Ratings. Instructor ratings will be gathered to analyze performance-related competencies such as situational awareness, preparedness, vigilance and decision making. The measure consists of 6 items in which questions 1 and 2 assessed the type of flight lesson (either ground or flight) and whether or not the student was on time for the lesson (either yes or no), respectively; question 3 asked whether or not the student accomplished the required tasks in a timely manner on a scale from *Strongly Disagree (1)* to *Strongly Agree (5)*; and questions 4-6 assessed decision making, situational awareness, and an overall rating of the quality of tasks performed on a scale from *Poor (1)* to *Excellent (5)* (See Appendix). The two dichotomous items in this measure (i.e. lesson type – ground or flight; on time for lessons – yes or no) were not significantly correlated with the other items. However, the remainder of the items (i.e.

accomplish tasks in time provided, decision making, situational awareness, and overall quality of tasks) were all significantly correlated. Sample items include:

1. Was [Name] on time for lessons?
2. Did [Name] accomplish the required tasks in the time provided?
3. How would you rate [Name]'s ability to make decisions in-flight during lessons (i.e. ability to make the appropriate choice for the situation)?

Procedure

The test battery was administered during the first two weeks of class during the Fall 2013 semester. The test was divided into two parts. Part I, including spatial and mechanical reasoning was timed, while Part II assessing personality characteristics, teamwork attitudes, assertiveness, and proactivity was untimed. There were two courses within the aviation department, both meeting at different times of the week, which were included in the analyses. The first section met on Mondays at 8:00 AM and the second section met on Tuesdays at 5:00 PM. Due to the different times of day the battery was administered, strict standardization procedures were enacted. Demographic measures of all students were obtained from professors and through academic records after students completed the battery.

After the initial test battery was administered, performance data was collected throughout the first and second semesters of Fall 2013 and Spring 2014, respectively. Specifically, the instructor ratings of student performance were collected half way through each of the two semesters. This allowed for students who had not yet completed any training to be included in the analyses and also for those students who had completed some training to be comparatively evaluated throughout the progression of the school year.

CHAPTER III

Results

Preliminary Analyses

Of the original 47 responses, a selected number (n=17) were deleted since these individuals either left the Aviation program, provided incomplete data, or were not evaluated by their instructors. After excluding these cases, the concluding number of valid responses was n=30. See Table 1 for measure reliabilities. Reliability was not conducted for the block counting or rotated blocks measures because scales had to be computed as a composite score prior to entering them into SPSS. Complete correlation tables are presented in Tables 2, 3, and 4.

Table 1. *Cronbach's alpha reliability table*

Measure	Reliability
Neuroticism	.764
Extraversion	.864
Agreeableness	.836
Conscientiousness	.800
Openness	.756
CMAQ	.815
AISQ	.900
Proactive	.845

Table 2. *Correlation matrix of personality and performance*

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Neuro	1													
Extra	-.49**	1												
Open	-.28	-.05	1											
Agree	-.68**	.38*	.19	1										
Consc	-.22	.17	-.08	.32	1									
CMAQ	-.53**	.29	.19	.58**	.21	1								
Proact	-.31	.3	.13	.46**	.50**	.34	1							
AISQ	-.67**	.53**	.24	.73**	.40*	.72**	.48**	1						
LT	.05	-.12	.06	.12	-.11	-.13	-.01	-.27	1					
On Time	-.33	.29	.16	.28	-.05	.24	.20	.37*	-.23	1				
Accomp	.12	-.08	-.02	-.15	-.09	-.23	.01	-.17	.00	-.2	1			
DM	-.02	.03	.09	.04	-.10	-.22	-.12	-.11	-.06	-.05	.47**	1		
SA	.03	-.01	.01	-.08	-.19	-.25	-.17	-.17	-.12	-.11	.56**	.93**	1	
Overall	-.01	.01	-.02	-.17	-.19	-.25	-.26	-.18	-.18	-.12	.37*	.81**	.80**	1

Notes: N=30 for all variables. * Denotes significance at p<.05 level and ** denotes significance at p<.01 level. Neuro=Neuroticism, Extra=Extraversion, Open=Openness, Agree=Agreeableness, Consc=Conscientiousness, CMAQ=Cockpit Management Attitudes Questionnaire, Proact=Proactive Personality Scale, AISQ=Assertive Interpersonal Schema Questionnaire, LT=Lesson Type, On Time=On time for lessons, Accomp=Accomplish tasks in time provided, DM=Decision Making, SA=Situational Awareness, Overall=Overall Quality.

Table 3: *Correlation matrix of cognitive ability and performance*

Variable	1	2	3	4	5	6	7	8
BC	1							
RB	.46*	1						
LT	-.09	-.09	1					
On Time	.06	.03	-.23	1				
Accomp	.07	-.15	.00	-.20	1			
DM	.04	-.22	-.06	-.05	.47**	1		
SA	.01	-.20	-.12	-.11	.56**	.93**	1	
Overall	.18	-.19	-.18	-.12	.37*	.81**	.80**	1

Notes: N=30 for all variables. * Denotes significance at p<.05 level and ** denotes significance at p<.01 level. BC=Block Counting, RB=Rotated Blocks, LT=Lesson Type, On Time=On time for lessons, Accomp=Accomplish tasks in time provided, DM=Decision Making, SA=Situational Awareness, Overall=Overall Quality

Table 4. *Correlation matrix of background information and performance*

Variable	1	2	3	4	5	6	7	8
Age	1							
FE	.87**	1						
LT	.10	.10	1					
On Time	.-.14	.04	-.23	1				
Accomp	.02	-.06	.00	-.20	1			
DM	-.10	-.17	-.06	-.05	.47**	1		
SA	.10	-.17	-.12	-.11	.56**	.93**	1	
Overall	.07	-.13	-.18	-.12	.37*	.81**	.80**	1

Notes: N=30 for all variables. * Denotes significance at p<.05 level and ** denotes significance at p<.01 level. Age: Age in years, FE=Hours of flight experience, Counting, LT=Lesson Type, On Time=On time for lessons, Accomp=Accomplish tasks in time provided, DM=Decision Making, SA=Situational Awareness, Overall=Overall Quality.

Test of Hypotheses

Pilot Profile

Hypothesis 1 stated that students who closely resemble the pilot personality profile would outperform those who did not fit the profile. As previously stated, individuals with high levels of conscientiousness and extraversion, and low levels of neuroticism are assumed to fit the personality profile. This was tested with bivariate correlations and was not supported in the resulting analyses. However, there were some correlation indices worth mentioning. For example, there was a moderate negative correlation between being on time for lessons and neuroticism, (r_{pb}=-.33, p=.075), indicating students that have higher levels of neuroticism tend to show up on time for lessons. Specifically, this result was tested using a point-biserial correlation since being on time for lessons was rated as yes (1) or no (2) in which most individuals were on time for lessons. In this sample, extraversion and conscientiousness were not significantly related to the performance measure. However, a linear regression indicated that neuroticism had a moderate beta weight when predicting timeliness for lessons (β=-.274, p=.21). This effect size indicates that there is a potential relationship between neuroticism and timeliness for flight lessons, but the present sample could have been too small to observe a significant relationship.

Assertiveness

Hypothesis 2 stated that students who are highly assertive will perform better than those with low assertiveness. This was tested with bivariate correlations and was partially supported. There was a significant correlation between the AISQ composite score and a component of the performance measure (r_{pb}=.37, p<.05), indicating that students who are more assertive tend to show up late for lessons. Again, these results may be indicative of the fact that almost all students were on time for lessons. A linear regression also indicated that the AISQ composite score had a substantial beta weight when predicting timeliness for lessons (β=.37, p=.044).

Proactivity

Hypothesis 3 stated that students who are more proactive will perform better than those who are less proactive. To test this, bivariate correlations were conducted and the results did not support the initial hypothesis. However, there was a moderate negative correlation between overall quality of tasks and the Proactivity composite score (r=-.26, p=.16), indicating that individuals who are more proactive may have lower overall performance. In addition, a linear regression indicated that the Proactive Personality Scale was not predictive of any items on the performance measure.

Cockpit Management

Hypothesis 4 stated that crew coordination will be positively correlated with performance. This was tested with bivariate correlations and the hypothesis was not supported. The CMAQ had weak to moderate negative correlations with accomplishing tasks in the required time (r=-.23, p=.22), decision making (r=-.22, p=.24), situational awareness (r=-.25, p=.19), and overall quality of tasks (*r*=-.25, *p*=.18). However, there was a positive relationship between the CMAQ and being on time for lessons (*r*=.24, *p*=.21), indicating that individuals who have better crew coordination skills may be late for flight lessons. A linear regression also signified that the CMAQ was not predictive of performance.

Spatial Reasoning

Hypothesis 5 stated that spatial knowledge will be positively related to performance. This hypothesis was tested with bivariate correlations and was not supported. The block counting measure had a consistently weak relationship with performance, with the largest being with overall quality of tasks (*r*=.18, *p*=.34). The rotated blocks measure had weak to moderate negative correlations with decision making (*r*=-.22, *p*=.24), situational awareness (*r*=-.20, *p*=.30), and overall quality of tasks (*r*=-.19, *p*=.31). However, a linear regression indicated that the block counting (β=.34, *p*=.10) and rotated blocks (β=-.35, *p*=.09) had substantial beta weights when predicting overall quality of tasks. The rotated blocks measure (β=-.25, *p*=.20) also had a fairly large beta weight when predicting situational awareness. The rotated blocks measure (β=-.31, *p*=.16) also had a substantial beta weight when predicting decision making as well. These effect sizes indicate that there could potentially be more significant relationships with the inclusion of a larger sample size.

CHAPTER IV

Discussion

Hypothesis 1 stated that students with elevated levels of conscientiousness and extraversion and low levels of neuroticism (i.e. pilot personality profile) would have higher performance than those who do not fit the characteristics of the profile. This was not supported but neuroticism was moderately correlated timeliness for flight less. In addition, conscientiousness and extraversion were not related to performance. Perhaps a reason neurotic individuals tend to show up on time for lessons could be because their anxious and nervous behavior causes them to feel they will stand out and will be criticized for showing up late. Therefore, neurotic individuals may do more to be on time than less neurotic people (James & Fleck, 1986). These results are similar to that of Back, Schmukle, and Egloff (2006) who found that more neurotic participants showed a higher level of over-promptness when compared to those with lower levels of neuroticism. While a significant relationship was not observed with conscientiousness and extraversion in predicting performance it is suggested that with continued data collection and a larger sample size, a significant effect may be obtained.

Hypothesis 2 stated that high assertiveness would be positively related to performance. Assertiveness tends to focus on the absence of anxiousness in light of stressful situations and acting in a confident, self-assured manner. In this sample, hypothesis 2 was partially supported, indicating that students who are more assertive tend to show up late for flight lessons. A potential explanation for this finding is that assertive people tend to be confident in their assertions without needing to prove or confirm of their actions. Perhaps being on time for lessons is not related to an individual’s inclination to express themselves openly and courageously. In addition, an overwhelming majority of the participants were on time for lessons so range restriction may have caused this result.

Hypothesis 3 stated that high proactivity would be positively related to performance. This was not supported but there were traces of a relationship when considering proactivity and overall performance. Specifically, participants who were more proactive tended to have lower overall performance. Proactive individuals tend to engage in self-initiated behaviors and act in advance of a situation rather than being reactive. Perhaps participants who were overly proactive may be perceived as "doing too much" in a flight situation. This may lead to retaliation or criticism from fellow colleagues and hinder performance as a whole. Further investigation is warranted to determine whether a more balanced dose of proactive behavior promotes performance.

Hypothesis 4 stated that cockpit management skills and crew coordination will be positively related to performance. This hypothesis was not supported, although there were weak to moderate correlations between the CMAQ and performance measure. Specifically, individuals who had high cockpit management skills tended to not complete their tasks in the required time; had lower decision making skills and were less aware of relevant situations; showed up late for lessons; and had lower overall performance. A potential reason for these findings could be caused by the way performance and crew coordination were measured. For example, crew coordination focuses on the interaction with others and the delegation of tasks. It also relates to interpersonal behaviors and an individual's mastery orientation. Perhaps the lack of interaction with an actual flight crew, and instead flying with a single flight instructor, may inhibit one's ability to utilize crew coordination skills, and thus make it difficult to identify how they relate to successful performance. These results also may be indicative of the weak to moderate negative correlations between the CMAQ and performance.

Hypothesis 5 stated that spatial reasoning would be positively related to performance. This hypothesis was not supported but the results did display that the block counting measure was consistently less related to performance than the rotated blocks measure. Perhaps the time given to complete each measure may explain these results. For example, for the block counting measure, participants were asked to answer almost twice as many questions in half the amount of time as the rotated blocks measure. Few participants were able to complete the rotated blocks measure so the resulting relationship with performance may be incomplete. In future research, it may be beneficial to allow participants more time to complete the measure in order to create a more complete representation of spatial reasoning skills.

Overall, the results did not support the original personality-performance hypotheses in the aviation setting. However, personality characteristics have consistently shown to play a role in understanding performance in the field. This research is applicable because the sample was selected from a population in which it was intended to generalize. Many of the participants will continue on to become pilots in commercial, private, or military settings. The aviation program at this Midwestern University will be able to refer to this information to identify students who are likely to perform well in the current academic setting and those who might need further training and development in particular areas. Although this research did not consistently identify personality characteristics that will aid in the identification of those students, the results can still be used as a reference to provide a narrower scope of pilot performance.

The inconclusive results may have been caused by several limitations in this study. The original sample included 47 students but was reduced to 30 after data on several students were omitted due to missing information or incomplete results. In addition, although personality data was collected from 47 participants, only 30 participants had both personality and performance data. Some students may have dropped out of the aviation program or had not taken any flight lessons for their performance to be evaluated. Another limitation of the study was that almost all participants were on time to their flight lessons so some of the results may have been an indication of range restriction. Lastly, the performance measure consisted of eight items that instructors used to rate student performance during flight lessons. Perhaps the small number of items did not accurately reflect what constitutes effective performance.

If there is to be a next iteration of this selection measure, it is recommended that the same measures be used but that more participants be included in the resulting analyses. There were several indices of potentially useful results, including beta weights and moderate correlations. Perhaps more of the results would be significant with a larger sample size. It is also recommended that the performance measure be revised to be on a more consistent 5-point scale instead of having items that are dichotomous. In future research, it would be beneficial to examine whether other components of the Big Five may contribute to successful performance, given that many of these personality variables were significantly correlated with one another. It is also recommended that future research delve deeper into whether there exists a healthy dose of assertiveness and proactivity when considering their relationship with effective performance.

CHAPTER V

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CHAPTER VI

Appendix

1. Please select the type of lesson:

☐ Ground Lesson
☐ Flight Lesson

2. Was your student on time for this lesson?

☐ Yes
☐ No

3. Did the student accomplish the required tasks in the time provided?

☐ Strongly Disagree
☐ Disagree
☐ Neutral
☐ Agree
☐ Strongly Agree

4. How would you rate this student's ability to make decisions in-flight for this lesson (i.e. ability to make the appropriate choice for the situation)?

☐ Poor
☐ Below Average
☐ Average
☐ Above Average
☐ Excellent

5. How would you rate this student's situational awareness in-flight for this lesson (i.e. ability to manage multiple tasks and adapt based on changing conditions)?

☐ Poor
☐ Below Average
☐ Average
☐ Above Average
☐ Excellent

6. How would you rate the overall quality of tasks the student was required to accomplish for this lesson?

☐ Poor
☐ Below Average
☐ Average
☐ Above Average
☐ Excellent