Collegiate Aviation Review

UNIVERSITY AVIATION
ASSOCIATION

Spring 2010 Volume 28: Number 1

UNIVERSITY AVIATION ASSOCIATION

COLLEGIATE AVIATION REVIEW

Wendy S. Beckman, Ed.D., Editor

Richard O. Fanjoy, Ph.D., Associate Editor

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Spring 2010 **Volume 28: Number 1**

The Collegiate Aviation Review (CAR)
Spring 2010, Volume 28, Number 1
Wendy S. Beckman, Editor

All correspondence and inquiries should be directed to:

University Aviation Association
3410 Skyway Drive
Auburn, AL 36830
Telephone: 334-844-2434
Email: uaa@mail.auburn.edu

ISSN Number: 1523-5955

ACKNOWLEDGEMENTS

The University Aviation Association gratefully acknowledges the generosity of Middle Tennessee State University and Purdue University in co-sponsoring this edition of the *Collegiate Aviation Review* (*CAR).*

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The University Aviation Association is the only professional organization representing all levels of the non-engineering/technology element in collegiate aviation education. Working through its officers, trustees, committees and professional staff, the University Aviation Association plays a vital role in collegiate aviation and in the aviation industry.

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To encourage and promote the attainment of the highest standards in aviation education at the college level.

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University Aviation Association
3410 Skyway Drive
Auburn, AL 36830
Telephone: (334) 844-2434
Email: uaa@auburn.edu

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Authors should e-mail their manuscript, in Microsoft Word format, to the editor at CARjournal@uaa.aero no later than June 1 (Fall 2010 issue) or December 1 (Spring 2011 issue). Manuscripts must conform to the guidelines contained in the *Publication Manual of the American Psychological Association, 6th ed.* Previous editions of the CAR should also be consulted for formatting guidance. All submissions must be accompanied by a statement that the manuscript has not been previously published and is not under consideration for publication elsewhere.

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Hemant Bhana
University of North Dakota

ABSTRACT

The research project determined whether boredom proneness and self-assessed boredom affect automation complacency in modern airline pilots. Modern transport category aircraft are increasing in automation sophistication. This paradigm shift is seeing pilots relegated to automation supervisory or monitoring roles instead of active participants in the flight. An unintended consequence is the potential for increased boredom. The study examines whether pilots who are more prone to boredom make a greater amount of automation complacency related mistakes. A sample of active professional airline pilots at a major airline in the United States completed an on-line survey (N=273). The survey incorporated four parts. The first segment collected general demographic data. The second portion administered the BPS, or Boredom Proneness Test (Farmer & Sundberg, 1986). The third segment administered the Pilot Automation Complacency Practices Scale, created by the author. Finally, the last portion queried the subject's self-assessed boredom level, and automation philosophy. The survey included numerous free comment sections for pilots to add information not specifically queried. Pearson Correlation Coefficients confirmed that boredom proneness does affect automation complacency in the sample. The BPS exhibited good validity with the self-assessment of boredom ($r=.499$, $p=0.01$). Boredom and boredom proneness also adversely affect attention span in airline pilots. The research is applicable to highly automated environments conducive to boredom where monitoring and supervision is required.

INTRODUCTION

Automation "…refers to systems or methods in which many of the processes of production are automatically performed or controlled by autonomous machines or electronic devices" (Billings, 1997, p. 6-7). Automation is silently prevalent in almost all aspects of daily life, all of which require different levels of monitoring. For example, pushing a requested floor in an elevator starts a complex process where the automated system delivers the elevator car to the desired floor and opens the doors when appropriate – all done silently to the user.

Aircraft automation is different in that it requires a high degree of monitoring by the user due to its dynamic nature (Billings, 1997). Sheridan and Parasuraman (2006) define eight levels of automation ranging from where the human operator must do everything to where the computer does everything, ignoring the human. The intermediate levels are most applicable to modern aviation, specifically the level where the automation "…executes the suggestion automatically, then necessarily informs the human" (p. 94). This rubric tasks the human operator, in aviation's case the pilot, with evaluating the computed suggestion and either stopping the automation or allowing it to continue. The pilot is now required to provide mostly supervisory control over the automation versus manually computing functions such as vertical and lateral navigation. This has effectively transformed the nature of the work an airline pilot performs from one where the pilot is an active participant in controlling the aircraft to one where the pilot is an overseer of the automation.

AUTOMATION COMPLACENCY

Automation complacency results when the operator over-relies or excessively trusts the automation and fails to exercise his or her vigilance or supervisory duties (Parasuraman & Riley, 1997). Alternatively stated, "Pilots may become complacent because they are overconfident in and uncritical of automation, and fail to exercise appropriate vigilance, sometimes to the extent of abdicating responsibility to it [which can] lead to unsafe conditions" (Research Integrations, 2007). The NASA Aviation Safety Reporting System (ASRS) publication Callback defines complacency throughout multiple issues as "…the state of self-satisfaction that is often coupled with unawareness of impending trouble" (Aviation Safety Reporting System, 2009). The definitions quoted clearly imply that complacency occurs when the automation supervisor is unaware of the current or impending actions of his or her respective machine, sometimes with tragic results.

One of the first studies of automation complacency tested subjects in a multi-task environment very similar to a modern aircraft flight deck (Parasuraman, Molloy, & Singh, 1993). The authors hypothesized that complacency is most evident when pilots are performing concurrent tasks such as simultaneously managing and monitoring the automation. They argued that the two most important elements of an automated system, its reliability and consistency, most directly influence how the operator is able to detect and respond to failures. The increased workload nature of the experiment is significant, since some cognitive scientists have argued complacency is a method of coping with the increase in workload (Elin Bahner, Huper, & Manzey, 2008). If the operator perceives the automation to be consistent and reliable, then he or she needs to allocate fewer cognitive resources to the monitoring aspect. Important to note is the workload threshold required for complacency is subjective, and varies between operators. How each operator perceives his or her individual cognitive load determines both the response strategy and how he or she allocates mental resources to cope with the situation (Prinzel, DeVries, Freeman, & Milulka, 2001).

Trust

A key element to the issue of complacency is operator trust. This construct allows the user to reallocate attention resources away from the close monitoring duties toward other activities by simply "trusting" the automation performs correctly. Unfortunately, an unwanted side effect is the decreased chances of detecting an automation abnormality. A good definition of trust is "…the attitude that…will help achieve an individual's goals in a situation characterized by uncertainty and vulnerability" (Lee & See, 2004, p. 54). According to this definition, the amount of trust guides the level of automation usage when the complexity or uncertainties of the situation make a complete understanding of the nuances of automation impractical. One factor affecting an operator's trust in an automated system is the perceived reliability of the system in question (Prinzel, DeVries, Freeman, & Milulka, 2001; Lee & See, 2004; Bailey & Scerbo, 2008).

Reliability

High levels of automation reliability and consistency tend to impart greater levels of trust in the operator, which he or she can then use as a coping mechanism. Rather than continue with the task of monitoring the automation, automation users can make assumptions on what the machine will do and concentrate on other duties. To prove this concept, Bailey et al. (2008) gave their subjects a flight task on a desktop simulator while simultaneously monitoring several displays for a single failure. The researchers repeated their experiment several times with the failure occurring in different places. Their results suggested that as the subjects gained experience with the overall system, their monitoring performance decreased at a level directly related to the level of familiarity and trust they had in the system. The researchers manipulated the system reliability, thus altering the amount of trust each operator had in the predictability of the machine. From this data, they could prove a direct relationship between the levels of trust and degraded monitoring performance. This is congruent with Lee and See, (2004), who also found that trust is directly responsible for monitoring level and operator oversight.

Risk

Along with perceived reliability, one of the major factors in determining the level of trust an operator places in the machinery is the risk involved with a particular action (Riley, 1996; Lee & See, 2004). The consequence of an action or inaction directly influences how much emphasis the operator places on the vigilance task associated with proper automation monitoring. Operators conducting a task with greater risk will monitor the automation with greater accuracy regardless of how much confidence or trust they have in the system. Riley (1996) identified this construct as a shortcoming of research on automation complacency. Previous research on complacency involved subjects performing automation monitoring tasks on static simulators where the consequences of a complacency error are extremely low. Riley (1996) argued that this research may not be indicative of "real world" applications since errors of omission and commission are often related to the seriousness of the potential outcomes. The introduction of risk may generate a new set of biases and emphasis points that directly affect a monitoring task.

Vigilance

The term vigilance commonly refers to the ability of an individual to maintain his or her attention for long and uninterrupted periods (Sawin & Scerbo, 1995). This ability is particularly important given the "monitoring" aspect to a pilot's job. Since automation now manages an increasing number of functions during a flight, vigilance becomes important at detecting subtle mode changes. Bailey et al. (2008) determined that vigilance performance varied directly with the complexity of the task. The more complex the task is, the greater the amount of monitoring errors they found in their sample, once again suggesting that the trust and reliance constructs are coping mechanisms. The more cognitively demanding a task is, the more the user is likely to "load shed" and assume the correct action of the automation rather than use resources to monitor it. More importantly, the vigilance performance decreased even more if the inflection or change was subtle.

Conventional theories by psychologists regarding reasons why vigilance performance decreases have centered on the monotonous nature of the activity. The monotony supposedly lulled the operator into a decreased state of vigilance through a lack of stimulation. However, new research has offered alternate theories for the performance decrement, instead arguing that vigilance is a demanding task associated with high levels of stress and concentration and not related to monotony (Sawin & Scerbo, 1995; Warm, Parasuraman, & Matthews, 2008). The reasons for this are complex. Typically, the research has found that the need to maintain high levels of vigilance for extended periods substantially increases the operator's workload by increasing the amount of stress (Hancock & Warm, 1989). In addition, a perceived lack of control over future events magnifies the stress factor in vigilance tasks. As the vigilance task extends, the stress and perceived lack of control tend to deplete cognitive resources and contribute to a feeling of dissatisfaction (Warm, Dember, & Hancock, 1996). The stress results in what cognitive scientists call the performance decrement, where vigilance performance in high workload situations can decrease rapidly from around five minutes of the onset of the task and stabilizes at a significantly lower level within 25 to 30 minutes (Warm, Parasuraman, & Matthews, 2008).

One of the factors that directly affect vigilance performance is boredom (Sawin & Scerbo, 1995; Kass, Vodanovich, Stanny, & Taylor, 2001). Kass et al. (2001) found that subjects with high scores on the Boredom Proneness Scale (discussed later in the review) experienced a performance decrement much sooner than less boredom prone subjects. They attributed this finding to the monotonous and under stimulating nature involved in vigilance tasks – concepts that directly contribute to boredom (Sawin & Scerbo, 1995). In summary, the performance decrement found in vigilance tasks is attributable to the stressful nature of the task itself, while the speed of onset depends on how prone to boredom a person is.

Boredom

Psychologists commonly define boredom "…as a state of low arousal and dissatisfaction attributed to an inadequately stimulating situation" (Mikulas & Vodanovich, 1993). Another definition adds the concepts of interest and attention. Fisher (1993) defined boredom as "…an unpleasant, transient affective state in which the individual feels a pervasive lack of interest in and difficulty concentrating on the current activity" (p. 396). The term "state" refers to a transitory period of consciousness that affects how a person views the world around them. For example, a person in a situation that meets the requirements posited by Mikulas et al. (1993) and Fisher (1993) of low arousal, dissatisfaction, inadequate stimulation, lack of interest, and difficulty concentrating may experience boredom. Due to its transitory nature, the "state" of boredom may be temporary. Boredom proneness, by contrast, is a trait referring to the propensity of an individual to become bored (Farmer & Sundberg, 1986). Individuals who are more prone to boredom may need lower arousal, dissatisfaction, and stimulation thresholds to experience the state of boredom than a person who is not as prone to boredom.

Theories on how people respond to arousal suggest individuals will seek out ways to cope with various stimulation levels in order to maintain the optimum arousal level (Mikulas & Vodanovich, 1993). If a person is in a situation with low arousal resulting in boredom, he or she is likely to seek ways to increase the arousal and avoid the boredom (Fisher, 1993). The perceived complexity of a particular situation is an important concept in this equation since people respond to stress and arousal according to their abilities. What may be an uncomplicated situation for one person may be extremely complex for another. Thus, boredom in individuals results in part from situations whose complexity is too low for that specific individual resulting in below optimum arousal levels (Mikulas & Vodanovich, 1993).

The second element of the definition, dissatisfaction, refers to an individual's perception of the action. For a person to be in a state of boredom, he or she must not enjoy the particular situation they are in (O'Hanlon, 1981). O'Hanlon (1981) reasoned the cause of this dissatisfaction is a person's "…aversion to monotonous elements of the situation [that are]…the source of the feeling" (p. 54). People have a natural aversion to monotony, which causes a person to feel dissatisfied with his or her current situation. O'Hanlon (1981) found boredom and job dissatisfaction strongly related.

The final component of the definition deals with inadequately stimulating situations. This concept is unique to each individual and depends on the individual's perception of the task, including any prior experiences with performing that task. O'Hanlon (1981) posited that monotony might be a driving factor in a person being bored. His work described the onset of boredom arriving within minutes especially if the person is engaged in a repetitive activity that he or she has done extensively in the past. Repetitive activities lose their complexity after continuous practice and fail to provide the level of arousal necessary to be stimulating. Research on job tenure found employees with longer tenure experienced greater boredom (Drory, 1982; Kass, Vodanovich, & Callender, 2001). Drory (1982) experimented on long haul truck drivers, and found significantly increased levels of boredom in drivers who had driven the same route repetitively. Kass et al. (2001) summed up the concept when they wrote "…repeated exposure to the same stimuli (e.g., job tasks) leads to lower levels of arousal, which results in less satisfaction and greater boredom" (p. 324). Therefore, for a person to stave off boredom there needs to be a source of stimulation either from the current environment or from somewhere else.

The etiology of boredom can be isolated into five factors. In work environments, the most common factors are the need for stimulation from external sources and stimulation through internal methods (Vodanovich & Kass, 1990; Vodanovich, Craig, & J, 2005). External stimulation refers to the perceived need for novelty, excitement, and variety from external sources and may explain why men and extroverts are more prone to boredom (Vodanovich & Kass, 1990; Vodanovich, Weddle, & Piotrowski, 1997;

Gosline, 2007). The other major factor, internal stimulation, deals with methods to keep oneself interested and entertained through internal mediums. Subjects who are dependent on internal stimulation need to be proficient at concentrating on and maintaining self-created tasks and often possess better absorption and self-awareness levels (Seib & Vodanovich, 1998). These elements are often associated with introverted people who require fewer outside stimuli to stave off boredom (Gosline, 2007). Research on working conditions suggest extroverted individuals who are more prone to boredom are best suited for opportunities that offer external and tangible rewards, while introverted people who are less prone to boredom are better suited to positions that offer intrinsic rewards (Vodanovich, Weddle, & Piotrowski, 1997).

Perhaps the best method of quantifying boredom for research purposes is by measuring an individual's proneness to boredom, that in turn can help predict a number of personality constructs a person is likely to experience (Farmer & Sundberg, 1986; Vodanovich, 2003). The most widely used tool is the Boredom Proneness Scale (BPS) by Farmer and Sundberg (1986), which is a full scale measure of the boredom construct. Other boredom indicators tend to analyze only specific aspects to boredom such as job boredom, or are subscales of larger boredom scales (Vodanovich, 2003). The BPS showed satisfactory internal consistency (α=.79, N=233) and good test-retest reliability (r=.83) after one week, with greater stability demonstrated by females (r=.88) than by males (r=.74) (Farmer & Sundberg, 1986). The original test employed a true/false format that some researchers began changing to a 7-point Likert scale to increase the measurement sensitivity (Vodanovich & Kass, 1990).

Boredom Proneness Factors

The work by Vodanovich et al. (1990) is particularly significant since it established a factor structure within the BPS scale allowing researchers to isolate what dimension is causing the boredom. In addition to the two major factors listed earlier, External and Internal Stimulation, Vodanovich et al. (1990) found evidence of three more factors: Affective Responses, which deal with emotional reactions to boredom; Perception of Time, dealing with issues associated with the coping and conceptualizing of time; and finally Constraint, which addressed individual reactions to waiting such as restlessness or patience. Other researchers have found similar factors incorporated in the BPS (see Vodanovich, 2003, for a review). However, the consensus amongst the literature finds the two most common and dominant factors are the need for External Stimulation and Internal Stimulation (Vodanovich & Kass, 1990; Vodanovich, Weddle, & Piotrowski, 1997; Gordon, Wilkinson, McGown, & Javanoska, 1997; Vodanovich, Craig, & J, 2005).

State versus Trait Boredom

Research examining a correlation between trait and state boredom has centered on measuring job satisfaction metrics (Kass, Vodanovich, & Callender, 2001) and by correlating the BPS with other job boredom scales that measure state boredom (Farmer & Sundberg, 1986). Some of the strongest evidence for the trait versus state link in boredom comes from the research on boredom and vigilance by Sawin et al (1995). In their study, the researchers administered the BPS and other psychometric tests measuring state boredom to their subjects, about to undergo a vigilance test on a desktop simulator. Their results suggest the BPS is a good indicator of vigilance performance. The test significantly correlated with state boredom measures providing "…evidence for the long-sought, elusive link between trait boredom and performance in vigilance" (p. 763). Research examining a link between state and trait boredom has involved correlating boredom proneness (trait boredom) in individuals with job boredom at work (state boredom). The results by Sawin et al. (1995) are significant in that they permit utilization of the BPS in measures that examine how state boredom affects automation complacency issues. The BPS scores "…reflect the propensity to become bored as a result of completing a monotonous and under stimulating task" (Sawin & Scerbo, 1995, p. 763).

Boredom and Cognitive Failure

Research completed by Wallace, Vodanovich, and Restino, (2003) examined a possible association with boredom proneness as measured by the BPS to cognitive failure. Their sample used a combination of military personnel and undergraduate students to whom the researchers administered the BPS and the Cognitive Failures Questionnaire (CFQ). The overall results demonstrated that "…boredom proneness scores were found to be significant predictors of cognitive failures" (p. 641). However, examining the results in detail found the factor most applicable to aviation in the CFQ questionnaire is distractibility (perceptions on divided attention tasks), since pilots often deal with multiple tasks when monitoring and supervising the automation (Parasuraman, Molloy, & Singh, 1993). Wallace et al. (2003) found that subjects scoring high on the affective and time subscales of the BPS correlated the highest to the distractibility subscale of the CFQ ($r=0.52$ and 0.53 respectively, $p<0.001$). This finding suggests that subjects who have an emotional reaction to boredom and who cannot properly cope with extended time passing will experience greater cognitive failures during multiple tasks.

Work on boredom and attention continued with Cheyne, Carriere, and Smilek, (2006). In this study, the researchers postulated that the inability to engage in and sustain attention is caused by boredom. This argument parallels the definition of boredom by Fisher (1993), when she proposed that part of the effect of boredom is a lack of interest and a difficulty in concentrating. Cheyne et al. (2006) found that their subjects who were more prone to memory failures and attention lapses also scored high on the BPS. Their conceptual model showed statistically significant and positive correlations between boredom proneness and attention disorders ($r=.33$, $p<0.01$) along with depression ($r=.18$, $p<0.01$).

Coping with Boredom

Coping with boredom, particularly in the workplace setting, involves two general strategies (Fisher, 1993). The first requires refocusing attention on the task and the second involves seeking additional stimulation. Refocusing attention on a task involves subjects forcing themselves to pay attention regardless of how they feel about it. This is particularly true if the task carries an element of risk similar to the way risk affects monitoring and vigilance performance. Another coping strategy for task refocusing involves goal setting and working toward the final result by emphasizing specific steps. This technique is congruent with the findings by Shernoff, Csikszentmihalyi, Schneider, & Shernoff, (2003), who posited that achieving flow (the area when attention, focus, and absorption are effortless and come without much conscious thought) best occurs when the goals and tasks are within a person's skills and abilities.

The other method for coping with boredom is to seek out additional stimulation either from the current task or by changing activities. Seeking additional stimulation from the current task particularly during monotonous tasks often involves "subsidiary behaviors," or actions in addition to the requisite tasks to increase the level of stimulation (Kishida, 1977). These behaviors included actions such as daydreaming, talking to colleagues, playing mental games, fidgeting, and looking around. While some of these behaviors reduced the monitoring performance slightly, they proved effective in reducing boredom slightly (Kishida, 1977). Finally, another coping mechanism involved changing activities by engaging in things such as reading and other non-work related activities (chatting, etc.). These results indicate individuals will undertake additional activities to bring their individual workload to an optimum level consistent with their abilities (Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003).

METHOD

The study utilized pilots employed by a major airline (as measured by revenue) in the United States. Each pilot was either a Captain or First Officer, and was experienced in a highly automated aircraft due to the nature of the airline's hiring practices and fleet make-up. Three hundred and one (301) subjects started the survey with 273 completing it, representing roughly 4.5% of the total pilot population at this specific airline. The sample yielded an error rate of 5.8% at a 95% confidence level. All participants voluntarily donated their time and expertise and were uncompensated for their efforts. Participants were under no time limits to complete the survey and could access the survey-related internet pages from a location of their choice.

The study recruited the sample subjects through posters placed on pilot domicile bulletin boards and through a recruitment message inserted in a "blast" e-mail sent to all pilots from the union representing them. Both the poster and e-mail message directed participants to a web site containing generalized information about the study along with a hyperlink to the survey.

The study utilized a 4-part survey consisting of 55 questions to measure both quantitatively and qualitatively, the dependent variables. The first portion of the survey requested general demographic information such as age and experience. The second portion administered the Boredom Proneness Scale (BPS) by Farmer and Sundberg (used with permission). The third portion administered the Pilot Automation Complacency Practices Scale (PACPS) created by the author. Finally, the survey ended by measuring some general attitudes toward automation. Survey respondents had several opportunities to insert free text regarding their individual practices or feelings toward automation.

Pilot Automation Complacency Practices Scale (PACPS)

The author-created PACPS derived its information from an examination of NASA Aviation Safety Reporting System (ASRS) data from a ten-year period ending in January 2009. The search criteria focused only on anomaly reports from Part 121 operations where the causal factor was flight crew human performance and contained variations of the terms FMC/FMS, automation, and complacency. The search criteria revealed 562 records. Since the ASRS program is voluntary and done primarily for immunity against certificate enforcement, the number of reports is under-representative of the actual number of events. A pilot may have had a complacency related event, but may not report it if no infraction occurred.

Automation complacency is a term interchangeable with automation overconfidence, and is broadly described as pilots "…becom[ing] complacent because they are overconfident in and uncritical of automation, and fail to exercise appropriate vigilance, sometimes to the extent of abdicating responsibility to it" (Research Integrations, 2007). Examining the evidence derived from the ASRS reports allows a factorial approach to the issue and reveals four subcategories pertaining to the causes of the broad issue of pilot automation complacency. They are:

1. Pilots fail to notice the automation mode or autopilot state after an FMS reprogram or other distracting event (Distraction Complacency).
2. Pilots do not crosscheck the automation for the correct restrictions, route, or information (Crosscheck Complacency).
3. Pilots fail to monitor the automation to ensure it is behaving as expected or required (Monitoring Complacency).
4. Pilots are using the automation, or relying on automation flight guidance, instead of exercising manual pilot skills or abilities (Automation Over-Reliance Complacency).

A panel of industry and academic experts reviewed the PACPS to ensure proper content validity, along with its efficacy in measuring the automation complacency concept. All of the behavioral questions on the scale originated from frequently observed actual flight crew experiences as reported to the NASA ASRS system. Thus, the scale is indicative of the "real world" practices and scenarios experienced by pilots in the course of their daily duties. The survey included questions assessing the participants' self-assessment to their boredom level during the majority of their flights (state boredom) along with questions regarding boredom coping mechanisms. Additional questions queried individual automation practices and philosophies. Finally, the survey ended with a qualitative open-ended question asking about general attitudes toward the overall topic.

Data Analysis

The Pearson correlation coefficient was the primary statistical tool used to analyze the results, looking for significant associations at both the 0.01 and 0.05 alpha levels (2-tailed). This allowed for a comprehensive cross referencing of all the variables and enabled identification of significant correlations between multiple dimensions of both the BPS and the PACPS. A phenomenological study type analyzed the free comments section of the survey regarding automation coping strategies, boredom coping strategies, and general comments.

Limitations

One of the problems inherent in surveys of this nature is the reliance on self-assessment. To counter this, survey question construction emphasized reporting of the deliberateness of a particular action (How often do you *deliberately…*). Finally, the study used participants of only one particular major airline, all of whom graduated from the same training facility.

RESULTS

Of the 273 survey respondents, 87.8% were male. The majority (54.4%) fell between the ages of 41-50 years old, with the next highest group between the ages of 51-60 years old (28.2%). Examining flying operations found 64.3% flew narrow-body aircraft in domestic operations while 35.7% flew wide-body aircraft in the international realm. Finally, 54.5% had flown their respective airplane for greater than four years. The next highest group (22.3%) had flown their airplane between 2 to 4 years. The aircraft longevity groups of one to two years and less than one year comprised 9.9% and 13.4% of the sample respectively.

Table 1 summarizes the correlations between boredom proneness factors and automation complacency related factors. Of note are the correlations between internal stimulation and automation over-reliance, suggesting that pilots who are better able to find stimulation from internal sources are less likely to commit an automation complacency related behavior. Conversely, pilots who have an emotional reaction to boredom (as measured by the affective scale on the BPS) are more likely to commit an automation complacency related action. This data point suggests that the pilots who score higher on the affective scale of the BPS have not developed adequate coping mechanisms for their boredom, and subsequently react emotionally to their situation. Table 1 only displays significant correlations at the p=0.05 or less levels. Correlations displayed in bold are significant to the p=0.01 level.

Table 1: *Boredom Proneness Factors and Automation Complacency*

		Boredom Proneness Factors (from the BPS)					
		External	Internal	Affective	Time	Constraint	Total
Automation Complacency (from the PACPS)	Distraction			**.198**	.125		.120
	Crosscheck	.132		**.279**	**.219**	.140	**.187**
	Monitoring	.146		**.196**	.125		.127
	Automation Over Reliance	.137	**-.211**	**.175**	**.214**		
	Total	**.167**	-.138	**.291**	**.219**		**.181**

The Boredom Proneness Scale exhibited good validity with the self-assessment of state boredom in the survey (r=.499, p=0.01) and is consistent with other correlations of trait and state boredom (Farmer & Sundberg, 1986; Kass, Vodanovich, & Callender, 2001). The BPS dimension regarding internal stimulation correlated negatively (p=-0.190, p=0.01) with attention lapses suggesting pilots who can find stimulation from internal sources experience fewer self-reported attention lapses.

The self-assessment of state boredom when correlated to the BPS factors indicated several significant correlations and summarized in Table 2. The data suggests that, in an airline environment, pilots who have an emotional reaction to boredom (the Affective scale), problems conceptualizing time (the Time scale), or require external sources of stimulation (the External scale) are considerably more likely to experience boredom than those who can find internal sources of stimulation (the Internal scale). The BPS factor of constraint (individual reactions to waiting such as restlessness and patience) was not statistically significant. All correlations in Table 2 are significant to the p=0.01 level.

Table 2: *Boredom Proneness Factors and Self-assessed Boredom*

	Boredom Proneness Factors (from the Boredom Proneness Scale, or BPS)				
	External	Internal	Affective	Time	Constraint
Self-assessed Boredom	**.470**	**-.255**	**.489**	**.452**	

Finally, the data in Table 3 indicates pilots are much more likely to commit an automation complacency related action and have an attention lapse when they self-assess themselves as bored. Table 3 summarizes the results comparing complacency related actions and attention lapses to self-assessed boredom. When pilots become bored, as measured by the Self-Assessed Boredom metric, they are less likely to monitor the actions of the automation and are more likely to over-rely on the automation instead of exercising basic piloting skills (recall the definitions of the Complacency related factors, which are part of the PACPS created by the author and explained earlier). Moreover, pilots who self-report themselves as bored are more likely to experience an attention lapse. Again, Table 3 only displays significant correlations at the p=0.05 level. Correlations displayed in bold are significant to the p=0.01 level.

Table 3: *Complacency Related Factors and Self-Assessed Boredom*

	Complacency Related Factors (from the PACPS)					Attention Lapses
	Distraction	Crosscheck	Monitoring	Over-reliance	Total	
Self-Assessed Boredom	.140	**.190**	**.252**	**.251**	**.305**	**.293**

DISCUSSION

The data clearly associates both boredom proneness and self-assessed boredom to automation complacency actions and attention lapses. Boredom is becoming a significant factor in modern aviation. In the free comment section, one pilot wrote, “boredom is a huge problem which increases with the length of trip. by [sic] day 4 i [sic] am gone.” Another pilot observed, “After boredom on a long flight, it’s [sic] hard to ‘speed-up’ to the [sic] brain activity to fly conscientiously!” The increase in boredom is also associated with the increased level and emphasis on aircraft automation. Modern pilot to aircraft interface designs center the aircraft on the automation, meaning a pilot is required to input many of the operational instructions through the FMC. One pilot observed, “The automation is getting harder to turn off on newer airplanes – need to go heads down into the FMC just to tune a VOR for example.” Other comments paralleled this theme and added the concept of dissatisfaction (an element of boredom) echoing one of the criteria necessary for boredom (Mikulas & Vodanovich, 1993). A pilot described the effect of automation as “…force[ing] us to become system monitors more than pilots. I must force myself to be actively engaged. Huge decrease in job statisfaction [sic].” Both the quantitative and qualitative responses indicate boredom as an increasingly important issue in modern aviation.

Internal and External Stimulation

Examining some of the personality constructs identified in the Boredom Proneness Scale helps identify some of the underlying dimensions of boredom reported in the sample. Table 2 summarizes the correlations between self-assessed boredom and the BPS subscales. The external, affective, and time subscales of boredom proneness correlated positively to state boredom while the internal subscale correlated negatively. This finding suggests that pilots who are more adept at finding internal sources of stimulation are less likely to self-report themselves as bored. Table 1 also displays a statistically significant negative association between the need for internal stimulation and automation complacency, especially the complacency subscale of over reliance. Thus, pilots who are better adept at finding internal sources of stimulation are less bored, and engage in less complacency related behaviors. Of the survey respondents, 85.3% indicated they hand fly as much as possible, an action that offers intrinsic rewards and could satisfy the need for internal stimulation. These pilots may be more practiced at hand flying due to their need for the intrinsic satisfaction found in the action and thus less reliant on the automation. This could explain why pilots who scored higher on the internal dimension of boredom proneness committed less automation over-reliance complacency related actions. The survey question that queried participants on how they occupied their time revealed the vast majority, 85.3% and 64.5%, engaged in an internally stimulating behavior such as reading and logic puzzles respectively. Another pilot wrote how he or she admired the scenery at altitude, an intrinsically pleasing act, by writing, “When weather permits, I enjoy watching the world go by below. In doing so, I mentally keep tabs on where we are (big picture)…” Another wrote how he or she enjoys “observ[ing] night sky, landscape etc.” One pilot described the importance of internal stimulation through reading by writing, “If it were not possible to read during cruise my boredom level would be significantly higher.” All of these actions are intrinsically rewarding activities and constitute an internal source of stimulation.

By contrast, the pilots who indicated a greater need for external stimulation indicated a small but positive association with automation complacency behaviors (see Table 1) and self-assessed boredom (see Table 2). The increase in self-assessed state boredom is possibly due to the limited environment in a flight deck that is largely devoid of external stimulation sources. In some aircraft, the flight deck space is small, making movement difficult. Moreover, many airline policies forbid some externally stimulating activities, such as video entertainment, thus limiting those sources for the pilots who need them. Of all the survey respondents, 97.8% indicated that chatting with their fellow aviators in the flight deck (an external source of stimulation) was a means of preventing boredom. One pilot rather candidly wrote, “…for me, the boredom level is directly related to how interesting my F/O [first officer] is. I get more bored when I cannot engage anyone in conversation.” In a similar vein, another pilot wrote that he or she enjoyed “chat[ing] with [the] flight attendants” and yet another stipulated “…boredom is a very large part of my flying time, thank God for the other guy in the cockpit.” Since external sources of stimulation are limited in the flight-deck environment, pilots who are more adept at internal stimulation sources appear better able to cope with boredom, and are less likely to engage in a complacent behavior.

The key term is the word cope, since the pilots the sample generalizes all require individual ways to deal with the boredom on their flights. Each person has found an individual coping mechanism to deal with the boredom for their unique situation, whether they are flying short legs in domestic operations or extended legs in the international realm. According to the free comments in the completed surveys, these mechanisms can range from "…eat[ing] pistachios on red eyes…" to "study[ing] for law school." One particular pilot developed a game he or she could play with the other pilot using the navigation fix page in the airplane's FMC. In each case, the individual pilot has determined his or her own unique strategy to remove the emotional aspect of boredom found when there is inadequate stimulation.

Affective and Time Responses

The affective subscale of the BPS is described as an individual having a "…emotional reaction to boredom" (Vodanovich & Kass, 1990, p. 118; Vodanovich, 2003, p. 571; Wallace, Vodanovich, & Restino, 2003, p. 638). An individual with a high score on the BPS questions that relates to this subscale suggests that he or she has not developed an adequate boredom coping mechanism and is dealing irrationally with his or her boredom. Thus, a high score on the affective subscale in this survey might indicate a pilot has difficulty finding an optimum method to deal with his or her boredom and then reacts emotionally to boredom inducing situations.

A similar concept exists with the BPS subscale of time, defined in the literature as "…items related to the use of time" (Vodanovich & Kass, 1990, p. 118). As with the affective subscale, a high score on the questions related to time could indicate inadequate coping strategies. All of the questions on this subscale involve how a subject perceives the passage of time, and whether he or she has developed adequate mechanisms to relieve any potential boredom caused by this construct.

Table 2 displays the correlation between self-reported boredom and Boredom Proneness factors. Of the five boredom dimensions, subjects who scored high on the affective subscale reported high self-assessed, or state, boredom ($r=.489$, $p=0.01$). Contrast this with the statistically significant negative correlation between the internal dimension of the BPS and self-assessed boredom ($r=-.255$, $p=0.01$) symptomatic of pilots adept in finding internal stimulation reporting less state boredom. In the free comments section, a pilot described his or her emotional reaction to boredom in the following manner:

> I was much more attentive on the 737-200 than I have been on the Airbus. Despite my intent to not rely too heavily on automation, it is easy to do. I am so bored/unhappy at [redacted] that I just put in for a voluntary furlough. I was more attentive when I was happier in my job, which is part of my reason for leaving.

Interestingly, this individual pilot self-assessed his or her boredom level as "very bored most of the time," which is one level below the maximum self-assessment level. Only 9.2% of the pilots in the sample rated themselves in this category. Of all the survey respondents, only one person (0.4%) self assessed their boredom level at the maximum level.

This finding parallels the data listed in Table 3, which positively associates greater self-assessments of boredom with automation complacency related actions ($r=.305$, $p=0.01$) and attention lapses ($r=.293$, $p=0.01$). In summary, pilots who have a greater emotional reaction to boredom self-report higher states of boredom as described in Table 2. Finally, the pilots who self-report higher states of boredom are also associated with greater complacency related behaviors and attention lapses as demonstrated in Table 3. The data in Table 1 support this hypothesis. Isolating the affective subscale of the BPS finds a statistically significant positive correlation to automation complacency practices.

Attention Lapses

Isolating the BPS affective subscale with the self-reported frequency of attention lapses measure also indicates a statistically significant positive association ($r=.288$, $p=0.01$). This association is significant especially when compared to how the BPS internal subscale associates with attention lapses ($r=-.190$, $p=0.01$). As with the issue of complacency practices, this could indicate that pilots who respond emotionally to boredom or who have not developed coping mechanisms experience attention lapses or cognitive failures at an increased frequency. This finding also parallels the work by Wallace et al. (2003) who reported subjects who scored high on the affective and time subscales of the BPS positively correlated with a greater amount of cognitive failures during multiple tasks ($r=.52$ for affective, $r=.53$ for time, $p<0.001$). According to Parasuraman et al. (1993), the airplane environment is a multiple task environment particularly when monitoring and supervising the automation is involved.

Risk

The issue of risk may be a mitigating factor in automation complacency (Riley, 1996). This issue may help explain the relatively weak association between boredom proneness and automation complacency actions. Riley (1996) argued that previous research on vigilance, an important component in automation supervision, neglected the concept of risk due to the reliance on desktop simulators for their practical data. The qualitative portion of the survey strongly supports the concept of how perceived risk influences automation vigilance and supervision. When asked about what strategies pilots utilize to ensure proper automation behavior, the variations of the term “crosscheck” appeared 25 times in the free text. This suggests that despite any perceived reliability, consistency, or level of trust, many of the pilots in this survey are deliberately monitoring the automation to ensure proper operation. One pilot emphatically wrote that he or she, “Do[es] NOT trust the auto system so avoid surprises [sic] that it seems to produce.” Another wrote how after “…15000 PIC hours and 35 years…most mistakes have been witnessed or personally executed already.” These pilots appear to be aware of the consequences of an automation vigilance mistake, and are taking active steps to increase their monitoring during critical phases. As an example, one pilot wrote,

> Always confirm the Flight Mode Annunciations (FMA). Keep your eyes moving and ears listening. Do not lean back in your seat and think nothing bad can/will happen. Always think about what to do next before the automation actually does it.

The concept of risk is a critical bias when considering automation vigilance and monitoring issues and strongly supportive of the findings by Riley (1996).

The common thread with almost all of the free comments regarding this issue involves an acute awareness of the consequences of an automation mistake. Many of the comments written by pilots involve their individual strategy to prevent altitude violations. One individual pilot summed up the concept when he or she wrote how the “fear of FAA punushment [sic] causes more attention to detail.”

Finally, 55% of the pilots in the sample indicated they were more likely to experience an abnormal event, such as an unstabilized approach, when supervising the automation versus hand flying. This finding strengthens the argument regarding risk and automation complacency. Since the majority of respondents believe they are more likely to have an event of some sort while flying on automation, they may be more inclined to monitor the automation a little closer to avoid any abnormal happenings. One pilot wrote,

> I never trust the automation. My first ‘glass’ was the 737-300 where we were dual qualified with the -200 [737-200, a non-glass airplane]. We had no school or simulator so we learned by ‘trial and error.’ This resulted in a healthy distrust of the automation.

In a similar vein, a pilot described a flight that utilized a procedure new to crew. Since this was a new technique associated with considerable risk, the vigilance performance by the crew increased. They described the experience by writing,

> Just last week I flew a TA (tailored arrival) test into LAX. The automation reduced thrust to flight idle about 50 NM east of "FICKY" and remained in idle until the turn to final at LAX. Perhaps 12-15 mins of throttles in idle. Since this was a test program we were monitoring the flight VERY closely.

Another pilot described his or her level of trust in the automation by writing, "Treating the automation like a bad copilot and watching everything the airplane is doing while in 'transitional' mode." Finally, a pilot described an automation related incident he or she had as a young helicopter pilot in the Coast Guard that almost resulted in an accident with numerous fatalities. At the end of the comments the pilot concluded, "Since then, I trust nothing." Clearly, the amount of risk involved in an operation determines the vigilance performance in the population group the sample generalizes.

Similar to the individual techniques pilots utilize to cope with boredom, the pilots in this survey have developed individual strategies to cope with the automation. A pilot wrote how he or she, "hold[s] my ID in my hand for a cockpit 'reminder' of this that I need to do." However, this concept is not limited to just remembering tasks. Several pilots described how their individual method to solving the issue of automation over-reliance and boredom involves utilizing the automation in sub-optimum ways as a means of coping. For example, one pilot wrote, "Very rarely do I let VNAV [computer controlled vertical navigation] descend the plane. Will use Vertical speed or level change. Will reference VNAV TOD." Another wrote, "I prefer VSpd to VNav for descents, utilizing the green arc." Both of these pilots have found coping strategies that decrease the level of automation and increase the level of pilot involvement. Numerous comments reflect how pilots have developed other unique methods to ensure proper automation performance.

APPLICATIONS

The implications of this research could involve topics such as employee selection, training, and operational procedures and are not limited to the airline industry. The data suggests that individuals who are better able to find internal sources of stimulation are better at staving off boredom, commit less complacency related actions, and have fewer attention lapses. This may influence how organizations select individuals tasked with vigilance and monitoring duties especially over extended periods of low stimulation where boredom might become an issue. Individuals who are better able to generate internal stimulation may be better in environments that emphasize intrinsic rewards, and may perform better on vigilance and monitoring actions.

An organization's training syllabus could also reflect the findings in the data. Since the concept of risk directly affects vigilance, training courses could expose and emphasize high-risk scenarios to students along with potential consequences of improper automation related actions. One pilot wrote very candidly how:

> The fleet tries all sorts of ridiculous solutions with no success but refuses to accept that the problem [a Boeing 757 fuel configuration issue] is the over reliance to automation and the mindset it has produced in the pilots assigned to this fleet.

This individual described a perceived training shortcoming where the training department has not adequately emphasized the risks involved with a particular action through demonstrated practice.

Finally, operating procedures need to recognize the impact of boredom on vigilance and provide individuals with some latitude in finding sources of stimulation. One particular pilot summed up this issue by writing:

> Unlike what official FAA and airline policy dictates, I find it absolutely crucial to find non-aviation items to engage the mind. In over 30 years of flying I have yet to encounter a by-the-book pilot that

> focuses entirely on the flying that I considered safe. All it does is put you to sleep or to make [sic] you so bored that you miss the obvious.

This parallels the findings of Kishida (1977), who found that individuals would seek additional stimulation during monotonous tasks by engaging in “subsidiary behaviors.” These behaviors may have the effect of slightly reducing monitoring performance, but prove effective in reducing boredom. Therefore, policies that ban hand flying and activities such as non-essential reading could prove counterproductive. While these activities may slightly degrade monitoring performance, the benefits gained in reducing boredom and its associated problems outweigh the risks. Operational policies and training need to emphasize the risk involved with engaging in a “subsidiary behavior” at an inappropriate time, but should provide some latitude for individuals to utilize this as a coping mechanism when appropriate.

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Predicting Student Persistence: Pre-Entry Attributes that Lead to Success in a Collegiate Flight Program

Elizabeth Bjerke and Margaret Healy
University of North Dakota

ABSTRACT

The purpose of this study was to examine student pre-entry attributes to predict student persistence and academic success in a professional flight program. The data set constructed for this study was drawn from a sample of 390 full-time, first-time students enrolled at a University, with Commercial Aviation as their declared academic major at the time of entry. The data examined the students' academic progress for the first year to the second year of enrollment. Pre-existing data were gathered from each student's institutional record and financial aid record. Multiple regression analysis was used to calculate the degree to which pre-entry attributes predicted student persistence and academic success. The study found significant relationships between pre-entry attributes in determining student persistence and academic success. Pre-entry attributes accounted for 9.6% of the variance in persistence, and 32.3% of the variance in academic success.

INTRODUCTION

Given that more students depart from their initial institution of higher education, than graduate (Tinto, 1993), the study of student persistence has been popular in higher education literature for over a half of century (Pantages & Creedon, 1978; Metz, 2005). Despite the vast amount of research and attention placed on the issue of student persistence, still more than a quarter of the students who enter four-year institutions leave after their first year of study (Braxton, 2000). This perplexing phenomenon has become known as the "departure puzzle" (Braxton, 2000). When a student decides not to persist at a particular institution, not only is the individual student affected, but the university is also impacted by the loss. A thorough understanding of all factors related to student persistence is necessary for individual student success and institutional effectiveness.

In their synthesis of over three decades of higher education research, Pascarella and Terenzini (1991, 2005) noted that numerous theoretical frameworks (eg. Spady, 1970; Tinto, 1975; Bean, 1980) have been developed to help guide and focus inquiry in the study of student persistence and the departure puzzle. Acknowledging the growing acceptance of the importance of student retention, Tinto (1993) describes an explosion of research and policy reports that have been written in order to seek a better understanding of the forces that shape student persistence.

The benefits received by students who persist to graduation are numerous. According to the United States Census Bureau (2007), the average income across all disciplines for an individual who has at least a bachelor's degree is nearly twice as much as an individual who only has a high school diploma. Besides economic gains, Pascarella and Terenzini (2005) in their meta-analysis of more than three decades worth of research cite numerous studies which demonstrate cognitive and social ways in which students who attend college are benefited.

Some students attend college with very specific professional and career goals in mind that can only be attained by receiving the education and certification at a collegiate level. For example, a student who wishes to become a medical doctor would have to graduate from an accredited medical school and pass the national board exam for their specialty. Many other professional programs have similar requirements. Students who wish to become professional pilots and fly for a major airline, the subjects of this study, must meet certification requirements specified by the Federal Aviation Administration (FAA) as well as hold a four-year degree.

REVIEW OF LITERATURE

In an analysis of early literature and research on student persistence, Spady (1970) found that most studies were merely descriptive and lacked a theoretical framework that could be tested. Spady (1970) then developed one of the first theoretically based models of student persistence by applying Durkheim's (1951) theory of suicide and comparing it to the decision to withdraw from higher education. A student's decision to drop out of school is by no means as severe or permanent as one's decision to end their own life; however, Spady (1970) argued that this sociological theory proved a "fruitful vehicle for summarizing a large proportion of current research, and focusing future attention on the interaction between student attributes and the influences, expectations, and demands imposed by various sources in the university system" (p. 64).

To further elaborate on student departure, Tinto (1975) used Spady's (1970) model as a base and defined other variables consistent with the literature. Even in Tinto's (1975) early conceptual model of student departure he argues that the departure decision is a longitudinal process that must be analyzed in that manner. He further defined his model in a book where he incorporated social anthropology work of Van Gennep (1960), particularly his rites of passage (Tinto, 1993). By using aspects from both Durkheim's (1951) theory of suicide and Van Gennep's (1960) rites of passage, Tinto (1993) proposed a longitudinal model of institutional departure that consists of six sub-sections: pre-entry attributes, initial goals and commitments, institutional experiences, integration, goals and commitments after time, and departure outcome. These six sections run on a continuum of time, and are also influenced by the external community in which a student interacts. Figure 1 illustrates Tinto's (1993) model of student departure.

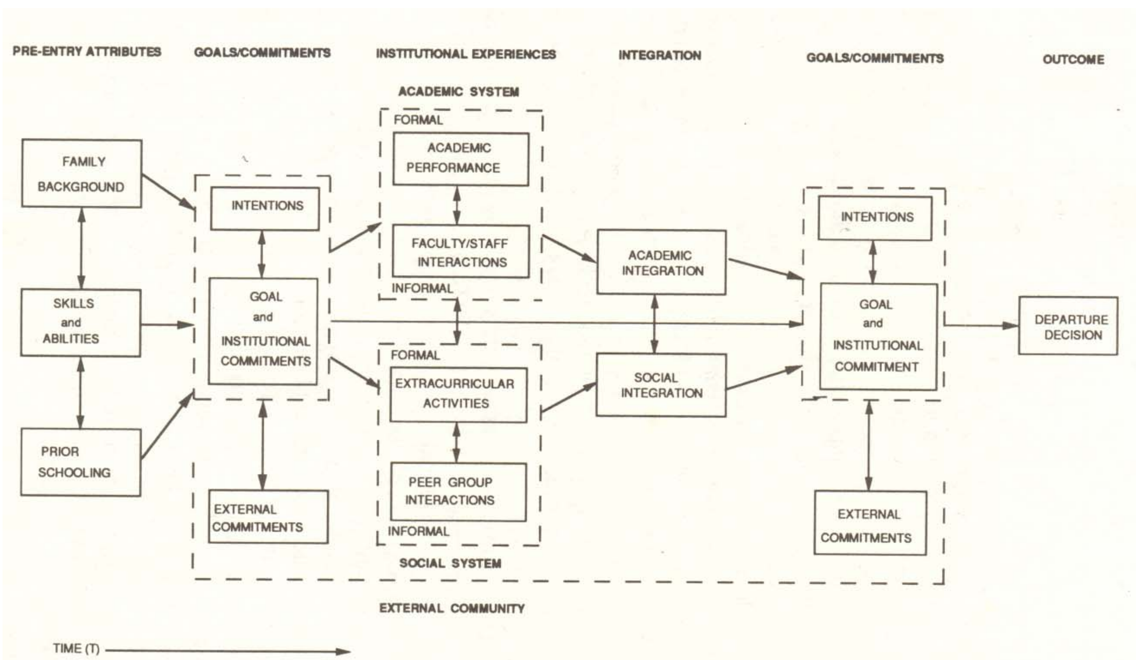

Figure 1. *A longitudinal model of institutional departure (Tinto, 1993)*

Less than half of the students who initially pursue higher education graduate from their first institution (Tinto, 1993). Given the increase in need for aviation flying professionals (Ott, 2006), and the apparent decline of interested student pilots (FAA, 2007), it is imperative that the students who initially indicate an interest in the field and have the requisite aptitudes successfully complete their degrees. Although few areas of study in higher education literature receive as much attention as student retention (Tinto, 1998), in regards to student persistence in aviation, little research exists that is focused on aviation education.

As a means to study aviation retention issues, Luedtke and Papazafiropoulos (1996) created a survey that was administered to current students, former students and alumni of one aviation program. Despite the three groups of subjects used, the sample size was relatively small, making generalizations to other programs very difficult from the results. A study conducted by Beckman and Barber (2007) attempted to analyze the factors that cause students to initially declare the professional flight major but change majors prior to completion. This research took on a unique approach in that it surveyed students just prior to graduation and asked them to reflect on when they changed majors and recount the reason for the switch. The data indicated the largest group of students did switch from professional flight to one of the other aviation majors. It was found that students stated the reason for the switch was one of three primary reasons: financial constraints, time constraints and future job prospects (Beckman & Barber, 2007). The authors posit that students initially choose the professional flight major because of the highly visible career track of a professional pilot, and that students discover more about the aviation industry while enrolled in aviation classes that causes them to change focus from flight to one of the other majors (Beckman & Barber, 2007).

This study focused on pre-entry attributes, the characteristics that a student brings with them to the institution prior to enrolling. It includes constructs such as family background, skills, abilities and prior schooling. The first set of goals and commitments is used to measure the student's intentions and dispositions prior to beginning their advanced education (Tinto, 1993). It attempts to quantify how committed the individual is to attaining their degree as well as their level of commitment to that specific institution in which they first enrolled.

Pre-entry attributes have been found to have a direct and indirect effect on student persistence and academic success (Elkins, Braxton, & James, 2000; Berger & Milem, 1999; Caison, 2007). The pre-entry characteristics most frequently cited in the persistence literature include gender, academic achievement as measured by high school rank and/or grade point average, and academic aptitude as measured by ACT and SAT scores.

Many researchers use gender as a variable when studying its effect on student persistence (Magio, White, Molstad, & Kher, 2005; Strauss & Volkwein, 2004; Braxton, Milem, & Sullivan, 2000). Gender is often found to have no significant relationship to student persistence (Herzog, 2005; Titus, 2004; Szafran, 2001; Murtaugh, Burns, & Schuster, 1999). However, gender may play an even more crucial role as a pre-entry attribute when analyzed within the context of student retention within a male dominated field of study such as aviation. In a multi-institutional study of engineering programs and persistence, gender was found to have significance in five of the eight institutions studied (Zhang, Anderson, Ohland, Carter, & Thorndyke, 2002).

There are two main ways in which researchers account for high school academic achievement: high school rank and high school grade point average. Researchers who utilize the class rank variable (Allen, 1999; Kahn & Nauta, 2001; Pascarella & Terenzini, 1980; Szafran, 2001) have found that it significantly correlates to student academic performance in college, thus it helps in predicting student persistence patterns. Murtaugh et al. (1999) found a decrease in attrition with increases in high school grade point average. Murtaugh et al. (1999) also state that there exists a "superior predictive value of high school GPA over SAT scores" (p. 369).

Many universities assess academic aptitude by using student scores on either the Scholastic Aptitude Test (SAT) or the American College Test (ACT) when granting admission into their institutions. This pre-entry variable has proven to help predict student success and persistence (St. John, Hu, Simmons & Musobo, 2001; Maggio et al., 2005; Caison, 2007). Depending on the predominant test that students present at an individual college or university, the researcher either convert ACT to SAT (Szafran, 2001; Braxton et al., 2000) or SAT to ACT scores (Leuwerke, Robbins, Sawyer & Hovland, 2004). Researchers have also broken down the composite ACT or SAT score and analyzed the effect of the math and verbal scores on student achievement and persistence. Leuwerke et al. (2004) found that engineering students with higher ACT math scores were more likely to stay in the program. Likewise, Zhang et al. (2002) found that higher verbal SAT scores were more likely to result in student departure from an engineering program. When analyzing major specific retention it is important to use all three aptitude scores in the process.

The purpose of this study was to examine student persistence in a professional flight program. Individuals seeking a career as a professional pilot with an air carrier are required to hold four-year degrees for most airlines, thus it is imperative that students who have the initial goal and commitment to pursue an academic major in flight are successful in completing the requirements. This research is focused on determining which pre-entry attributes can best be used to predict student persistence and academic success. The research questions are derived using a framework based on Tinto's (1993) interactionalist theory of student departure.

1. What is the relationship between a student's pre-entry attributes and persistence?
2. What is the relationship between a student's pre-entry attributes and academic success as measured in cumulative grade point average?

METHODOLOGY

Setting

This study was conducted with students enrolled in a public, four-year, research-intensive university. During the Fall of 2007, there were 12,559 students enrolled in one of the 193 fields of study offered at the university. These fields of study are divided into 10 main academic divisions and range from baccalaureate to doctoral degrees. The Department of Aviation currently offers four Bachelor of Science in Aeronautics degrees: Commercial Aviation, Air Traffic Control, Flight Education and Aviation Systems Management. The department also works closely with the College of Business to offer two Bachelors in Business Administration degrees: Aviation Management and Airport Management.

Commercial Aviation is the largest aviation major at the university and consistently accounts for over 60% of all aviation majors. This degree prepares students for careers as professional pilots in either an airline or corporate setting. The Commercial Aviation degree has been accredited by the Aviation Accreditation Board International since the accrediting body's inception in 1992.

Participants

Two cohorts of students comprise the sample for this study. Each cohort consists of first time, full time freshman enrolled as Commercial Aviation students. One cohort began in the Fall of 2006, the other in the Fall of 2007. The reason for utilizing two sets of incoming students was to ensure a large enough sample size.

Data Collection

The data used in this study were obtained from two existing data sets: institutional academic records and financial aid records. The Office of Institutional Research provided the pre-entry attributes and academic record information from university records. The study utilizes a quantitative approach to predict student persistence and academic achievement. The dependent variables in this study include student persistence in the spring and following fall semester, and academic achievement measured by the term grade point average.

Pre-entry attributes collected on each student included the following variables: gender; age; ethnicity; high school grade point average; ACT scores broken down by composite, math sub score and verbal sub score; region of high school attendance; adjusted gross income; parental level of education and admitted credit hours. These pre-entry characteristic variables are consistent with previous retention research. Table 1 presents the pre-entry variables used in this study.

Table 1. *Pre-entry Attribute Variable List*

Variable Name	Variable Description	Source
GENDER	Gender	Institutional Record
AGE	Age of student when enrolled	Institutional Record
ETHN	Ethnicity	Institutional Record
HSGPA	High School Grade Point Average	Institutional Record
ACTC	Composite ACT Score	Institutional Record
ACTM	Math ACT Score	Institutional Record
ACTV	Verbal ACT Score	Institutional Record
REGION	Region of High School	Institutional Record
INCOME	Adjusted Gross Income	Institutional Record
DADEDU	Father's Education Level	FAFSA
MOMEDU	Mother's Education Level	FAFSA
ADMCH	Admitted Credit Hours	FAFSA

Procedures

Once the dataset was complete it was imported into the Statistical Package for the Social Sciences (SPSS) version 16.0. The initial analysis of the data was purely descriptive. Frequencies were reported for each pre-entry attribute. Next, means and standard deviations for independent variables were computed. Since there were numerous variables used in this study, each research question was initially examined by looking at the correlations between the independent and dependent variables. A correlation is a single number that describes the degree of relationship between two variables (Trochim, 2005). The significance for this study was set at the .05 level.

Next, multiple regression analysis was used to answer the research questions. Multiple regression analysis is used to develop a statistical model for predicting the value of a dependent variable (persistence and academic success) based on numerous independent (pre-entry attributes) variables (Berenson, Levine, & Krehbiel, 2002). Initially, all independent variables were inserted into the regression analysis by using the enter method. This method enters in all independent variables regardless of significant contributions (Mertler & Vannatta, 2005). The second step entered the same set of variables using the stepwise forward method. The stepwise forward method enters independent variables one at a time into the model based on the magnitude of contribution to the overall prediction (Mertler & Vannatta, 2005). The process stops when the inclusion of another variable does not have a significant effect on the overall prediction. Due to the nature of the variables used in this study, it was decided to replace missing values with the mean.

FINDINGS

The sample for this study was two cohorts of entering first-time, full-time students to the university with Commercial Aviation as their declared major during the Fall of 2006 and the Fall of 2007. The reason for using two cohorts was not to run comparisons between the groups, but to get a larger more significant total sample size. The sample includes 390 students who met these criteria. Demographic information about this sample is presented in Table 2.

Table 2. *Demographic Information on Gender, Age, and Ethnicity (N=390)*

Characteristics	**N**	**%**
Gender		
Male	340	87.2
Female	50	12.8
Age		
18 and younger	322	82.6
19	62	15.9
20 and older	6	1.5
Ethnicity		
White	345	88.5
Hispanic	11	2.8
Asian, Pacific Islands	8	2.1
Non-resident, alien	5	1.3
American Indian	4	1.0
Black	2	0.5
Not Reported	15	3.8

Of the sample, there were 340 male students (87.2%), and 50 female students (12.8%). The age of the sample at the time of entry ranged from a low of 17 to a high of 29. The mean age for the sample was 18.7 with a standard deviation of 0.9. The majority (88.5%) of the sample were White, non-Hispanic with the remaining sample being represented by Hispanic (2.8%), Asian, Pacific Islands (2.1%) , non-resident alien (1.3%), American Indian (1.0%), Alaskan (1.0%), Black (0.5%), and not reported (3.8%). Due to the lack of variability in ethnic make-up, the sample was dichotomized to White and non-White for further analysis.

The frequencies in Table 3 depict the student's academic achievements in high school for the sample. The listing includes high school grade point average, ACT composite scores, ACT math scores, ACT verbal scores and how many college credit hours they had earned when admitted to the university. The high school grade point average is depicted on a 4.00 scale with the low of 2.27 to a high of 4.00 with 40 records (10.3%) missing this variable. The mean high school grade point average for the sample was 3.27 with a standard deviation of .44. The ACT composite score ranged from a low of 12 to a high of 33, the mean score was 23.53 with a standard deviation of 3.24. The ACT composite score was not available for 80 students (20.5%). The ACT math score had a range of 16 to 35 with the mean of 24.0 with a standard deviation of 3.74, while the ACT verbal score had a range of 10 to 35 with a mean of 22.2 and standard deviation of 4.40. Both the ACT math and verbal scores were missing from 100 (25.6%) of the records. The majority (56.7%) of the students were admitted without any prior college credits, however 99 students (25.4%) did have up to 10 credits at the time of enrollment, 40 students (10.2%) had between 11-20 credits at the time of enrollment, and 30 students (7.7%) had more than 20 credits at the time of enrollment.

Table 3. *High School Academic Information (N=390)*

Characteristics	**N**	**%**
High School Grade Point Average		
2.00-2.50	12	3.1
2.51-3.00	99	25.4
3.01-3.50	111	28.5
3.51-4.00	128	32.8
Missing	40	10.3
ACT Composite Score		
12-19	25	6.4
20-21	59	15.2
22-23	84	21.5
24-25	62	15.9
26-27	37	9.5
28-33	43	11.0
Missing	80	20.5
ACT Math Score		
16-19	35	9.0
20-21	45	11.6
22-23	50	12.8
24-25	68	17.4
26-27	43	11.0
28-33	49	12.6
Missing	100	25.6
ACT Verbal Score		
10-19	73	18.7
20-21	62	15.9
22-23	51	13.1
24-25	44	11.3
26-27	25	6.4
28-33	35	9.0
Missing	100	25.6
Admitted Credit Hours		
0	221	56.7
1-10	99	25.4
11-20	40	10.2

Family background characteristics are represented in Table 4. Family background characteristics include region of residence prior to college, both mother and father education levels and adjusted gross family income. The regions of residents are broken down according to the United States Census Bureau. The majority (55.4) of the students come from the Midwest. The second largest region represented by this sample is the West with 118 students (30.3%). The Northeast accounts for 24 students (6.2%), the South for 19 students (4.9%) and other accounts for 13 students (3.4%). Father's education level indicates that 193 (49.5%) had a college education, while 94 (24.1%) had a high school education and nine (2.3%) had an elementary school education. Mother's education level indicates that 208 (53.3%) had a college education, while 86 (22.1%) had a high school education. The missing records for father's and mother's education level were 94 (24.1%) and 96 (24.6%) respectively. The parental adjusted gross income ranged from a negative \$39,611 to \$767,182 with a mean of \$92,412 and a standard deviation of 82,123. The parental adjusted gross income data was missing from 83 (21.3%) records.

Table 4. *Family Background Information (N=390)*

Characteristics	N	%
Region of Residence		
Midwest	216	55.4
West	118	30.3
South	19	4.9
Northeast	24	6.2
Other	13	3.4
Father's Education Level		
Elementary School	9	2.3
High School	94	24.1
College	193	49.5
Missing	94	24.1
Mother's Education Level		
Elementary School	0	0
High School	86	22.1
College	208	53.3
Missing	96	24.6
Parental Adjusted Gross Income		
<30,000	40	10.3
30,000-60,000	63	16.2
60,001-90,000	80	20.5
90,001-120,000	57	14.6
>120,000	67	17.2
Missing	83	21.9

As seen in Table 5, the retention rate after the first semester was 91.8%, indicating that 358 of the 390 students remained enrolled at the university for the Spring semester. The retention rate between the first and second year of enrollment dropped to 82.6%, indicating that 322 of the 390 students remained enrolled at the university after the first year. The overall retention rates between first and second year students for the university the 2006 and 2007 cohorts of first-time, full-time students was 75% and 78% respectively. Of the 390 students who initially enrolled as a flight major, 67.4% or 263 students remained as a flight major after the first year of enrollment. Of the remaining students, 20 (5.1%) switched to the Air Traffic Control major, 6 (1.5%) switched to airport management, 33 (8.5%) remained enrolled at the initial university but switched out of the department of aviation, and 68 (17.4%) left the university all together.

Table 5. *Persistence Patterns (N=390)*

Characteristics	N	%
Retention after the first semester		
Yes	358	91.8
No	32	8.2
Retention after the first year		
Yes	322	82.6
No	68	17.4
Declared major after first year		
Flight	263	67.4
Air Traffic Control	20	5.1
Airport Management	6	1.5
Other (UND)	33	8.5
Left UND	68	17.4

What is the relationship between a student's pre-entry attributes and persistence? Two dependent variables were assessed: enrollment at the initial institution during the second fall semester, and declared major (flight or non-flight) at the beginning of the second fall semester. Since this research question assesses the relationship between numerous pre-entry variables to a single dependent variable, multiple regression analysis was utilized as the primary statistical test.

The full model analysis determined that there was a relationship between pre-entry attributes and student persistence between the first and second year. As seen in Table 6, these independent pre-entry attributes accounted for 9.6% (R=.310, R^2=.096, F=1.705, *df*=11, 176, *p*=.076) of the variance in institutional persistence after the first year. High school grade point average had the most significant relationship with student persistence after the first year.

Table 6. *Beta Weights, t Values, Significance of t, Correlation Coefficients and Significance of the Pre-entry Independent Factors with Second Fall Semester Enrollment for the Total Sample*

Factor	**Beta**	**t**	**Sig. of t**	**Corr.**	**Sig.**
Gender	-.008	-.102	.919	-.083	.128
Age	.065	.866	.388	.035	.318
High School GPA	.297	3.433	.001	.243	<.001*
ACT Composite	-.035	-.193	.847	.005	.475
ACT Math	-.032	-.278	.781	.038	.303
ACT Verbal	-.097	-.675	.501	-.003	.486
Ethnicity	-.054	-.738	.461	-.026	.360
Admitted Credit Hours	.062	.782	.435	.107	.072
Father's Education Level	.107	1.390	.166	.102	.083
Mother's Education Level	.007	.086	.931	.023	.376
Adjusted Family Gross Income	.075	1.009	.314	.042	.281
Full Model $R^2 = .096$					

*$p<.05$

Since this study is focusing on student enrollment in a professional flying degree, the same pre-entry attributes were studied in regards to maintaining the declared flight major between the first and second year of enrollment. The same regression analysis was conducted replacing enrollment in the second fall semester, with declared major (flight or non-flight) for the second fall semester. Table 7 lists the *Beta* weights for each factor, the *t* values for the *Beta* weights, the significance of the *t* values, the correlation coefficients of the independent variable with the dependent variable of declared major following the first year, and the significance of the correlation.

The full model analysis determined that there were no significant relationships between pre-entry attributes and declared major between the first and second year. These independent pre-entry attributes accounted for 7.4% (R=.272, R^2=.074, F=1.281, *df*=11, 176, *p*=.238) of the variance in declared major after the first year. Since no significance was found, no further analysis was completed between these two areas.

Table 7. *Beta Weights, t Values, Significance of t, Correlation Coefficients and Significance of the Pre-entry Independent Factors with Declared Major Second Fall Semester Enrollment for the Total Sample*

Factor	Beta	t	Sig. of t	Corr.	Sig.
Gender	-.024	-.299	.765	-.040	.292
Age	.052	.686	.494	.051	.245
High School GPA	.200	2.287	.023	.108	.070
ACT Composite	.047	.258	.797	-.089	.114
ACT Math	-.080	-.681	.497	-.050	.249
ACT Verbal	-.299	-1.582	.116	-.112	.063
Ethnicity	-.077	-1.042	.299	-.061	.204
Admitted Credit Hours	.044	.552	.582	.028	.353
Father's Education Level	.059	.763	.446	.065	.188
Mother's Education Level	.062	.779	.437	.045	.268
Adjusted Family Gross Income	.126	1.677	.095	.086	.120
Full Model $R^2 = .074$					

*$p<.05$

The first research question explored the relationship between pre-entry attributes and student persistence. Student persistence was defined as either enrollment at the university after the first year, as well as declared major (flight or non-flight) after the first year. The only significance was found between high school grade point average and enrollment after the first year.

What is the relationship between a student's pre-entry attributes and academic success as measured in grade point average? Since this research question is assessing the relationship between numerous pre-entry variables to a single dependent variable, multiple regression analysis was utilized as the primary statistical test. Fall grade point average was used as the dependent variable in regards to academic success.

The first analysis was conducted by placing all of the pre-entry factors into a full model regression simultaneously to determine the *Beta* weights for each factor, the *t* values for the *Beta* weights, the significance of the *t* values, the correlation coefficients of the independent variable with the dependent variable of Fall grade point average following the first year, and the significance of the correlation. Table 8 shows the results.

Table 8. *Beta Weights, t Values, Significance of t, Correlation Coefficients and Significance of the Pre-entry Independent Factors with Fall Semester Grade Point Average for the Total Sample*

Factor	**Beta**	**t**	**Sig. of t**	**Corr.**	**Sig.**
Gender	.114	1.670	.097	-.057	.217
Age	.148	2.273	.024	.091	.107
High School GPA	.545	7.275	<.001	.467	<.001*
ACT Composite	-.231	-1.490	.138	.112	.063
ACT Math	.047	.465	.643	.155	.017*
ACT Verbal	.067	.544	.587	.129	.039*
Ethnicity	-.025	-.400	.690	.023	.377
Admitted Credit Hours	.078	1.147	.253	.185	.005*
Father's Education Level	.134	2.026	.044	.172	.009*
Mother's Education Level	.136	2.009	.046	.182	.006*
Adjusted Family Gross Income	.117	1.821	.070	.082	.131
Full Model R^2 = .323					

*p<.05

The full model analysis determined that there was a relationship between pre-entry attributes and student academic success. These independent pre-entry attributes accounted for 32.3% (R=.568, R^2=.323, F=7.624, *df*=11, 176, *p*<.001) of the variance in academic success after the first semester. High school grade point average had the most significant relationship to fall semester grade point average.

In utilizing the stepwise forward regression (see Table 9), high school grade point average was found to have a significant impact on the variance out of all the pre-entry attributes being studied. This was followed by the mother's education level, age at entry and father's education level. These four variables accounted for 28.6% of the variance (*F*=18.366, *df*=4, 183, *p*=.000).

Table 9. *R^2 Change Results Based on Stepwise Forward Regression for the Pre-entry Independent Factors on Fall Semester Grade Point Average for the Total Sample*

Factor	**R**	**R^2**	**R^2 Chg.**	**Sig. Chg.**
High School GPA	.467	.218	.218	.000
Mother's Education Level	.499	.249	.031	.006
Age at Entry	.520	.271	.022	.020
Father's Education Level	.535	.286	.016	.046

Factors not in equation: Gender, ACT Composite, ACT Math, ACT Verbal, Ethnicity, Admitted Credit Hours, Adjusted Family Gross Income

DISCUSSION AND CONCLUSION

The only pre-entry attribute that had a significant relationship in predicting student enrollment after the first year was high school grade point average. It was determined that high school grade point average accounted for 5.9% of the variance in the stepwise forward regression model.

Persistence was also measured in relation to retaining students in the professional flight major. There were no significant findings in regards to pre-entry attributes and declared major (flight or non-flight) after the first year. This indicates that when persistence is studied from a program standpoint versus an institutional approach the pre-entry variables do little in predicting student persistence. These findings would suggest that admission policies and program specific policies should more greatly favor a student's high school grade point average, over standardized test scores. It seems that high school academic achievement is a better measure of a student's overall college academic performance and motivation than the test scores.

The lack of statistically significant pre-entry attribute variables that can assist in predicting student persistence in this sample of students may be another area of further research. Since this sample population consisted of students who entered into the university with the same initial major (professional flight) declared, a major that has a high cost associated with completing the degree requirements, perhaps students with similar backgrounds self-selected into this program. That would explain the lack of significance in the pre-entry attributes in their ability to predict persistence patterns both for remaining enrolled in the university as well as in the specific flight major. Further research should examine student pre-entry attributes for other specific majors in order to more fully understand student persistence patterns and the differences that may exist between academic majors.

There was a relationship with numerous significant variables to predict student academic achievement based on the pre-entry attributes. The significant variables relating to Fall semester academic achievement included high school grade point average, mother's education level, age at entry and father's education level. These variables accounted for 28.6% of the variance in the stepwise forward regression model.

These results indicate that a student's background, both in the sense of high school academic achievement as well as parental education level, influences how well a student will perform during their first year of college academically. Parental education levels and incomes are variables typically included as a measure in socio-economic status. Since this sample consists of students with only one declared major, further analysis and research should be conducted that would compare the parental education levels for various groups of students with similarly declared majors to see patterns and similarities exist. Since the major analyzed in this study is a high cost degree, one may expect the parental education attainment to be higher in order to afford the more costly program.

It is important to note that more pre-entry variables were significant in predicting academic success than were found significant in predicting student persistence. This is just further evidence that the student persistence puzzle is more complex, and less fully understood. By empirically testing and analyzing the various components of Tinto's (1993) theory of student departure, one by one the pieces of this complex puzzle can be put into place. Through enough research and discussion about student persistence taking place in universities and specifically in aviation programs, the student persistence puzzle will take shape. Through implementing new ideas and initiatives more students will successfully persist in their aviation studies and graduate.

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The Impact of Transition Training on Adapting to Technically Advanced Aircraft at Regional Airlines: Perceptions of Pilots in Training and Instructor Pilots

John C. Di Renzo Jr.
Joint Interagency Task Force-South, US Southern Command

Timm J. Bliss
Oklahoma State University

ABSTRACT

The purpose of this research study was to test a hypothesis regarding newly trained regional airline pilot and instructor pilot (IP) perceptions of how effectively pilots learn and use new technology found in technically advanced aircraft (TAA), given initial type of instrumentation training. The research questions focused on the type of initial instrumentation training to determine the differences among pilots trained using various types of instrumentation ranging from aircraft equipped with traditional analog instrumentation to aircraft equipped with glass cockpits. This investigative study failed to disprove the null hypothesis (H_0): *The type of instrumentation training (during initial training) has no significant effect on newly trained regional airline pilots' perceived ability to adapt to advanced technology cockpits in more sophisticated and/or newer aircraft*. Therefore, no evidence exists from this study to support the early introduction and training of TAA. While the results of this investigation were surprising, they are nonetheless instructive. Even though it would seem that there would be a relationship between exposure to and use of technically advanced instrumentation, apparently there was no perceived relationship for this group of newly trained airline transport pilots. However, the results of this investigative study raise many new questions and provide a number of ideas for future research projects.

INTRODUCTION

Attempts to instrument aircraft for communications, navigation, and for flight without reference to the natural horizon began in earnest in the 1920's (Bilstein, 2001). Since that time, great advances have been made in aviation related technologies. Where once a lack of aircraft systems was the limiting factor for flight into instrument meteorological conditions (IMC), now advanced aviation technologies found in technically advanced aircraft (TAA) present a significant challenge to pilots and crews trying to assimilate and effectively use ever increasing amounts of information.

The debate about how to best train future airline transport pilots abounds and new concepts regarding the role of active learning in scenario-based exercises are beginning to supplant more traditional approaches to flight training (FAA Education and Research, 2006). These new aviation technologies are pervasive and can be found in most aircraft, ranging from large commercial aircraft to small general aviation aircraft commonly used for initial flight training. Furthermore, the pace of technological advancement is increasing and will continue to present significant challenges for the aviation community (FAA Education and Research, 2006).

Given the proliferation of TAA, pilot training has become a point of critical interest. How should new pilots be trained and what is the effectiveness of that training as they move from the flight school to airline cockpits? Additionally, what is the role of traditional analog instrumentation training verses digital instrumentation training? Is training on analog instrumentation, digital instrumentation or a combination of both best for transition to TAA? Do pilots trained exclusively on traditional instruments experience more difficulty transitioning to TAA as compared to those pilots trained on a combination of analog and digital instrumentation, or as compared to those pilots exclusively trained on digital instrumentation?

The problem addressed in this study is to identify newly trained regional airline pilot and instructor pilot (IP) perceptions of their ability to learn and use advanced aviation technology. These systems are complex and a pilot must possess a significant degree of familiarity with automated systems. Much needs to be known about how current training of new pilots/crews prepares them to adapt to technically advanced cockpits in more sophisticated commercial aircraft. The following hypothesis was established for this research study:

$H_{0:}$ The type of instrumentation training (during initial training) has no significant effect on newly trained regional airline pilot's perceived ability to adapt to advanced technology cockpits in more sophisticated and/or newer aircraft.
$H_{1:}$ The type of instrumentation training (during initial training) has a significant effect on newly trained regional airline pilot's perceived ability to adapt to advanced technology cockpits in more sophisticated and/or newer aircraft.

METHODOLOGY

This study used a mixed method design to allow the researcher to make an interpretation whether the results from both sets of data (quantitative and qualitative) support or contradict each other. The quantitative component used a non-probability sample of pilots in training (PT) to gather data about student pilot perceptions regarding transition to technically advanced cockpits. The qualitative component used an open-ended opinion survey administered to the regional airline instructor pilots (IP) to determine their perceptions regarding the ability of newly trained regional airline pilots to learn and use advanced cockpit technology.

The quantitative component used an analysis of variance (ANOVA) statistical analysis design to compare the means of the independent groups (Fraenkel & Wallen, 2003). The Shapiro-Wilk test was used to test for normality*;* to ensure the respondent sample came from a normally distributed population (Shapiro & Wilk, 1965). The Levene test was used to determine homogeneity of variance. Additionally, the Levene test checked the assumption of the null hypothesis. That is, that the population variances were equal and no significant differences existed between the research groups (Levene, 1960).

This research study required newly trained regional airline pilots to make a self-assessment of ease of transition into TAA after completing advanced systems training with Pinnacle Airlines. Pilots were administered a questionnaire focusing on level of experience, initial training type and method, and overall level of perceived proficiency/ability at the completion of training. *Type*; therefore, indicated if PT received initial flight training on analog instrumentation, digital instrumentation or a combination of both. *Method* of training addressed whether pilots received traditional maneuver based training to the FAA Practical Test Standard (PTS), commonly referred to as "Stick and Rudder" training, or whether they received scenario based FAA Industry Training Standards (FITS) training. Note that either maneuver based training or scenarios based training may be conducted in either analog instrumented aircraft or digitally instrumented aircraft. PT were also asked about their perceived level of comfort flying TAA under varying circumstances - such as hand flying the aircraft to minimums in IMC or when piloting in an emergency situation. This investigation also sought to compare actual airline training data from the pilots in training to the initial training they received. However, access to proprietary training data was not available.

The study sought to answer the following four research questions:

1. What is the perceived ability of newly trained regional airline pilots initially trained on only analog systems to adapt to more advanced cockpit technologies?
2. What is the perceived ability of newly trained regional airline pilots initially trained on only digital systems to adapt to more advanced cockpit technologies?
3. What is the perceived ability of newly trained regional airline pilots initially trained on both analog and digital systems to adapt to more advanced cockpit technologies?
4. What are IP perceptions/observations of newly trained regional airline pilots' ability to adapt to TAA, as compared to the perceptions of the PT?

Description of Research Instruments

The first research instrument used in this study was a structured questionnaire created to ascertain PT attitudes regarding TAA training provided by Pinnacle Airlines. The questionnaire consisted of ten multiple-choice questions and 22 Likert scale questions. The multiple-choice questions were generated to collect demographic information and to determine the newly trained pilot's level of experience and comfort with TAA. Likert scale questions were used to determine pilot attitudes/perceptions about how initial training and proficiency with analog and/or digital systems affects ability to transition to advanced cockpits. For each Likert scale question, a score of five indicated strongly agree, four agree, three neutral, two disagree and one strongly disagree.

The study also incorporated a qualitative component to assess IP perceptions and opinions about how the pilots in training adapted to TAA training. A separate questionnaire of five open-ended questions was presented to the IP to compare their perceptions with those of the newly trained pilots. They were asked their opinions/observations across a number of subjects including, but not limited to:

- Benefits of scenario-based training (i.e. method of training)
- Maintenance of basic flying skills in a highly automated cockpit environment
- Benefits of the type of initial flight training received by pilots in training (i.e. analog only, digital only, or a combination of analog and digital training)
- Comfort level of PT flying TAA after completing training

To insure the highest level of quality, the research instruments were validated by testing with a small group of professional pilots and aviation industry professionals. There were changes made to the PT questionnaire because it was considered too lengthy and concerns were expressed that respondents would not fully complete the survey. There were no changes to the IP instrument.

Selection of the Research Participants

The PT sample was selected from pilots receiving initial training in technically advanced regional airline aircraft in 2008 at Pinnacle Airlines in Memphis, Tennessee. The PT sample included 46 male pilots and two female pilots. These 48 participants were categorized into three distinct groups: (Group One) pilots receiving *analog only* initial and instrument flight training using computer-based training (CBT), flight training devices (FTD), full motion simulators, and/or actual aircraft; (Group Two) pilots receiving both *analog and digital* initial and instrument flight training using CBT, FTD, full motion simulators, and/or actual aircraft; and (Group Three) pilots receiving *digital only* initial and instrument flight training using TAA cockpit CBT, FTD, full motion simulators, and/or actual TAA. After gathering and analyzing the research questionnaires, there was only one respondent in the digital only group. Consequently, this group was eliminated by the researcher from the statistical analysis section of the study.

Each class of Pinnacle students was trained for approximately six weeks at Pinnacle Airlines' primary training facility in Memphis, Tennessee. Pilots learned to fly the CRJ-200 TAA to FAA FAR Part 121 standards. The training included technology training on systems such as: Flight Management Systems (FMS), Electronic Flight Instrumentation Systems (EFIS), Engine Indication and Crew Alerting Systems (EICAS), Aircraft Systems and Operation, Crew Resource Management (CRM) and Emergency Procedures, Swept Wing Aerodynamics and Aircraft Performance, and the Pinnacle Airlines' Flight Operations Manual (FOM).

For purposes of this study, *analog only* training was conducted on traditional steam gauge instruments using the pitot static system and suction pump or electrically driven gyroscopic instrumentation. In addition, *digital* instrumentation training was conducted on CBT devices, FTDs and/or simulators that represented airspeed indicators, attitude indicators, altimeters, heading indicators, turn and bank coordinators and vertical speed indicators, and other instrumentation where these instruments were displayed on computer screens and powered by the electrical system (i.e. glass cockpit).

The second sample included four IP who provided training at Pinnacle Airlines during the time this study was conducted by the researcher.

RESULTS

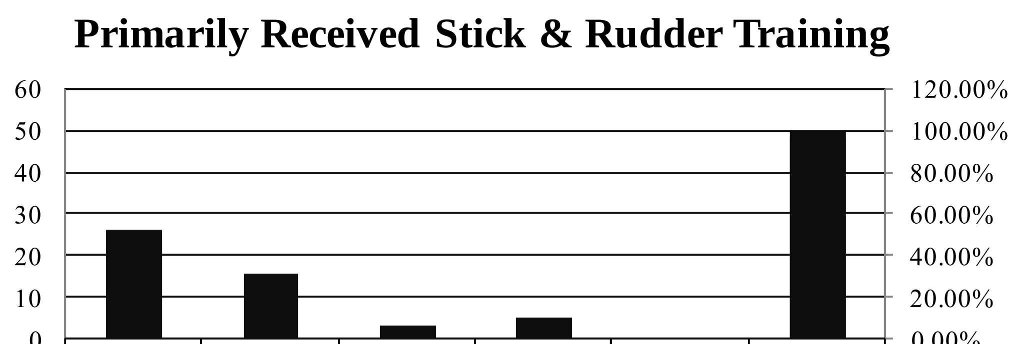
The quantitative component of this study administered a closed-ended survey to 48 pilots in training, 46 (96%) males and two (4%) females. The majority of respondents (71%) was between the ages of 22-30 years of age, had been flying between 5-10 years (42%), and had logged more than 2,501 flight hours (42%). Fifty percent of the responding pilots in training learned to fly at FAA FAR Part 141 pilot schools and the majority of pilots (69%) had not been recently hired as a regional airline pilot.

In addition, the respondents were asked to provide information regarding their flying experience. The majority of respondents (73%) indicated that they learned to fly on analog only instruments. Approximately one-third (35%) of the pilots in training received no digital training/TAA training during their initial instruction. Again, about one-third (35%) of the pilots had one - two years of glass cockpit experience. Lastly, 44 percent of responding pilots in training had logged between 50-100 hours of IMC time.

The Likert scale statement that examined the primary maneuver based (stick and rudder) training received by the pilots in training is presented in Table 1. The majority of participating pilots (83%) reported that they had primarily received maneuver based (stick and rudder) training. Only five pilots

(10%) did not receive maneuver based (stick and rudder) training as their primary training method.

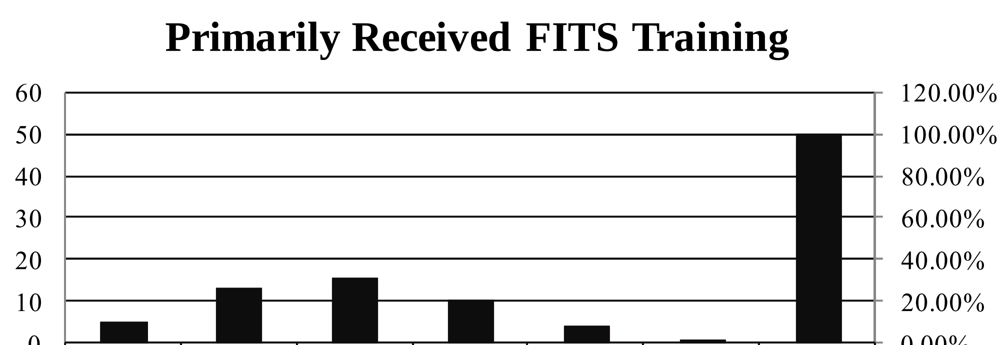
Table 1. *Primarily Received Stick & Rudder Training*



	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Freq	25	15	3	5	0	48
Percent	52.08%	31.25%	6.25%	10.42%	0.00%	100.00%

Eighteen pilots (38%) reported that they had primarily received scenario based FITS training as indicated in Table 2. Fourteen pilots (29%) did not receive scenario based FITS as a primary training method. There were fifteen pilots (31%) that provided a neutral response to this question. Pilots cannot *primarily* receive both maneuver based (stick and rudder) training and *primarily* receive scenario based FITS training. While a pre-test of the questionnaire was conducted with professional pilots, the responses to this question may indicate that some pilots in training did not understand the question, or that some did not fully understand scenario based FITS training.

Table 2. *Primarily Received FITS Training*

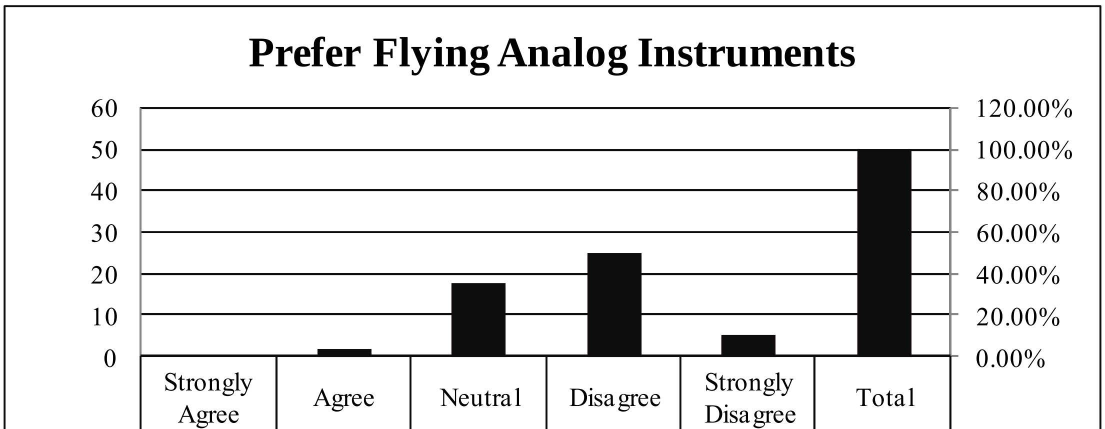


	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Did not answer	Total
Freq	5	13	15	10	4	1	48
Percent	10.42%	27.08%	31.25%	20.83%	8.33%	2.08%	100.00%

Seventeen pilots (35%) responding to this study reported that their initial flight training had prepared them for flying TAA. An equal number of pilots disagreed their initial flight training prepared them for TAA. The remaining pilots (29%) provided a neutral response to this question. Interestingly, despite the fact that no statistical significance was found between the research groups, pilots in this study seemed to be split about whether or not their training prepared them to fly TAA - regardless of type of training.

As shown in Table 3, only two pilots (4%) agreed they still prefer to fly analog instruments after completing transition training. The majority of pilots (62%) stated they did not prefer to fly analog instruments after completing transition training. Surprisingly, seventeen pilots (35%) provided a neutral response to this question.

Table 3. *Prefer Flying Analog Instruments*

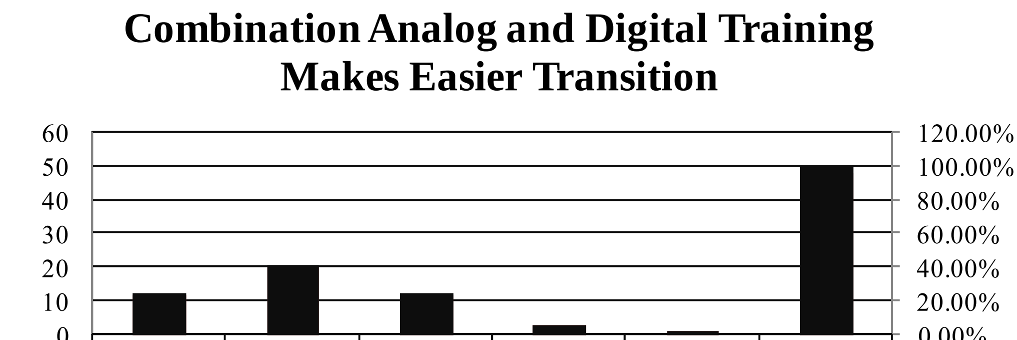


	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Freq	0	2	17	24	5	48
Percent	0.00%	4.17%	35.42%	50.00%	10.42%	100.00%

Table 4 indicates that the majority of pilots (67%) agreed that a combination of analog and digital training made it easier to transition to technically advanced cockpits. Only four pilots (8%) disagreed that a combination of analog and digital training made it easier to transition to technically advanced cockpits.

Regarding another question, seven pilots (14%) agreed that there is no significant difference between analog and digital training when transitioning to technically advanced cockpits. However, the majority of responding pilots (58%) disagreed that there is no significant difference between analog and digital training when transitioning to advanced technology cockpits.

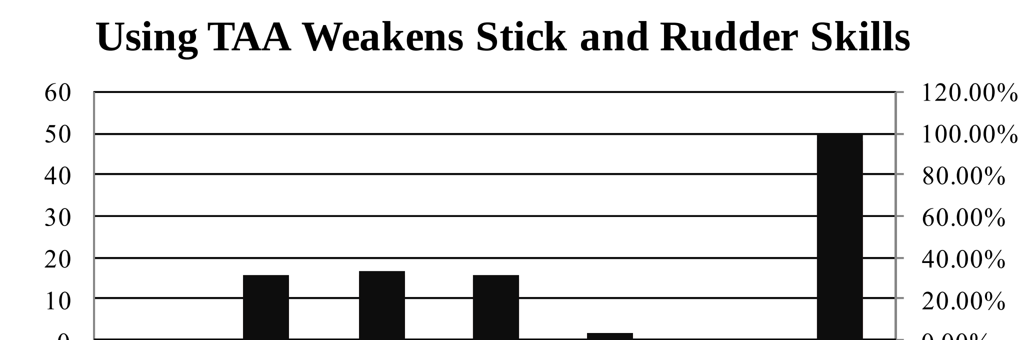
Table 4. *Combination Analog and Digital Training Makes Easier Transition*



	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Freq	12	20	12	3	1	48
Percent	25.00%	41.67%	25.00%	6.25%	2.08%	100.00%

Forty-one pilots (85%) agreed that using advanced technology made a safer pilot. Only one pilot (2%) disagreed that using advanced technology made a safer pilot. In a follow-up question (Table 5), fifteen pilots (31%) agreed that using advanced technology weakens basic piloting (stick and rudder) skills. However, seventeen of the pilots (35%) disagreed that using advanced technology weakens basic piloting (stick and rudder) skills. Once again the results for this question are particularly interesting. The pilots surveyed are nearly evenly split on this question.

Table 5. *Using TAA Weakens Stick and Rudder Skills*



	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Did not answer	Total
Freq	0	15	16	15	2	0	48
Percent	0.00%	31.25%	33.33%	31.25%	4.17%	0.00%	100.00%

To examine the difference on the 22 Likert scale questions across the two remaining pilot groups (analog vs. analog/digital), an analysis of variance (ANOVA) was conducted. This analysis determined that the model was not significant, Wilkes' $\lambda = 0.25$, F (44, 40) = 0.90, $p = 0.63$, Partial η^2 (effect size) = 0.50, Power = 0.67, indicating that no significant difference exists on the 22 Likert scale questions by the analog vs. analog/digital groups. A low Wilkes score of 0.25 indicates a departure from a normal distribution for this population and constitutes a violation of one of three assumptions necessary for an ANOVA. As is the case with most of the individual *F* scores, the grand mean *F* score (0.90) is low and is not significant. The p score of .063 is larger than .05 which was set as the alpha. Therefore, there is greater than a .05 or 5% chance that an error will occur and cause a Type I error (i.e. rejecting the null hypothesis when it is actually true). Effect size was .50 and is a measure of the quality of the strength of the difference between the two variables and is used to determine whether the difference between the groups is meaningful in a practical sense. An effect size of .50 is considered medium. The greater the effect size, the more meaningful is the statistical difference identified by the *F* score. Since most of the *F* scores were not statistically significant, the effect size is irrelevant. Lastly, the Power was 0.67. Power was set at .80 for this investigation. Setting the power at .80 means there is a 20% chance of committing a Type II error. A Type II error occurs when the researcher rejects the alternative hypothesis (i.e. fails to reject the null hypothesis) when the alternative hypothesis is actually true. The higher the power, the less likely a Type II error will occur. A power of 0.67 means there is a 33% chance of committing a Type II error. Since most of the *F* scores were not statistically significant, the power is irrelevant as well.

The qualitative component was administered using an open-ended opinion survey of IP to determine their opinions regarding the ability of a newly trained regional airline pilot's ability to learn and use advanced technology. Five specific questions were presented to the IP. These questions and the responses from the IP are stated:

1. *Do you believe that scenario-based training improves the ability of a pilot/crew to master TAA? Why or why not?*

- IP 1: No. I believe that basic aviation skills should be achieved first. A student should be able to fly aircraft in all modes (auto, semi auto and manual) before attempting scenario based training. Until the student feels comfortable with all Glass Cockpit and scenario training.
- IP 2: I believe scenario based training improves pilots' abilities . . . period. I don't think it makes you any better for an antique DC-9 or a CRJ.
- IP 3: Yes it does improve crew's ability in advanced aircraft in that there is a relationship to realistic type flying one can expect.
- IP 4: Yes, a scenario based training event encourages the student to consider and deal with multiple variables occurring in real time as opposed to a single profile/emergency etc. . . . It is especially valuable for upgrade candidates.

The majority of the IP (75%) believed that scenario based training does improve the PT ability to master TAA. One IP (25%), however, thought that pilots must first master maneuver based (stick and rudder skills) training before attempting scenario based training in TAA.

2. *What is your opinion regarding the impact of TAA on the ability of pilots/crews to maintain stick and rudder skills?*

- IP 1: Because the pilots rely so much on and use the automation, basic aviation skills suffer. Additional periodic simulator refreshers would help overcome this.
- IP 2: Flying a glass cockpit aircraft diminishes the stick and rudder skills of that used for general

aviation.

- IP 3: Advanced aircraft such as a CL-65, a pilot becomes a manager of automation and computers. It takes away stick and rudder skills unless the pilot flies aircraft without the auto-pilot.
- IP 4: Students have a tendency to rely on automation too much and often, after a problem, they attempt to change automation settings when they should just fly.

All of the IP (100%) agreed that the use of TAA and automation creates new challenges with regards to maintaining basic stick and rudder skills. Most believed that pilots who fly TAA will require additional simulator training and/or must periodically "hand fly" the airplane to maintain basic maneuver (stick and rudder) skills.

3. *Do you believe that the type of initial flight training has an impact on the ability of new regional airline pilot transition to TAA? If so, what in your opinion is the best mix/type of initial training?*

- IP 2: I have seen the best performance come from pilots who learned to fly gliders first.
- IP 3: Yes. Having a background from a bridge program helps, nevertheless, it does not replace experience and logged aircraft time.

Only 50% of the IP answered this question. Neither IP actually addressed the question as stated. This question was apparently unclear and no inference can be made from the answers provided. However, specific reference is made to training and experience that occurs after initial flight training.

4. *In your opinion, is there a significant performance difference among newly hired pilots based on their initial type of flight training? If so, which pilots perform at higher levels and why?*

- IP 2: The low time pilots that go to a regional jet specific training course like Jet U. or Simuflite are far below a pilot who has flown the King Air for 500 hours.
- IP 4: Bridge program students seem more technically proficient, but have more trouble with the big picture and decision making - CFI, freight dogs, etc . . . have trouble with the level of automation and standardization.

Only 50% of IP answered this question. Again, neither IP actually addressed the question as stated. However, these IP both agreed that experience (usually measured in flight hours, by type of aircraft, and by type of flight experience) is a relevant factor when transitioning to TAA.

5. *In your opinion are none, some, or all of your pilots in training completing training at Pinnacle Airlines completely comfortable flying advanced technology aircraft? Why or why not?*

- IP 1: Not all pilots are completely comfortable. Those with computer skills appear to be most comfortable. Those who have had previous experience as part of a crew using advanced technology are most comfortable.
- IP 2: About 25% wash out that I have seen. The "career change at 50 years of age" and the "rich kid spoiled brat 18-21 years old" are the two worst types. Both are at opposite ends of the spectrum. One can't get it because they are too old and the other expects it to be handed to them because that's how life has been since birth. Both types are frustrating to work with. Little progress/success is usually made.

Only 50% of IP answered this question. Specific reference is made to level of computer/automation proficiency, experience as crew members and age as relevant factors when transitioning to TAA.

Qualitative analysis of the data revealed two themes about IP perception of PT ability to transition to TAA. One theme centered on the role of scenario based training during initial flight training. The second theme was that other factors may play a larger role in adaptation to TAA then type of training (i.e. analog verses digital instrumentation training). Other variables may include: the total number of logged flying hours, pilot age, type of aircraft flown, experience as members of flight crews, the quality and efficiency of bridge programs, and automation skills. Consequently, a major hypothesis generated from the qualitative analysis was that maturation (the natural changes of the participants over time) and/or specific experience maybe more relevant to success for PT when transitioning to TAA.

CONCLUSION

Most of the newly trained regional airline pilots (69%) participating in this research study agreed that the type of initial instrument training was significant when transitioning to TAA. However, no statistical evidence from this investigation was found to support this opinion. Additionally, PT were evenly divided in their belief that their initial flight training had sufficiently prepared them for transition to TAA. The obvious conclusion is that a closer examination of initial flight training is warranted. Even if initial flight training was sufficient, as would appear to be the case given the pilot response to ease of transition, many of the responding pilots perceived it not to be the case; so then, what changes to initial flight training might change the perception of these pilots in training?

Despite the fact that three groups of PT were initially surveyed in this investigation, the groups were of significantly unequal size and the vast majority received analog only training. Perhaps all of these pilots, as a whole, were much more similar than they were different. Most of these pilots learned to fly on analog instrumentation. While the IP were not asked about their initial training, it is likely they learned to fly on analog instrumentation too. Therefore, it may be concluded that this study was conducted prematurely. Perhaps, there are not yet enough pilots receiving initial instruction in TAA to make this comparison between pilot groups.

Even though a review of the literature regarding human factors research (Endsley & Kiris, 1995; Lani & Wickens, 2007; Miller & Parasuraman, 2007) indicated numerous problems with the use and design of automation in complex commercial aircraft, only a minority of pilots in this study reported difficulty understanding the status of automation or mode display in advanced cockpits. Since all of these students were transitioning to TAA, it is possible they did not possess enough experience to make a judgment about mode display or systems state. Additionally, instructor comments seemed to indicate that their PT may experience problems when programming systems during flight. This appears to be an indication that this group of PT may not fully appreciate the complexity of the technology. Indeed, as is the case in most aviation training courses, completion of this training (including the check ride) may constitute only the beginning of the learning process rather than mastery of the subject matter.

Research cited in this investigation (Dornan, Craig, Gossett, & Beckman, 2006; French, Blickensderfer, Ayers, & Connolly, 2005; Robertson, Petros, Schumacher, McHorse & Ulrich, 2006) demonstrated the benefits of scenario-based training for some aspects, but not all aspects, of learning to fly TAA. The majority of pilots in training reported that they had primarily received maneuver based (stick and rudder) training, but some of these pilots reported they had also primarily received scenario based FITS training. Clearly, the pilots that reported receiving both types of training did not understand the question or they did not understand the difference between the two training methods. Given that the majority of responding pilots in training indicated they first learned instruments on only analog instruments, and given that scenario based FITS training was initially designed to instruct students in TAA, these pilots may not clearly understand the differences between each method of pilot training. The majority of student pilots in this study may have had their first scenario based flight training experience in the Pinnacle Airline training program and may not fully appreciate the industry training standards component of FITS. If the majority of pilots in training received maneuver based (stick and rudder) training, they may not have had a frame of reference to make this distinction. To be absolutely fair; however, it is important to note that scenario based FITS training does not eliminate the requirement to master the maneuvers to the Practical Test Standard (PTS).

Finally, there is at least one more significant conclusion to be drawn from the responses of this group of airline pilots. The majority of the responding PT believed that using TAA makes them safer pilots; however, only 40 percent agreed that using TAA made them a better pilot. Clearly, this group of pilots was considerably less certain that TAA made them better pilots. Additionally, as a group, their responses were almost evenly divided when asked if TAA weakens stick and rudder skills. When asked if TAA makes pilots dependent on advanced systems, more pilots disagreed than agreed, but once again the pilots were divided in their opinion. A significant number (31%) of the pilots in training agreed that TAA did cause dependence on advanced technology and 25 percent were uncertain (neutral) in their response to the question. Apparently, significant concern exists regarding the effects of TAA on basic flying skills. This perception was also noted in the IP survey results. A concluding fact of this study is the legitimate concern, according to the PT, that TAA does weaken stick and rudder skills and to some degree may cause dependence on advanced systems.

The qualitative component of this investigation provided credibility to the concept that scenario based training may be a significant factor leading to success when transitioning to TAA. Additionally, other factors besides type of initial training may be more directly linked to success or failure when transitioning to TAA.

Two themes emerged from the qualitative analysis. The first theme is that while type of training may not be a valid indicator of success when transitioning to TAA, method of training (i.e. the early introduction of scenario based training) may be a relevant factor. The majority of IP surveyed (75%) agreed that method of flight training did make a difference. One instructor pilot stated: "I believe scenario based training improves pilots' abilities . . . period." This unequivocal statement indicates that when PT approach flight training with an event driven perspective, they more easily adapt to the complex tasks associated with flying TAA as a member of a flight crew. In the words of another instructor, "scenario based training events encourage the student to consider and deal with multiple variables occurring in real time as opposed to a single profile/emergency etc. . . ."

The second theme uncovered by qualitative analysis is that other factors may be more relevant to success such as: total number of logged flying hours, pilot age, type of aircraft flown, flight crew experience, the quality of bridge programs, and automation skills. A major hypothesis generated from the qualitative analysis was that maturation and/or specific experience maybe more relevant to pilots in training when transitioning to TAA. Several IP statements, previously mentioned, seem to confirm this conclusion:

- “The low time pilots that go to a regional jet specific training course like Jet U. or Simuflite are far below a pilot who has flown the King Air for 500 hours.”
- “Yes. Having a background from a bridge program helps, nevertheless, it does not replace experience and logged aircraft time.”
- “Not all pilots are completely comfortable. Those with computer skills appear to be most comfortable. Those who have had previous experience as part of a crew using advanced technology are most comfortable.”

In some cases these statements may confirm long standing traditional measure of success (i.e. flight hours logged), but in other cases non-aviation specific experiences, such as exposure to automation, also may be related to success.

Additional research is needed to determine how best to train future commercial airline pilots. This particular research study raised many more questions than it answered. Examples of such questions include:

- What are the effects of TAA training on safety and the retention of basic piloting skills?
- What are the effects of age and life experience when transitioning to TAA?
- What level of computer literacy is required for successful transition to TAA?
- What technology design and particularly what human-machine interface is best suited when transitioning to TAA?
- Do pilots always recognize their ability to determine mode display and/or systems status or are these skills that develop only with exposure and experience?
- How should pilot training methodology evolve as TAA become more widely used during initial training?

Perhaps it is too early to determine how best to conduct initial training of pilots in TAA. And for some student pilots, TAA are not yet an option at the flight school where they are undergoing initial training. However, the numbers of TAA are steadily increasing in general aviation and at collegiate flight schools. As is the case with the FITS literature, this type of investigation should continue.

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Open-ended Practical Projects Improve Preparedness of Undergraduate Students for Aerospace Industry

Sergey Dubikovsky, Thomas A. Goodrich, Ronald Sterkenburg
Purdue University

ABSTRACT

The Aviation Technology Department in the College of Technology at Purdue University has been effective at graduating students who have mastered the technical knowledge and concepts taught in traditional academic settings. Through a well-established combination of courses, the program has also exposed its students to a variety of materials and processes that gives them practical knowledge about aerospace materials, sheet metal fabrication and repair, corrosion, heat treatment, and painting. Over the years, this approach has provided graduates with the knowledge and skills they've needed as they entered the job market after graduation. However, in recent years the program has gone through an extensive curriculum change designed to produce graduates who have the skills needed to be immediately productive in entry-level positions, and to move quickly to higher-level positions. This is accomplished by introducing project-based courses in which students are tasked to solve industry-like problems using Six Sigma tools, work in teams, and collaboration with companies and with instructors and students at other universities. Under this new paradigm, students do not just follow their professors' instructions - they attempt to solve real-world open-ended problems with a range of possible solutions. This paper will provide some details and outcomes of this approach.

INTRODUCTION

In today's more demanding job market, employers are seeking applicants who have developed the intellectual and physical skills needed to be immediately productive when they begin their new careers in industry. This requires not only the knowledge and skills that previous students have learned in traditional teaching contexts, but also practical experience, which can only be acquired by actually doing a job. As a result, American universities, in general, are adding more hands-on engineering projects to their curriculum to attract new students (Collicott, 1998). Most students are motivated by hands-on projects, which help sustain students' interest in technology and the curriculum, thereby preventing them from switching to other majors (Costlow, 2005).

Previous inquiries have looked at the development of curricula that were specifically-designed to implement an educational approach integrating the traditional delivery of knowledge with a program that develops student skills and provides practical experience in those same subject areas. The goal of the new curriculum is to help the graduates of the Aeronautical Engineering Technology program to be hired in entry-level engineering positions in areas such as liaison engineering, technical support, field engineering, supply chain and project engineering. It is also expected that graduates will move up into management and leadership positions within two to five years (Dubikovsky, Stanley, & Wild, 2008). The mechanism for achieving these goals is the addition of two new courses to the curriculum: Aircraft Materials and Manufacturing Processes (AT308), and Advanced Manufacturing Processes in Aviation (AT408). At Purdue University, these courses have now been in place long enough that several classes of students have taken the courses and the content has been refined and polished.

COURSE STRUCTURE AND CONTENT

AT308. Freshman aviation technology students are required to take required AT 108 and AT 166 courses. In these classes, students deal with, and get practical experience in working with, a variety of materials and processes, including aerospace materials, welding, sheet metal fabrication and repair, and corrosion, heat treatment, and painting. In these courses, students acquire, practice, and master basic skills that will be necessary in later courses.

AT308, which is the redesigned Aircraft Manufacturing course, is intended to take students to the next level by exposing them to additional topics like introduction to strength of materials, structural joint design, the use of CNC equipment, and quality-control systems such as ISO 9000. The course, however, goes well beyond merely offering additional course material; in this course, students are given work orders, as if they were employees of a company; this introduces them to the experience of using their new-found knowledge to accomplish a long-term goal (Dubikovsky, 2009).

Students work in teams, learning how to work together and how to handle disagreements or problems that may occur (Samuel, 2005). However, each one is still required to take personal responsibility for his or her individual work. Their manufacturing facility (the laboratory) is equipped with a variety of industrial tools including lathes, milling machines, testers, and other machining equipment. During the course of the semester, each student participates in an instructor-supervised project by filling a variety of different roles; for example, a student will most likely work as a machinist, a team leader, a quality control inspector, and in several other capacities over the fifteen-week period. By doing this, each student not only gets a variety of practical experience, but also sees how a project develops and how it looks from a variety of different perspectives. In the end, students learn how to follow instructions, understand logic and systems and the reasons and science behind them.

AT408. The logical continuation of this course of study is the newly-created Advanced Manufacturing course, which emphasizes design process and advanced materials manufacturing. Students in this final senior-level course have already developed basic aircraft materials skills from prerequisite coursework in the curriculum. In AT408, students integrate baseline technical skills with advanced problem-solving skills and processes involved in design and manufacture of more complex component parts, including aircraft components and assemblies which play a critical role in flight safety in industry. The course is entirely project-based, allowing students to perform research and to design products to specific requirements, which takes them through all the steps of the design process, starting with a requirement or need all the way to final assembly in just fifteen weeks (Billing, 2007; Kim, Kamoua, & Pacelli, 2005-2006).

The students take their assigned responsibilities very seriously and work diligently to develop solutions to the tasks, in part because they are in charge in their own learning (Massa, 2008). Prior to this point in the curriculum students have learned to perform assigned duties, but have not created their own work guidelines or taken full responsibility for an entire project (Shakirova, 2007). This course allows students to take a project from the design stages through to completion, with the instructor performing the role of facilitator and supervising the independent work of the teams (Beringer, 2007).

EVALUATING THE EFFECTIVENESS OF THE PROGRAM

Ultimately, of course, the most valid way to evaluate the effectiveness of such a program of study would be to see whether students with these more practical skills and actual experience are more likely to be hired and how well they succeed in the workplace. This will be an important subject for further study in the near future when such data become available.

In the meantime, however, one thing that researchers can look at is whether the students perceive value in this educational approach as they are going through the program. While it is true that student perceptions may not indicate whether the program is actually accomplishing what is intended, those perceptions do suggest whether students understand the value of the more practical approach and whether they are buying into it.

In order to get a preliminary look at how students perceive the value of their participation in the sequence of classes outlined above, students completing AT308 in the spring semester of 2009 were asked to respond to a six-question survey. In the fall semester of 2009, students completing AT408 were asked to complete the same survey. The class lists (and therefore the survey samples) were not identical because not all AT308 students chose to take AT408 in the fall semester of 2009, and one AT408 student had already taken AT308 during a semester prior to the spring of 2009. There were twenty-nine students in the survey sample for each semester; in the AT308 class, twenty-nine of thirty-six students completed the survey, and in the fall semester AT408 class, all 29 students in the class completed the survey. In any event, the sample of students was self-selecting in that they voluntarily signed up for the courses, either because of an individual interest in the subject matter or because the courses were required for their course of study. The relatively small sample size for the survey was the direct result of the size of the laboratory classes in which the survey was taken.

The survey was set up using a Likert Scale of five categories which asked students to select one of the following choices in response to each of the survey's six statements: "Strongly Disagree," "Disagree," "Neutral," "Agree," and "Strongly Agree." Survey questions one and four addressed student attitudes concerning structured vs. open-ended course organization and team working situations, while questions two, three, five and six assessed their attitudes concerning the course's approach to the acquisition and practical application of knowledge and skills. Because of the preliminary nature of the investigation, student surveys were intentionally kept short and to the point.

SURVEY RESULTS

Structured vs. open-ended course organization and team working situations

Question 1. Students were asked to respond to the following statement: "When given the choice, I would prefer to work on a highly-structured project that has an identifiable correct solution rather than work on an "open-ended" project where I must find a satisfactory solution to the problem."

In AT308, during the spring semester, forty-one percent of the students disagreed or strongly disagreed with this statement, indicating that they preferred the "project-oriented" assignment over the traditional laboratory assignments. Twenty-eight percent had no opinion on the matter, and thirty-one percent preferred the structured situation.

In the fall, after taking AT408, fifty-two percent of the students indicated a preference for project-oriented learning. This represents a more than twenty-five percent increase over those expressing that same opinion in the spring. While the uncommitted percentage remained the same at twenty-eight percent, those preferring the more structured assignments fell from thirty-one percent in the spring to twenty-one in the fall (see Figure 1).

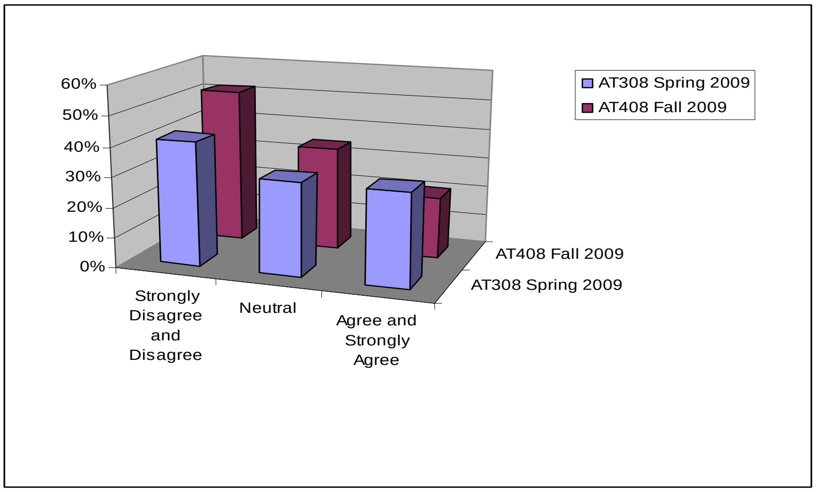

Figure 1. Answers for question 1 “When given the choice, I would prefer to work on a highly-structured project that has an identifiable correct solution rather than work on an “open-ended” project where I must find a satisfactory solution to the problem.”

Question 4. Students were asked to respond to the following statement: “I think I might learn more in a laboratory situation if I didn’t have to work with other students.”

When AT308 students responded, forty-eight percent of them indicated that they disagreed or strongly disagreed with this statement. Twenty-four percent had no opinion, and twenty-eight percent agreed or strongly agreed with the statement. Sixty-nine percent of the AT408 students said that they disagreed or strongly disagreed with the statement, showing a forty-three percent increase in the number of students who felt they learned more in the laboratory setting when working with other students. The percentage of “no opinion” students went down to fourteen percent from twenty-four percent, and the pool of those still preferring to work by themselves dropped from twenty-four percent to seventeen percent (see Figure 2).

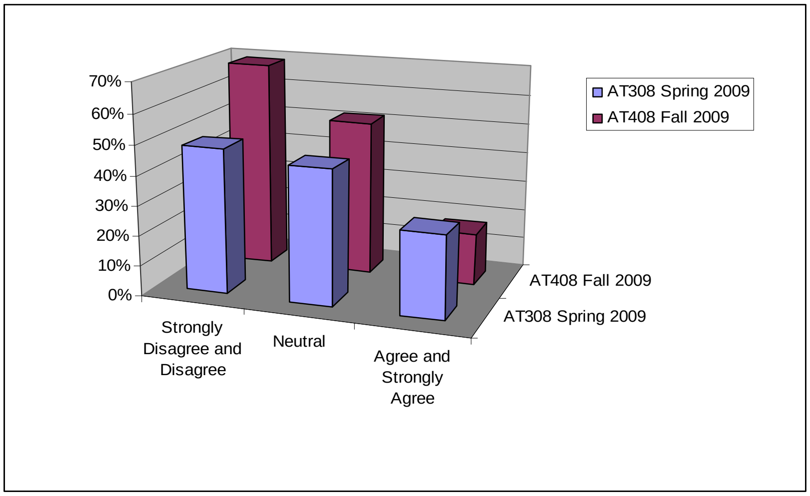

Figure 2. Answers for question 1 "I think I might learn more in a laboratory situation if I didn't have to work with other students."

Acquisition and practical application of knowledge and skills

Question 2. Students were asked to respond to the following statement: "I have found most of my laboratory assignments offer me a chance to put into practice what I have learned in my coursework."

During the spring semester, in AT308, ninety-three percent of the students agreed or strongly agreed with this statement, indicating that they saw the practical application of their classroom material in their laboratory assignments and were able to put it into practice. Three percent had no opinion on the matter, and three percent said the laboratory assignments did not give them a chance to put their knowledge into practice.

In the fall, after taking AT408, only seventy-nine percent of the students indicated that they saw the practical application of the material in their lab assignments. The uncommitted percentage rose to twenty-one percent, and the percentage of students saying they saw no relationship between the classroom assignments and the lab assignments dropped to zero.

Question 3. Students were asked to respond to the following statement: "Sometimes I am not able to easily connect what I learned in class with the lab activities."

Forty-eight percent of the AT308 class disagreed with the statement, saying that they were able to connect what they had learned with lab activities. Twenty-eight percent had no opinion, and twenty-four percent agreed that they were not able to connect the classroom material with the lab material. When the same question was asked of the AT408 students, fifty-nine percent disagreed, which was a twenty-three percent increase over the responses to that question during the previous semester. The "no opinion" percentage stayed about the same at thirty-one percent, and the percentage of those who admitted to having trouble making the connections dropped to ten percent.

Question 5. Students were asked to respond to the following statement: "Having worked in project groups with other students, I believe I have developed important work skills that I didn't have before."

During the spring semester, eighty-six percent of the AT308 students answered that they agreed that they had developed new skills; only seven percent had no opinion, and seven percent said they had not developed new skills. At the end of the fall semester, seventy-nine percent of the AT408 students said they had developed new skills; the percentage with no opinion remained constant, and the percentage of those who said they had not acquired new skills rose to fourteen percent.

Question 6. Students were asked to respond to the following statement: "Having had laboratory classes at Purdue, I have a greater appreciation of the practical application of the things I've been learning in my classes."

When the spring semester AT308 class responded, ninety-seven percent agreed that they had a greater appreciation of the practical applications of their course materials. Only three percent had no opinion, and no students disagreed. When the fall semester AT408 class took the survey, ninety percent said they had a greater appreciation of the practical applications of their course materials. Ten percent had no opinion, and no students disagreed with the statement.

INTERPRETING THE RESULTS

Structured vs. Open-ended Course Organization

In the first course of the two being reviewed, a large minority of students preferred the non-traditional, hands-on approach to the laboratory assignments over the typical highly-structured approach. When the same question was asked of students in the second course, the percentage of those preferring the new approach went up ten percent, and those holding that opinion were now in the majority (Question 1). It appears that students recognize that the less-formally-structured approach provided an additional value to the course; that value may have been interpreted by students as being another dimension of learning, or it could just be that they found the activity more interesting or engaging. Either way, students expressed a clear and growing preference.

Working With Teams

In this case, the results show not only a substantial increase in the percentage of students who did not object to working with others in a team learning and work situation, but also a ten percent reduction in the group with no opinion and a ten percent reduction in those who stated that they would prefer not to work with others in teams (Question 4). This across-the-board shift suggests both that students may be developing cooperative interpersonal skills, but that they were beginning to understand the organizational advantages of working with others. If either or both of these are the case, then students with this experience have the potential to be effective in a work environment much faster than those without that experience.

The Acquisition and Practical Application of Skills

In this area, students taking the two courses seem to believe that they have an increasing ability to connect what they learn in the classroom with the activities of the laboratory and the work world (Question 3). The ability to make and use those connections is the first and essential step in making an education practical; without the ability to apply what one knows, no amount of abstract knowledge is helpful to a potential employer. Having made those connections, a large majority of the students surveyed believe that they have developed important work skills. While a few more in AT408 say they have not learned new skills (fourteen percent, up from seven percent), the reason for this may very well be that the focus of AT408 shifts much of the emphasis to the planning, organizing, and project management skills necessary to bring the whole project to completion (Question 5). The same reasoning may account for the slight fall (from AT308 to AT408) in the percentage of students who recognize the lab assignments as an opportunity to put their classroom knowledge into practice (Question 2). Having said this, students in both classes responded in very high numbers (ninety-three percent in AT308, and seventy-nine percent in AT408) that the assignments did offer the opportunity to apply what they had learned. Finally, most students in both classes (ninety-seven percent in AT308 and ninety percent in AT408) said they had a greater appreciation of the practical applications of the classroom material (Question 6). At least from the perspective of the students, this means that the new approach to laboratory assignments has been successful.

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Why Teach Aviation?
A Snapshot of the Motivations and Influences Associated with the Careers of Professional Pilot Program Faculty

David Carl Ison
Rocky Mountain College

ABSTRACT

The purpose of this study was to identify the motivations and influences that affect the decision of a sample of individuals to enter careers as professional pilot educators at the collegiate level. Six faculty members at four year, University Aviation Association member institutions were selected to participate in the study. Three individuals had a civilian background while the other three followed a military career path. Civilian faculty followed more varied career paths while those of military faculty were more structured. Civilian faculty pursued higher levels of education more for personal interests while military faculty did so due to expectations in the service. Familial and mentor support were both cited as important influences in most cases. The majority of faculty did not directly pursue a career in the professoriate but instead found their way to the occupation in a variety of ways. All but one faculty member were happy with their decision to enter higher education.

INTRODUCTION

Overview of the Study

From 1940 to 2009, there has been substantial interest in higher education faculty in the United States. The seminal work of Wilson (1942), followed by studies by Finkelstein (1984) and Reybold (2003), investigated the overall attributes of the U.S. professoriate. More specific data on this group has been collected via large scale surveys including the National Survey of Postsecondary Faculty (NSOPF) conducted by the Department of Education (National Center for Education Statistics, 2006) and the Higher Education Research Institute Faculty Survey (2004). Several studies have been conducted on faculty in specific subject areas (Ison, 2009; Reybold, 2003; Fleet, Rosser, Zufall, Pratt, Feldman, and Lemons, 2006) and those of particular demographic attributes (Conley, 2005; Cross, 1991).

The goal of all of these aforementioned research studies was to better understand faculty through a collection of educational, occupational, and demographic distinctions. While these investigations have lead to a large database of information on individuals serving as faculty, what is much less understood is "[w]hat attracted them to faculty work? When did they decide to pursue academic careers? [And w]hat people and experiences were most influential in their decisions to become professors?" (Lindholm, 2004, p. 604).

According to Lindholm (2004) "there has been much written on how personal and environmental factors shape people's career choices [….] Very little theory or research, however, has focused specifically on the vocational development of college and university professors," (p. 603). The dearth of data on the motivations and influences associated with faculty career choice is problematic because "the answers to these questions are especially important given that projected increases in student enrollments coupled with widespread faculty retirements over the next decade will create a need to recruit large numbers of new faculty," (Lindholm, 2004, p. 604). What is more concerning is that even less data exists on the career choices of postsecondary faculty in specific subject areas. One such specialty in which a gap in research exists is professional pilot education. The only recent studies on this faculty cohort focused solely on the collection of occupational, educational, and demographic features of the group (Ison, 2009; Johnson, 1999).

Because aviation higher education has assumed an ever-increasing role in the production of aerospace industry professionals as the U.S. military, previously a major supplier of such individuals, has faced cutbacks while at the same time the industry, in general, has continued to grow, this lack of research is distressing (Echaore-McDavid, 2005). Industry expectations for highly qualified employees to operate and to manage increasingly complex aviation technologies has placed even more of a burden on aviation higher education to produce a workforce with these features (Brown, 2007; Echaore-McDavid, 2005; Hansen & Oster, 1997; Baty, 1985).

Further information on professional pilot program faculty is needed to supplement existing data in order to best understand these individuals. To fully comprehend the nuances associated with professional pilot educator careers, it is necessary to explore what influences and motivates individuals to pursue careers within the professional pilot education professoriate. This information is critical to aviation program and general higher education administrators in addition to current professional pilot program faculty and those considering pursuing such a career path. It may also assist in the recruitment of future faculty and the retainment of existing faculty.

Purpose of the Study

The purpose of this study was to determine the factors that might influence the career choice of the aviation professoriate among full-time professional pilot education faculty who are employed at four-year, University Aviation Association (UAA) institutions.

Research Question

This study sought to answer the following research question: What are the factors that influence individuals to become professional pilot education faculty?

REVIEW OF LITERATURE

Aviation Higher Education and the Importance of Professional Pilot Faculty

Even in light of the cyclical nature of the aviation industry, flying remains a critical component of the U.S. economy. Further, the aviation industry continues, over the long term, to grow. According to the Bureau of Transportation Statistics (2008), revenue passenger ton miles more than tripled from 1981 to 2007. The number of passengers carried by U.S. airlines (in millions) has increased from 605,434 in 1997 to 811,593 in 2008 (Federal Aviation Administration, 2009; Federal Aviation Administration, 2001). General aviation has also expanded, with the number of active aircraft (in thousands) increasing from 192.4 in 1997 to 231.6 in 2007 (Federal Aviation Administration, 2009; Federal Aviation Administration, 2001). Along with these augmentations has come the need for more pilots and other aviation professionals even though the industry has suffered in reaction to the recession in the U.S. economy from 2008 to 2009 (Ross, 2009).

In the past, the military was a major supplier of aviation professionals, however, due to cutbacks and retention efforts, aviation higher education has had to produce more of the workforce needs for the industry (Donoghue, 2008). More complex aircraft and navigation systems, along with the need for proper management skills to handle crew situations and flight operations, necessitate well educated employees. These requirements for a highly educated workforce have shifted the hiring preferences among professional aviation employers to those individuals who have a college education. Airlines and corporate aviation departments currently have a strong preference for pilots who have college educations (Brown, 2007; Echaore-McDavid, 2005).

Therefore a growing industry coupled with an increasing desire for workers within that industry to have a college education point to the increasing importance of faculty who will provide such an education. Seeking to understand what drives these critical individuals to become faculty is necessary to insure that industry and higher education stakeholders have the best information available to seek out new faculty, to guarantee an adequate supply of future faculty, and to retain those who are already teaching.

Faculty Career Motivations and Choices

Theoretical background of career motivations and choices.

A significant amount of research has been conducted on the motivations and choices associated with the selection of career or vocation. Robinson, Murrells, and Marsland (1997) defined a career as "paid work and often implies continuous commitment to employment and progression through a series of hierarchical positions in an occupation" (p. 603). Expanding on this description, a career is also the "world of work" with horizontal and/or vertical mobility (p. 603). From these investigations into career motivations and choices have arisen a plethora of theories. Some theories assume a defined decision about what vocation to pursue that individuals make at some point during their life. Another take on career choice is that it is "less [of an] outcome of a single choice and more as an evolving sequence over a life-span" (Robinson, Murrells, & Marsland, 1997, p. 603). Yet another perspective is that "career patterns were determined not by individual choice, but by the extent to which they were enhanced, limited, or determined by features of the social structure" surrounding the individual making such a choice (Robinson, Murrells, & Marsland, 1997, p. 603).

Other theories focus more on the concept of a "fit" between an individual and a particular vocation while others point to a more conscious choice that an individual might make to enter a specific career line. Holland's Theory of Careers builds upon his research on personality. According to Holland and Gottfredson (1976), workers fit into one of six personality types who have preferences for certain work environments. Holland (1997) stated that, although persons may exhibit traits of more than one personality type, they predominately react consistently enough to allow them to be categorized into one primary type. These types are realistic, investigative, artistic, social, enterprising, and conventional.

Weinrach and Srebalus (1990) describe each typology noting that realistic types prefer using machines and tools. An example career of a realistic type would be a machinist. Investigative types are analysts an example of which is a scientist. "Artistic individuals tend to be expressive, nonconforming, original, and introspective. […] Decorators and musicians are artistic types" (p. 42). The social personality type seeks to help others. Teachers typically fall into this type (Johns Hopkins University, n.d.). The fifth type, the enterpriser, "manipulate others to attain organizational goals or economic gain.

[…] Salespeople, office managers, and lawyers are enterprising types" (Weinrach & Srebalus, 1990, p, 42). The last type, the conventionalist, "enjoy systematically manipulating data, filing records, or reproducing materials. […] Secretaries, file clerks, and financial experts, are conventional types" (Weinrach & Srebalus, 1990, p, 42).

According to Holland (1997), there are six types of environments that correspond to the aforementioned personalities. The most common arrangement is that an individual will migrate towards the environment most fitting to their personality. Thus, an artistic type would most likely choose work in an artistic environment. This is a logical conclusion because as more persons of a particular type come together in a work environment, the more that environment will replicate the sentiments of those working within it. There are, of course, exceptions as certain personalities do have psychological commonalities with other types. Finally, the behavior of a worker "is determined by an interaction between personality and environment" (Holland, as cited in Weinrach & Srebalus, 1990, p. 41).

Roe's theory on career choice recognizes the innate response of individuals to their hierarchy of needs as described by Maslow (1954; 1948). Roe and Lunneborg (1990) described eight occupational groups in which persons fall: service, business contact, organization, technology, outdoor, science, general culture, arts and entertainment. Service oriented individuals involve "a situation in which one person is doing something for another" (Roe & Lunneborg, 1990, p. 71). Business contacts are similar to Holland's enterpriser where persuasion is a key element of the occupation. Organization types are best described as white-collar. Technology involves production and is much like Holland's realistic personality. Outdoor somewhat speaks for itself, where individuals prefer things such as farming or forestry. Science persons are those who are "primarily concerned with scientific theory and its application under specified circumstances other than technology" (Roe & Lunneborg, 1990, p. 71). Among those considered in the category of general culture, "[i]nterest is in human activities, rather than in individual persons. This group includes occupations in education, journalism, jurisprudence, the ministry, linguistics, and the subjects usually called the humanities" (Roe & Lunneborg, 1990, p. 71). Because of the crossover that may exist among educators at different levels, namely postsecondary faculty, such persons may be hard to distinguish between science and general cultural types. Arts and entertainment persons use their "special skills in the creative arts and entertainment" and perform in a capacity much like Holland's artistic individuals (Roe & Lunneborg, 1990).

Within each of these occupational personality segments, Roe and Lunneborg (1990) noted that there are six levels at which an individual may work. The highest levels were the professional and managerial, which were followed by the semiprofessional and small business, skilled, semiskilled, and the unskilled. Overriding all of these concepts are five general "origin[s] of interests and needs" (Roe & Lunneborg, 1990, p. 74) of each person. These include:

> Genetic inheritance […] limits. […] The degrees and avenues of development of inherited characteristics. […] The pattern of development of interests, attitudes, and other personality variables. […] The eventual pattern of psychic energies, in terms of attention-directedness. [… And t]he intensity of these needs and their satisfaction (Roe & Lunneborg, 1990, pp. 74-75).

Building on the premise of need fulfillment, Astin (1984) found that work is important to individuals because it provides for this fulfillment. Astin (1984) stated that work provides for survival needs in terms of the economic outcomes provided by work which bring forth the required food, shelter, clothing, and health. Pleasure needs are satiated through work activities and the intellectual/emotional pleasure coming from the performance of tasks such as problem solving. Contribution needs are fulfilled by the feelings of helping others or participating with others. Self-worth and self-esteem sprout from the interactive fruition of subordinate needs. Further, socialization, expectations and opportunities influence how an individual goes about satisfying their needs. The outcome of career choice is dependent upon what one feels they can do, what jobs are available, and how each available option fits into need fulfillment.

Krumboltz's Theory brings together many of these concepts into a more parsimonious explanation of career decision making. This theory is built upon the foundations of social learning. Social learning is brought forth through direct contact with positive or negative experiences, immersion experiences in which an individual is in close contact or within a particular environment associated with future work, and through experience of others (Mitchell & Krumboltz, 1990). Mitchell and Krumboltz (1990) stated that the premise of this particular theory hinges upon three components: genetic endowment/ability, environment, and experiences. Although this theory is, on the surface, simpler, Krumboltz offers a complex means to sketch the career decision making process along with the various inputs necessary to reach such a decision over an extended period of time.

Super (1973) provided what is probably one of the most comprehensive summaries of the concept of vocational development. Super (1973) found that there are ten components of career choice:

- People differ in their abilities, interests, and personalities.
- They are qualified, by virtue of these characteristics, each for a number of occupations.
- Each of these occupations requires a characteristic pattern of abilities, interests, and personality traits […].
- Vocational preferences and competencies, the situations in which people live and work, and hence their self concepts change with time and experience […] making choice and adjustment a continuous process.
- This process may be summed up in a series of life stages characterized as those of growth, exploration, establishment, maintenance, and decline […].
- The nature of the career pattern […] is determined by the individual's parental socioeconomic level, mental ability and personality characteristics, and by the opportunities to which he is exposed.
- Development through the life stages can be guided, partly by facilitating the process of maturation of abilities and interests and partly by aiding in reality testing and in the development of the self concept.
- The process of vocational development is essentially that of developing and implementing self concept […].
- [This] process [is one] of compromise between individual and social factors […].
- Work satisfactions and life satisfactions depend upon the extent to which the individual finds adequate outlets for his abilities, interests, personality traits, and values (Super, 1973, pp. 262-263).

In summary, a range of theories have been formulated on how individuals select a career as well as what motivates them to make such choices. Among these suppositions it is clear that there are certain fundamental commonalities. For one, it is recognized that individuals have certain preferences or traits. Another is that occupations tend to attract individuals with specific traits. Also, there are external factors that tend to influence the decision process. As a final point, worker satisfaction in their career selection is related to the compatibility or match between their traits and those naturally found within a vocation.

Faculty-specific motivations and choices.

There have been a number of studies that have been conducted to investigate the motivations and career choices made by higher education faculty utilizing the theoretical principles outlined previously. According to Austin (2002), an "[i]ndividual's understanding of the faculty career begins with the graduate school experience or even earlier, not with the first faculty position" (p. 96). This leads to "anticipatory learning" i.e. individuals take on attributes of those who are currently in the position(s) that they seek. Clark (1987) noted that as potential faculty progress through the grooming stages of the pre-professoriate, individuals "assume identities that define and steer them for years and, often, for a lifetime of work" (p. 187).

Lindholm (2004) purported that faculty make two independent decisions that lead to the career choice of the professoriate: the choice of discipline and the choice of academic versus non-academic career paths. Finkelstein (1984) also found that faculty make these two critical decisions. Logically, the choice in discipline is most often chosen before exiting college, though it is possible that individuals may return to gain the needed education in a different major or subject at a later point. Choice to enter academe most often occurs at some point beyond the baccalaureate, although some individuals focus in on an academic career before completing their bachelor's degree.

Baldwin and Blackburn (1981) reported that "[p]rogress in one's career is undoubtedly stimulated and qualified by the interactive effects of internal and external forces" (p. 602). Examples of these influential forces are offered by Reynolds, McCullough, Bindixen-Noe, & Marrow (1994): formative experiences (family, socioeconomics), personal characteristics (age, gender), professional characteristics (occupation, status), and perceived reward system. Finkelstein (1984) investigated faculty career influencers and found that the primary motivation could be traced to intellectual factors, e.g. desire for research, and the second was the encouragement from a mentor who frequently is a faculty member. Neophyte faculty tend to be drawn more by the former motivation.

The issue of "happenstance" also plays a role in the pursuit of academics – simply being in the right place at the right time – sometimes connects individuals with faculty positions. However, this is less likely among larger, prestigious research universities where prospective faculty need a proven record of publication, a terminal degree from a well-respected institution with an esteemed faculty advisor. Another critical component was identified by Althauser and Van Veen (1995). The career of an individual is subject to the "link between structural features of the labor markets and the socioeconomic attainment of individuals" (p. 91). Thus market forces must be favorable to allow entrance into available positions.

Reybold (2003) conducted a study in which a number of faculty were interviewed concerning their transition from doctoral student to academia. Instead of being some specialized procedure or ritual, Reybold (2003) stated that the "apprenticeship into the professoriate is tacit, embedded in the everyday activities and practices of their professional training milieu" (p. 235). Reybold (2003) described five core archetypes of how students/apprentices are transformed into faculty. These findings appear to align with other research on career choice both inside and outside of the professoriate.

The first embodiment of faculty pathways is the anointed:

> For the anointed, the doctoral program is a formal apprenticeship toward the professoriate, characterized by one participant as an enticing "inside track" to success in the academy. Generally initiated by a faculty mentor, the apprenticeship usually focuses on research and publication within the mentor's area of expertise. Interestingly, this mentoring relationship typifies the student's membership and acceptance into the field. The anointed devotes considerable time and energy to the primary professional goal of establishing and maintaining a relationship with the mentor; for the student, this relationship symbolizes a developmental affiliation with the field (p. 240).

These individuals tend to be more concerned with research agendas as opposed to teaching. Also, the anointed types prefer to have regular, supportive input of faculty during doctoral studies particularly in the dissertation phase. Faculty mentors of the anointed may help interest the individual by inviting them to participate in research, or providing extended assistance in an individual's research interests (Reybold, 2003, pp. 241-243).

The next model, the pilgrim, enters the professoriate via a carefully planned path:

> This plan is strategic, concentrating on the accumulation of academic experiences commensurate with a faculty position. Although focused around research productivity, some students also seek independent teaching experiences and even committee service at the college or university level. Accomplishments toward future faculty roles are often discussed in terms of "lines on my vita" or future tenure expectations. Faculty and mentors may be utilized as resources to accomplish these strategic goals, but any mentoring association between the student and a faculty member is more functional than relational (Reybold, 2003, p. 244).

Rather than leaning on faculty as heavily as the anointed, the pilgrim uses mentors as a reference resource. They also tend to try to build experience through deliberate knowledge building. For example, one interviewee began presenting research at conferences early in their "career" so as to build a more substantive curriculum vitae. The pilgrim takes extensive credit for their progression toward the professoriate (Reybold, 2003).

The visionary model believes that they are drawn to the professoriate for the need of social change:

> These students characterize their future faculty position, particularly their teaching and research roles, as a forum for achieving social change or educational reform. In other words, faculty roles are vehicles for initiating and sustaining this vision, even to the point of sacrificing certain professional goals such as research productivity and, for some participants, tenure (Reybold, 2003, p. 245).

Visionaries tend to believe there is more to research and teaching. Namely, these are just means to an end, and that end is the furtherance of some grander agenda. Through their efforts in higher education, one interviewee desired to help rectify the oppression of women while another sought to amend common stereotypes. This type of individual does not value tenure as highly as the other archetypes (Reybold, 2003).

Reybold (2003) further describes the philosopher category as one who seeks the professoriate as:

> … a personal quest for intellectual growth and enlightenment. The philosopher's goal is to encourage their students and colleagues toward their own quest for personal development. They idealize their faculty roles, even to the point of expressing a passionate emotional connection to the professoriate and academe (p. 247).

These individuals can be described as perpetual students. They also describe themselves as proponents of pleasant learning environments or of an advocacy approach to handling students and learning (Reybold, 2003).

Finally, Reybold (2003) described the drifter. This type of faculty member happens upon the professoriate:

> The drifter expresses no singular commitment to academe. For these doctoral students, the professoriate is neither an ultimate professional goal nor a penultimate bridge to some greater personal or social cause. Many are not sure they even want to be a professor; their odyssey may take them through the professoriate at some point in their professional migration, but it may just as well lead to a corporate position. So these students are keeping other career options open… just in case (p. 248).

These individuals appear to view their migration towards the professoriate as a result of luck or coincidence. They do not show the level of allegiance or desire as the other archetypes. Further, they appear to be the least confident of all types in their abilities as a faculty member (Reybold, 2003). Yet even though there are commonalities among faculty in career choice and motivations, it is necessary to recognize the differences that may exist across subject areas in order to insure an adequate supply of qualified instructional personnel (Lindholm, 2004). Thus is logical to investigate the unique attributes of faculty within individual subject areas.

METHOD

Participants

The population for this study comprised of 193 individuals that responded to a survey on aviation faculty conducted in a separate study by Ison (2009). These individuals were full-time, professional pilot education faculty that were employed at University Aviation Association (UAA) member four-year institutions. Non-random, purposive sampling was utilized to select individuals from this larger group. Berg (2007) defined this type of sampling as when "researchers use their special knowledge or expertise about some group to select subjects" (p. 44). As Gay and Airasian (2000) noted, "the primary focus in qualitative research is on identifying participants who can provide information about the particular topic [… thus] sampling in qualitative research is almost always purposive" (p. 139). This type of sampling was deemed most appropriate for the goals of the study.

Finley et al (2003), senior faculty at the University of Nebraska – Omaha (B. Bowen, personal communication, June 12, 2008), and senior faculty at the University of Nebraska – Lincoln (M. Grady, personal communication, July 21, 2008) recommended that faculty that had a broad spectrum of experience and qualifications be selected for participation in the interview component of this study. A further requirement mentioned by each of the aforementioned sources was that every effort must be made to select those who are most likely to provide the detailed and comprehensive description of all essential attributes. The findings of Ison (2009) discovered that aviation faculty follow one of two primary pathways to reach the professional pilot professoriate, the military and non-military. In consultation with four senior research faculty at the University of Nebraska – Lincoln (M. Grady, R. Joekel, B. LaCost, and D. Sanger, personal communication, October 15, 2008), a target of three military and three non-military faculty was set for the interview process. Equal numbers of individuals were selected, as the findings of Ison (2009) noted a near even split between military and non-military faculty. A larger list of potential interview participants was extracted from those who were part of the survey respondent pool that fit these constraints because not all of those who were selected were expected to be able to or agree to participate.

To evaluate the potential of individuals to provide rich descriptions of their careers and choices within those careers, information about potential interviewees were collected from their school websites. Further, peripheral information was used to choose these persons. For example, one of those selected for participation authored a widely used aviation textbook. Another had given a well received presentation at a recent University Aviation Association conference. One selectee gives public presentations and speeches on a regular basis both inside and outside of their aviation education job functions. Another participant is on an advisory board to an industry grouped that necessitates extensive writing and speaking engagements. One participant was the chair of one of the largest aviation programs in the United States and had an extensive background in leadership functions, as well as a broad ranging career in aviation. The remaining individual had extensive and impressive experience, academic achievements, and an established job history in aviation higher education.

Thus, each of these individuals had a varied set of backgrounds to give insight into why and how different persons choose to or simply ended up in aviation higher education. Moreover, it was apparent that the backgrounds of these individuals and the positions they have held and/or currently hold indicated they would provide substantive data.

Interview Protocol

A semi-standardized interview method was used to query the selected sample of faculty concerning their career paths, choices and motivations. This technique was chosen due to its improved flexibility over the standardized interview. Berg (2007) stated that the semi-standardized interview is:

- More or less structured
- Questions may be reordered during the interview
- Wording of questions is flexible […]
- Interviewer may answer questions and make clarifications
- Interviewer may add or delete probes to interview between subsequent subjects (p. 93).

All but one respondent was interviewed via telephone. The primary reason for the use of telephone interviews was the geographic dispersion of the respondents. As Berg (2007) notes, this was an appropriate method when researchers need "the ability to reach widespread geographic areas at an economical cost" (p. 109). All interview sessions were recorded using a portable tape recorder.

Guidance on the development of the design of an interview study as well as the creation of individual questions regarding career choice and impetus was garnered from the literature. Ferony (1996) utilized interview questions that were open-ended, analytical, and generative. Data was recorded and transcribed. A sample of individuals was selected from a larger pool of participants which was meant to reflect the demographics of the population. The interview questions used were:

- What influenced the choice of teaching as a career?
- What caused you to become interested in teaching?
    - What life events influenced this choice?
    - What career experiences influenced this choice?
- What strategies were used to get into teaching? (p. 154)

Analysis was conducted in a methodical process. First, participants reviewed transcripts, then interviews were read through by the researcher, and finally, analysis was done at the paragraph, sentence and line level.

Horrace (1989) provided even more guidance on the types of questions to use to explore career choices and motivations. Questions used in this study explored the respondent's primary occupation, parental occupation, family status, educational background, transition (voluntary or involuntary or retired), point in life decision was made, long-term career goals, why did you choose teaching. Lindholm (2004) used a semi-structured interview process to secure faculty career data utilizing the following protocol:

1. How is it that you came to work at (this institution)?
2. What attracted you to pursuing a faculty career?
3. When did you decide that you wanted to be a professor?
4. Were there particular people
   who were influential in shaping your career decision? If so, what effect did they have?
5. Did particular incident(s) or
   experiences influence your career decision? If so, how?

Additional guidance on question construction was adopted from Campbell (2006) and Dierberger (1998). Although the general questions offered by this research were quite similar to those in other studies, extremely detailed probes accompanying these inquiries offered a more focused and in depth investigation into the data sought. Furthermore, certain questions relied heavily on research concerning faculty conducted by Finkelstein (1984). For example, queries into the attributes of the parents of an individual, including occupational and educational histories allowed analysis in comparison to previous research. Other examples included investigations into family life and school experiences (Campbell, 2006; Dierberger, 1998). Also, Dierberger (1998) included a question concerning the Maslow (1948) need of self-actualization. This question was modified slightly and adopted to gain insight into highest level of motivation among faculty.

During the question development and construction process, individual queries were compared to career motivation and selection theory. Aspects of Super's (1973) theory such as parental influences and vocational experiences were built into the questions. The pursuit of data on work satisfaction is a measure of alignment of individual preferences and the field and position in which one works. These concepts were reinforced by Super's (1973) theory which of course is closely aligned with that of Maslow (1948). Work by both Baldwin and Blackburn (1981) and Reynolds, McCullough, Bindixen-Noe, and Marrow (1994) pointed to a need to investigate the internal and external forces that influence career choice. These aspects were included in the interview protocol. Further, questions were designed so that the archetypes of faculty career paths presented by Reybold (2003) were gleaned upon evaluation of interview responses. Questions also were designed to bring out responses that could typify individuals in relation to Holland's theory on career choice and alignments.

To insure quality data collection, an interview schedule was developed based upon the guidance in Berg (2007): "The specific ordering (sequencing), phrasing, level of language, adherence to subject matter, and general style of questions" (p. 99) were tailored to the fact that all panel members were familiar with aviation, higher education, and each had attained a graduate level education. Berg (2007) indicated that there were four primary question types: essential, extra, throw-away, and probing. Essential questions "concern the central focus of the study" (Berg, 2007, p. 100). The majority of the questions utilized in the study were of the essential type. Each such question was open-ended to prompt as much unbiased input from the individuals as possible (Finley et al, 2003).

Additional probes, those questions designed to "provide interviewers with a way to draw out more complete stories from subjects" were included on the schedule to assist the interviewer as necessary throughout the process. These items came directly from Berg (2007), as well as from other studies that utilized panel of expert interviews (Prochaska-Cue, 1988; Dolezal, 1991; Masse et al, 1998; Elit & Otchet, 1999; Giacobbi, Jr., 2002; Finley et al, 2003; Finch, Begley, Sutherland, Harrison & Collins, 2007).

Before beginning the interview process, the schedule was pretested. Berg (2007) stated that "the schedule should be critically examined by people familiar with the study's subject matter [… such as] other researchers" (p. 105). As suggested by Berg (2007), the researcher conducted practice interviews with the schedule to correct any noted problems.

Validation of the Interview Instrument

Validity in the context of this qualitative context is the determination of "whether the findings are accurate from the standpoint of the researcher, the participant, or the readers of an account" (Creswell, 2003, pp. 195-196). This study followed the validation methods outlined by Kvale (1996) for each stage of the interview development and analysis process. During the design phase, significant efforts were undertaken to carefully and logically plan the methods based upon what was found in the research literature. Also, ethical concerns were a focus with special care to follow what Kvale (1996) describes as "a valid research design [that] involves beneficence – producing knowledge beneficial to the human situation while minimizing harmful consequences" (p. 237). While interviewing faculty participants, the "trustworthiness of the subject's reports" (Kvale, 1996, p. 237) was assured by recording the sessions. Interview integrity was augmented with procedures laid forth by the available literature.

Transcription was completed verbatim from the recording of the interview sessions assuring "valid translation" (Kvale, 1996, p. 237). To maximize the precision of the data, a professional transcriptionist was contracted. A confidentiality agreement was made with this individual to insure confidentiality. These transcripts were then confirmed by the researcher by comparing them to the recordings. According to Creswell (2003), reliability, known as the "stability or consistency of responses […] play[s] a minor role in qualitative inquiry" (p. 195). Thus, respondents were given the opportunity to review their responses for accuracy. No discrepancies were reported within the interview transcripts.

Procedure

A group of six individuals was selected from the pool of participants who completed the survey instrument in a previous research study by Ison (2009). Three persons were selected from each of the primary pathways identified by Ison (2009), i.e. civilian and military. These individuals were contacted via email to inquire into whether they would like to participate in the interview process. Upon agreeing to participate, the researcher arranged for an in-person or telephone interview. Each interview session was recorded and then transcribed verbatim. Respondents were given the opportunity to check the transcript for accuracy of their inputs.

RESULTS

The results stemmed directly from the analysis of the interviews that were conducted with each of the six professional pilot faculty members. Initially, the findings were constrained within the responses to the interview questions. As the data was organized and coded using NVivo qualitative research software, specific topics emerged. The comments on each topic from respondents within the same pathway were grouped together. This allowed for the identification of commonalities within a pathway membership and simplified the comparison and contrast analysis with those who had taken the alternative career pathway. As the analysis of data progressed further, the interview, the literature review, and the applicable research question were used to direct the organization of the findings. Coded topics and concepts were then linked to the appropriate common subject areas.

The majority of the results lent itself to be organized in NVivo free nodes. The free nodes utilized were educational history, school experience, occupational history, decision to become a professor, actions taken to pursue a career in higher education, mentors, discouragement received, and an inquiry into what faculty might do differently. More complex topics were placed within NVivo tree nodes so as to separate and organize the data. The tree nodes used were family and happiness with career choice. Subordinate within the family tree node were parents, relatives, and siblings. Within happiness with career choice, the general subject was subdivided to specifically extract if faculty believe that teaching was their "calling."

Civilian Faculty Responses

Occupational history.

The occupational backgrounds of those civilian faculty were varied and circuitous. One common trait was that each faculty member reported that they had been involved in aviation for quite some time with individuals reporting flight experience of 28, 31, and 39 years. Two individuals had the rank of associate professor, with one working in aviation higher education for 5 years and the other 23 years. The other civilian faculty was a full professor and had been in aviation higher education for 21 years.

The first individual reported becoming interested in aviation in childhood then learning to fly in high school. This person graduated from college in 1973 and sought out a bush pilot position. When that did not become immediately available, this respondent went to airframe and powerplant (A&P) mechanic school. Soon thereafter, this person fulfilled the dream of doing some bush flying by working with a mission-oriented aviation organization in Brazil. After a brief time this individual returned to the U.S. to finish the A&P training they worked as a flight instructor and charter pilot in a large metropolitan area. Within a short period of time, a bush flying opportunity became available in Alaska. This individual reported some very interesting and unique flying experiences during this single season occupation. This included flying a tremendous amount of fish to and from remote and rugged parts of Alaska. Upon the end of the fishing season, this faculty member returned to flight instruction and charter work in a rural location. Following a downturn in the economy in the late 1970's this individual decided to pursue a spiritual career path and attended seminary.

Upon completion of this program, this individual wanted to better their career chances by pursuing an advanced degree. An agreement was made with someone at the school at which this person was interested in attending that would allow the person to go to school and do some flight instruction at the institution's flight department. After about a year of doing so, this individual was brought on as an assistant professor of aviation. From that point (1985) the individual has been a professional pilot educator in higher education.

The second interviewee noted becoming interested in aviation as a child after a positive experience with flying on a transoceanic flight. Formal flight training followed in college. Soon thereafter, this individual was flight instructing at a university flight program and then entered the aviation job arena as a corporate pilot. This individual served as a chief pilot, started three major flight departments including one for a Fortune 500 company. This individual flew internationally and gained experience in jets and turboprops. This respondent had a mix of managerial and flight duties at these different companies. Later, this individual was involved in consulting on an airport development project. This person had just had a child and around the same time the loss of their spouse played a critical part in them a career path change. From this point they began to pursue a career in higher education. However, this person still plays an active role in industry and reported being the liaison between the school at which this individual teaches and business aviation organizations.

The last individual had the most diverse career path and perhaps the most indirect in terms of flying. This individual entered the job market with an engineering degree over forty years ago. This respondent then worked in broadcasting for a few years and then decided to pursue an engineering-related occupation. This individual was initially hired by a major airline to do industrial engineering work. Due to escalating managerial requirements, this individual went back to get a master's of business administration degree (MBA) with emphasis on technical systems management. This individual also showed interest in law and pursued a law degree while continuing to work for the same major airline.

Upon completing the law degree, this person was given more of a counsel-like position in the airline and began to work with flight crews. After being an employee of the airline for almost ten years, this individual became involved in flying through learning to fly outside of work.

This individual bought an airplane and began to fly with increasing regularity. This increased focus on flying also helped at work, boosting participation in flight-related incidents that involved arbitration. Happening simultaneously, this faculty member was operating his own aviation business that focused on flight training. Due to the close proximity of flight school business to a local higher education institution, this individual gained a relationship with the school. This turned into a 15 year stint in academics from classroom teaching to administrative duties. In 2001, this individual retired from this position and took a year off to do some travel. Immediately thereafter this individual re-entered higher education at a different institution and has resided there since.

The common thread among these faculty is the multitude of occupations that they held during their progression towards entering aviation higher education. Of course, each one found his or her way into flying differently, but two especially seemed to be destined for participation in aviation. As one of these respondents noted "I had my first airline flight on a 707 and then somewhere along the ride across the Atlantic Ocean and I told my parents 'I want to be a pilot.' […] I don't know. You ask aviators why they like to fly. I don't know. It's just always been there." The other similar faculty showed dedication to aviation early in life:

> I started flying in high school. I was, as far as I knew the only person in my high school that had a pilot's license. Between my junior and senior year in high school I went to the local airport and said I wanted to learn to fly and made a deal with them that I would work at the airport, pump gas, clip grass, and all that kind of thing but they would pay me off in flying lessons.

Even the remaining faculty member who did not seem as immediately drawn to aviation succumbed to influences of aviation peers to become involved in aviation. Surrounded by airline pilots, this individual was coerced to start flying. And from the quick adoption of flying it was apparent that this individual had simply had a delayed start and love for flying.

Educational history.

Civilian faculty reported a range of different degrees and subject areas in which these degrees were received. One respondent received a bachelor's degree in an aviation-related field 35 years ago. They then received a master's degree in divinity about ten years later. This was followed by an EdD in educational administration and adult higher education which was received one year ago. Another faculty member received the bachelor's 28 years ago in aviation management. A master's degree in aerospace education was completed three years later. This individual completed a PhD in leadership within the last year. The other civilian faculty member attained a bachelor's degree in industrial engineering 38 years ago. They then got an MBA four years later. They followed with a Juris Doctor degree four years after the MBA.

The completion of degrees beyond the bachelor's level appears to have been brought about by personal desires and motivations in addition to some posturing for academic careers. The individual who received the EdD, specifically did so to help improve held academic credentials viewing such an education as an inevitable requirement in higher education. The individual who pursued a PhD wanted something that could help this individual to improve this person's standing in both industry and in academia, to "bridge between the two worlds and have credentials across those both roads, and that's really what drove me to do it." The remaining faculty member pursued their master's and J.D. degree out of interest in the subject areas. The master's degree did seem to be helpful in improving the status of the individual in their workplace and both advanced degrees opened up opportunities within the workplace.

School experience.

Faculty were asked about their experience with higher education as a student. Specifically, faculty were queried about performance in school and perceived difficulty of schoolwork. One faculty member admitted that as an "undergraduate, I had a lot more potential than my grades show. I had too good of a time." But at the advanced education levels this individual reported doing very well "so it is just probably a lot of just growing up and maturing." Similarly, another faculty member stated the undergraduate grades this respondent received were lower than they could have been, but in the case of this faculty member, the performance was blamed on distractions: "I ran out of money [….] I wasn't very focused as an undergraduate student and developed no study habits." But at higher levels of school the story was different: "[it] came fairly easy and I made really good grades." This was attributed to the fact that this individual "had settled down and had been out on [their] own, started working, developed the kind of habits to sit down at a desk for a pretty good while and read and study and write." The remaining faculty member reported finding school easy "all the way through."

Decision to become a professor.

Faculty reported several different ways they came to become a professor in professional pilot education. One individual stated that it was basically happenstance – this particular person originally intended to pursue one career path and ended up in aviation education:

> Because once I started here, up until just recently if you wanted to work on a doctorate and you were a faculty member, you couldn't get your doctorate at the same university. In other words, I couldn't get a doctorate anymore and counseling kind of fell by the wayside, once they kept promoting me and whatever in aviation and I just never even took a class in counseling, because that was my original intention to work on a doctorate in counseling.

This faculty member reported having a philosophical shift after working in higher education for a few years: "Before I was a pilot who just happened to be at this institution of higher education and teaching and an educator, but later on after about 10 years I started thinking of myself as an educator who is a pilot."

Another civilian faculty member got involved in teaching in a more academically traditional way:

> Actually beginning grad school I was approached while I was working on my master's to teach a ground school […] and at that point they never had a graduate assistant instructor. Now they do it all the time. From 1981 I became a graduate assistant instructor in their program teaching private ground school. That was my first taste of it and I found it quite interesting.

Additionally, the academic career was appealing for personal reasons:

> That probably is what led me to in 1989 then go back to teaching for two or three years when I started my family and I enjoyed it, and that is probably what led to realizing when I needed to exit industry until my daughter got grown, that this was an avenue that I enjoyed.

The remaining faculty member could not identify a particular point in their life at which this individual chose to enter aviation higher education. This respondent originally thought to teach in another subject area, but did state that there was an innate draw to teaching:

> Ironically, I don't know if I decided I wanted to be [a professor], but certainly was very attracted to [college teaching] and figured that I would probably get there sometime [….] If you had asked me as a college kid I would have mentioned in there sometime and in fact I think some of the psychological career type placement testing when I was a senior in college, I think I may be interested. I could have seen myself teaching broadcasting in college.

Actions taken to pursue a career in higher education.

Two civilian faculty provided specific actions that were taken in pursuit of careers in aviation higher education. One noted specific academically-related action while the other took more of a practical teaching route. The former faculty stated that it would become necessary to pursue a doctorate to continue moving up in academia. The latter individual sought out aviation-related teaching opportunities and was located closely to a higher education institution with an aviation program thus this individual figured that the two would eventually overlap. Eventually this individual approached the local institution about working in their aviation department. The other civilian faculty member did not specifically prepare for entrance into higher education: "Well, I fell into this position, I suppose. I didn't really plan on it, in my case. I came up here not even to be part of the aviation program, I came up here to work on a different degree." However, this individual did eventually pursue a doctorate degree to gain academic credentials in order to better positioned in higher education.

Influences from family.

An inquiry was made into the influences that family had on an individual's selection of a career in aviation higher education. Specifically, probes were made to extract information about the parents, siblings, and other relatives. All civilian faculty respondents stated that they grew up in middle class households. The parents of two faculty members each completed college. Both fathers had received a bachelor's degree and one mother had received a master's degree. The remaining faculty member had a father who achieved a master's degree and a mother with an incomplete college education. One father worked as a medical technician, another was an active duty Navy surface warfare enlisted man, and the other was in the oil industry working in chemicals. Two faculty noted that their mother was a homemaker while they were growing up, while the other faculty member stated their mother worked regularly through their childhood. Two faculty had mothers that were at some point involved in education with both working as librarians.

All civilian faculty had brothers or sisters. One civilian faculty had an older brother that was in the military. Another faculty member had an older brother that was in the military and an older sister that is a college professor in English. The other faculty member had a larger family, three brothers, and ranked third in birth order. None of the brothers were involved in aviation or education. None of the civilian faculty stated that their siblings influenced their career choices.

When asked if relatives played a role in getting into aviation, all faculty reported someone who did so in their family lives. One faculty member stated "my uncle was in the Air Force and he took me for a ride when I was 12 years old and I said, oh, this looks like fun. And it stuck with me. I always kind of thought to become a pilot." Another reported a similar instance early in life. The other faculty member worked in and around aviation and was eventually drawn to flying through camaraderie. Two faculty members recognized that their mother's roles in education did have a minor role in influencing their affinity for teaching. Only one faculty member specifically reported being influenced by relatives to enter higher education:

> My grandfather did teach college for his whole career […] We would go there almost every summer and some Christmases and visit so I did have that kind of exposure into faculty life and especially for that era and that point in time that geographic location and was really the academic life right out of an old movie. Ivy covered halls, the faculty met everybody and called each other professor, ate dinner together and was really the kind of stereotypical image of academic life and for a kid going over there and getting into the basketball games and football games and stuff like that when we would visit, made a very positive connection.

Mentors.

All civilian faculty reported having multiple mentors along their pathways to the professoriate. One individual noted a specific individual as the primary influence in their academic pursuits: "watching him in the way he did things, the way that he talked, it was inspiring in and of itself." Yet others were also influential: "[the] chair of the department now, has been a rock all of these years. We have kind of just grown up in the program together." One of the other faculty stated that "I had mentors all around. My mentors have always been someone one or two rungs above me in industry." This individual reported having a specific mentor currently who is on the board of directors of a large business aviation organization. This faculty member stated that they continue to seek inputs from all mentors encountered: "I have had these mentors forever."

The remaining civilian faculty member mentioned a wide range of mentors encountered along the way. This individual mentioned a father of a friend that helped steer general life pursuits. Another mentor was a boss early along the individual's career and suggested pursuing an advanced education. Finally, this faculty member noted that there was one person in particular that was "the most influential long-term and probably to some extent toward the college [teaching career….] He and I were pretty close. He gave a lot of career advice and he was one that had first started suggesting teaching kind of things."

Discouragement received.

Only one individual reported any kind of discouragement or resistance when in pursuit of aviation higher education. The majority of this seemed to stem from the fact that this faculty member was a successful woman who was clearly a minority, breaking into aviation at a very early stage in the assimilation of women into the industry:

Well, you know I came into business aviation in 1982 […] if you know the history of that time, very, very few women [were in aviation.] I was the first woman pilot [at a particular entity] in 1983 and so I was in that batch of first corporate women that literally kicked open a lot of doors, and so yes there were obstacles if you can imagine the early 1980's, the South, there were a few people that didn't think I needed to be there.

Happiness with career choice.

Two civilian faculty members stated they were happy with their career choice in aviation higher education. "No question about it, sure, yes." "Yes. I have enjoyed it. It has been a good ride, a good trip." The other faculty member said "No. I think academia is incredibly frustrating." When probed about whether they would take part in aviation higher education again they said no. However, they did mention that if they could be a dean or other academic administrator, a position they feel could impart more change, they would consider possibly participating in aviation higher education.

When civilian faculty were asked if aviation higher education was their calling, only one stated that it was. Of the remaining two faculty, one clearly did not believe that aviation higher education was their calling while the other was less exclusive:

> I don't know if I would go that far. I have had trouble my whole life with the whole concept of calling.[…] I think it is something that I definitely reached a decision to do and it was a firm decision. It wasn't just the path of least resistance but I'd be skeptical of the term calling.

Inquiry into what faculty might do differently.

Faculty were then asked if they would do anything differently in choosing the professional pilot education career path. Only one stated they would most likely have avoided becoming involved in academia. In fact, this individual already had some plans to exit aviation higher education: "I have actually started a nonprofit […] this summer and am actually truthfully probably working my way back to industry." The remaining two faculty were satisfied with their paths to their positions. One remarked "the way it worked out was probably best." When the other faculty was asked if this individual would change anything along their career path, this person stated "my gut reaction is to say no […] there is not anything that I sit here and go home each day saying, man I wish I had done this or done that."

Military Faculty Responses

Occupational history.

Individuals who served in the military had a fairly methodical career progression. Two out of the three respondents entered military service through participating in Reserve Officer Training Corp (ROTC) programs in college. The final respondent entered the military through a U.S. military academy. All military faculty that participated in this part of the study had served in the U.S. Air Force. Also, each individual retired from the military meaning they had served for an extended period of time. The length of flight experiences displayed were 27, 33, and 39 years. These individuals have been involved in higher education five and a half, six, and five years respectively.

One military respondent entered the Air Force so this individual would not be required to follow the family business. This respondent almost immediately became a pilot after graduating from college and continued in that capacity for 20 years. This faculty member flew a large tactical nuclear bomber for most of their time as a pilot. This respondent then became involved ROTC bringing this person in contact with a higher education campus. Upon retirement this individual was located at a campus where there was a new aviation program. This individual exited as a colonel. This faculty member was asked to help in the process of growing the school. This respondent reported being an associate professor and the program coordinator.

The next military faculty spent 21 years as an active duty Air Force pilot and served in a wide range of duties. This individual was a pilot instructor early on. Following this duty, this individual flew large transport jet aircraft soon followed by becoming a classroom instructor at the U.S. Air Force Academy. This respondent eventually ended their career flying very important personnel (VIP) in transports. This individual exited as a lieutenant colonel. Following retirement from this duty this individual became director of the aviation program at a small college and reported having reached the associate professor level.

The last military respondent entered the Air Force through ROTC and then spent 23 years in the service. While in the service this individual had a mix of flying and administrative duties although these were all related to flying. This faculty member progressed through the following duties: Director, Transportation, Military Airlift Command (MAC); Deputy Group Commander, Air Transportation, Airlift Group (MAC); Commander, Aerial Port Squadron (MAC); Commander, Airlift Control Element (MAC), C141 Aircraft Commander qualified; Manager, Air Transportation Plans and Programs Division (MAC); Commander, Base Transportation Squadron Aerial Port Operations Officer; Chief of Safety, VC140 Aircraft Commander qualified; Flight Safety Officer,. C141 Aircraft Commander/Instructor qualified; and Squadron Administrative Officer, C123 Aircraft Commander qualified. This individual exited as a colonel.

Following service in the military, this individual entered the airline world as a pilot progressing through the following duties: Assistant Chief Pilot, A320 Captain qualified; Manager Line Operations, B737 Captain qualified; Line Assigned Captain, B737 Captain qualified; and Flight Safety Manager/Investigator, B737 Captain qualified. Upon leaving the airlines, this individual became an adjunct faculty member at a large university. This individual eventually gained a full-time position and has resided there since. This faculty member reported being the chair of the aviation department and held the rank of assistant professor.

The responses offered by military faculty did show that these individuals tend to follow structured occupational paths to reach aviation higher education. This should not necessarily be surprising due to the structure of military life and careers. Also, these individuals did not really talk about flying in terms of a destiny but seemed to be an assumption necessitated by being associated with the Air Force.

Educational history.

Much like the occupation paths, military faculty have stable educational histories which were characterized by a bachelor's degree in a variety of fields followed by a master's degree that was attained under the strong encouragement by military rank protocols. Only one individual had completed a degree beyond the master's level and the remaining two faculty were not pursuing such further education.

One military faculty member received a bachelor's in agricultural business 34 years ago. During service in the military this individual received a master's degree in aeronautical science. This degree was received 21 years ago. No further education has been or is being pursued. The next military faculty member received an undergraduate degree in mechanical engineering in 1982. Ten years later this faculty member received a master's degree in engineering. No further education was received or is currently being pursued by this individual. The remaining military faculty member received a bachelor's degree in secondary education, a major in biology, and a minor in chemistry in 1967. This individual then received a master's of arts degree in management in 1975, followed by an associate's degree with a specialty in management in 1979. The associate's degree was attained to better serve in a teaching capacity at the school at which it was received. Lastly, this individual just received a PhD in business administration in 2008.

It was made clear by all three individuals that the pursuit of a master's degree was a requirement for promotion and favorable assignments while in the military. Considering that these individuals retired at the rank of lieutenant colonel or colonel, it was not a surprise that they pursued advanced education. At the same time, it appeared that the achievement of this level of degree precluded any motivation for further education in the military. The one individual that did attain a doctorate did so to position themselves more favorably in academia.

School experience.

Military faculty reported mixed results for their experiences as a student in higher education. One individual did not feel as though school was very challenging but "[I] didn't get very good grades in college because [they] had a ROTC scholarship and had pretty much already selected my career path and I was kind of meeting the minimum requirements." This individual did not report having any trouble succeeding in graduate education. Another military faculty member stated that in "undergraduate I did very well, you know, I was probably a B average […] but I worked two jobs." At higher levels the performance by this individual was more impressive: "I did a lot better at the master's degree because I got a 3.66 [GPA …] and for the PhD I got a 4.00 [GPA]." The remaining individual reported that throughout school "I was a good student. I did well. It seemed to come fairly naturally."

Decision to become a professor.

Two of the interviewed military faculty made it evident that they had been interested in teaching for quite some time. Interest in education, in particular higher education, came early for these two individuals. One individual stated that upon being exposed to the world of higher education teaching, this person seemed to have found a good fit: "I can remember saying to a coworker, I feel as though I discovered what I am, I am a teacher. Whether it is in an airplane or in a classroom I really like teaching." Similarly, the related faculty member said:

> Well I've been teaching off and on, because remember I went to college to be a teacher and actually did teaching in college at a high school okay. And then you got to remember I went in the Air Force and when you go in the Air Force usually you have an opportunity to instruct, which I did, so I was able to flight instruct.

The remaining military faculty member appeared to flow into higher education less as a personal pursuit and more out of being in the right place at the right time. This faculty member also discovered teaching as a viable option later in life. When asked about when they decided to enter higher education this individual remarked "the day I retired." This respondent expressed plans to enter the airline world as a pilot but did not due to the September 11th terrorist attacks:

> So I decided I was going to be an airline pilot and essentially was being considered for interview with [a major airline] and 9/11 happened. So that one went bye-bye and then I fell back into the I think I want to be a professor and a job opened up.

Actions taken to pursue a career in higher education.

When asked about the specific actions taken to pursue a career in aviation higher education, each military faculty noted actively performing some kind of preparatory task to position themselves for this career. One faculty member pursued the required civilian licensure so they would be qualified to be a versatile aviation faculty member:

> Well, I went and got, let's see, I went and took a bunch of FAA writtens because I wasn't properly, didn't have the CFI rating and frankly hadn't done much flying [….] And then in order to be qualified for this job, I had to have a minimum of a ground instructor. I went and got advanced and instrument ground instructor ratings.

Another faculty member stated that while pursuing academic qualifications, i.e. advanced education, due to the needs of a rising military officer, it was realized that other benefits came at the hands of such pursuits: "the accumulation of degrees was actually the credentialing needed for the next job opportunity, promotion opportunity, success opportunity." The remaining faculty member sought out a teaching position at the Air Force Academy as interest in teaching grew. While this faculty member did not know when a decision was made to get into higher education as a long term career, this individual was confident it would happen at some point in life.

Influences from family.

Military faculty provided insight into a mixture of different family backgrounds. All three respondents stated that their fathers were active duty military personnel at some point in their lives. This was noted to have played some role in their pursuit of a career in the military. Two military faculty reported that their fathers played a significant role in influencing them to pursue aviation. All fathers had some college education, but only one had completed a four year degree. Among the mothers of military faculty, all were received some college education with two having completed a bachelor's degree. The two mothers that had completed four years of college were also school teachers while the remaining mother was a nurse. One mother was a stay at home mother, while the other two worked. All reported enjoying a middle class upbringing.

All military faculty reported having siblings. One stated that being the middle child with an older sister who now runs a campground and a younger brother that works at an airport but "he has no interest in flying." The next faculty member had two brothers and this individual was the middle child. Only one of these brothers was involved in an aviation-related job field. The remaining military faculty member was the oldest of two boys. Their brother was not involved in education or flying. None reported being influenced in career decisions by their siblings.

As far as other relatives that influenced military faculty into pursuing aviation and/or higher education, there was a variety of responses. One faculty stated that there were absolutely no relatives that played a role in this process, although this individual indirectly related distaste for continuing in the family legacy of agriculture. Another faculty member reported having quite a few relatives in the military and got to know the Air Force well through the eyes of these family members, causing a leaning towards aviation. This individual hinted that maternal involvement in education may have had some influence on being inclined to enjoy that type of career. The remaining faculty member painted a detailed picture of relatives that guided this individual into higher education:

> I have held teaching in very high esteem. Scattered throughout my family past is a lot of educators and I always thought teachers were noble. My maternal grandfather [...] was fairly involved in my life, all things considered. He had been a superintendent of schools and a professor of education at [a large university in the West...] My mom's sister's career was a classroom teacher in [the Northwest], elementary, learning disabilities. My wife, when we were first married, she was in public education, special education teacher.

Mentors.

Two out of the three military faculty noted that mentors played an important part in guiding these individuals along their paths to higher education. One stated that a prominent member of the University Aviation Association "helped me a little bit and kind of pointed me in the right direction to make myself qualified for a potential job, and after I was hired he helped me somewhat before he left." The other mentored faculty stated there were many peers that acted as mentors but one person specifically helped more than the rest: "I admired him and he filled my head with a lot of good stuff about the nobility of education, the importance of integrity in the classroom." The remaining military faculty member reported more self-guidance taking matters into one's own hands to find their way into higher education.

Discouragement received.

Only one military faculty respondent encountered any kind of negative sentiment towards choosing a career in aviation higher education. Friends questioned why this individual would choose such a career in light of the potential earnings and prestige in the airline world:

> As I was getting ready to retire from the military many of my peers who were also retiring [….] At the time it was easy to get a good airline job, United, Delta, FedEx, they were all hiring [….. My peers] looked at me a little bit sideways and said, what are you doing? Oh yeah, you're one of those brainiac academic types.

Happiness with career choice.

All military faculty reported that they were happy with their career choice as professional pilot educators. One faculty member acknowledged the importance of passing the torch of knowledge to the next generation of pilots: "I really love aviation and it is a way of giving back to that profession by doing my best to make a better breed of younger people who will carry on." Another military faculty stated very similar sentiments:

> How often does the person in their career have the opportunity to give back to the next generation the experience level gained so they don't have to repeat some of the same errors. That's personally rewarding as well as educationally rewarding.

The remaining faculty stated that teaching was critical to their happiness in the world of work: "When I thought what I liked best about my career, it was the teaching. Sure I liked the flying […] but I think overall most satisfying part about it is mentoring [….] That's very much what education is."

Faculty were then directly asked if they felt as though teaching was their calling. Two responded positively. "I would. I absolutely would. […] I very much think it is a calling." "Oh yeah. Absolutely." One faculty member said it was not. "No, I wouldn't consider it a calling. I would consider it a profession that you are in."

Inquiry into what faculty might do differently.

When asked if they would do anything differently, military faculty stated that they would not change their decision to become professional pilot educators. One said "in retrospect, I wish I would have started earlier." Another talked about wanting to have worked on academic qualifications earlier in life: "In theory, I would have like to squeezed in a PhD along the way." The other faculty member would do it all the same way again noting the great satisfaction received in doing the job: "one of the personal rewards is to be able to take your work experience and your background and be able in an educational form to use that to instruct subject matter for those who follow you."

Comparison to Previous Research

Faculty motivations and archetypes.

Faculty interview data was compared to previous findings on faculty career motivations and choices. Robinson, Murrells, and Marsland (1997) stated that career choice was a life-long, ongoing process. This was found to be true among all types of professional pilot faculty. Interview findings also were aligned with Holland's (1997) premise that there is a fit between the individual and their vocation. Professional pilot faculty appeared to be a mix of scientific and social types seeking both research activities and interaction with people. Naturally, as Holland (1997) surmised, persons with these attributes would be drawn to environments that are suited for such tastes. Clearly, institutions of higher education provide this type of environment. The one faculty member who stated not being particularly happy with the career choice of aviation higher education appeared to fit the conventional personality and favored a similar environment. This conflicts with the environments most closely associated with higher education: the social and scientific. This could help explain their dissatisfaction.

Need fulfillment, as described by Roe and Lunneborg (1990) also could be seen in the interview responses. All faculty showed that they gained pleasure from performance of problem solving and learning tasks as well as through helping others. These actions and desires fulfill the pleasure and contribution needs. Social learning was seen in many of the interview responses. Immersion in the environment and with the people working in the field helped influence not only some faculty member's choice to follow a career in aviation but also higher education.

Also the interplay of ability, environment, and experiences appeared to be a factor. All of the faculty interviewed had academic abilities that had made them successful in a variety of scholarly pursuits. Their environment influenced their choice to pursue their aviation and higher education careers, for example, one faculty was engrossed in the airline world while another was exposed to teaching opportunities as part of their job functions. Experiences were wide ranging in terms of flowing into higher education stemming from positive influences from peers, success in flying, and through fulfillments brought about by getting some familiarity with teaching and the academic life. The idea of a good fit of career and individual is reinforced with Super's (1973) theory which alludes to the need for individuals to have an adequate outlet for their skills, interests, personality, and values. The faculty members that reported they were most satisfied and had found their calling in aviation higher education appeared to fall into the confines of this theory.

Austin (2002) noted that faculty, specifically, often experience anticipatory learning where individuals migrate towards the attributes of those within their career choice. Most of the interviewed faculty did seek the credentials and experiences that would suit them best for a career in academia. Professional pilot faculty seemed to be influenced by many, if not all, of the factors identified by Reynolds, McCullough, Bindixen-Noe, and Marrow (1994). Formative experiences, such as family, played a prominent part in shaping the careers of aviation faculty. Personal characteristics also played a role, as one individual encountered challenges that others did not because of their gender. The professional characteristics definitely drew individuals into aviation higher education. All interviewed faculty were pilots in some capacity and they all were involved in some sort of flight instruction which is a potential grooming avenue for entrance into educational pursuits. The perceived reward system also was a factor. Explicitly, one faculty member saw what the academic life might be like and was immediately drawn to it.

Other factors identified by Finkelstein (1984) were shared by professional pilot educators. One was intellectual related where there is clearly academic/scholarly interest on the part of the faculty member. Mentoring was also identified as playing a big role in the shaping of faculty career paths among aviation faculty interviewed. Another occurrence observed by Finkelstein (1984) that occurred among aviation faculty was that of being in the right place at the right time. At least two faculty reported such alignments took place that placed them into a position leading them to aviation higher education.

Professional pilot educators appeared to depart from previously discovered attributes about faculty at large. Finkelstein (1984) found that the choice to enter academia typically occurs in the graduate education arena but many decide while still involved in undergraduate education. Although professional pilot educators seemed to pick their path towards aviation either early in life or at least close to their college years, there was little, if any, interest in higher education until later in their lives.

Finally, it was interest of to the researcher to see what archetypes were identified that Reybold (2003) might apply to professional pilot faculty. Only one faculty appeared to be in line with the pilgrim model, which follows a "carefully planned path" (Reybold, 2003, p. 244). Another faculty could be identified as a visionary which "characterize their future faculty position, particularly their teaching and research roles, as a forum for achieving social change or educational reform." (Reybold, 2003, p. 245). The remainder of the interviewed faculty were best described by the drifter model which "expresses no singular commitment to academe […] their odyssey may take them through the professoriate at some point in their professional migration, but it may just as well lead to a corporate position" (Reybold, 2003, p. 248).

DISCUSSION

The primary goal of this study was to investigate the motivations and influences behind the pursuit of aviation faculty careers. The findings of this study successfully allowed for the reaching of these research goals. The interviews conducted during this study were able to identify the motivations and influences that shaped the selection of professional pilot higher education as a career among a cohort of faculty. An equal number of individuals from the previously identified primary pathways (military and non-military) were queried so as to collect a balanced insight into such motivations and influences. The similarities and the differences between these groups further improved the characteristic profiles of all types of professional pilot faculty to include the internal and external factors that shaped their career choices.

Interview responses provided a detailed look into occupational and educational histories. Civilian faculty reported having a wide range of occupations on their path to the professoriate. Flying was clearly an overwhelmingly common thread in such occupational histories. Flight experience averaged more than 32 years. Time in aviation higher education was lengthy as well, with the average of 16 years. The career paths of military faculty were much more structured and succinct. All interviewed military faculty entered the military directly after completing college. These individuals progressed through their military careers through a range of flying and managerial positions. Only one individual was a "hybrid" where the individual entered the civilian flying world between their military service and entering postsecondary professional pilot education. The flight experience among these faculty averaged 33 years. The average length of time these military faculty have been in aviation higher education was five and a half years.

The educational histories of both civilian and military faculty were disparate. Subject areas in which faculty received their degrees were scattered across education, flying, engineering, and business-oriented subjects. Military faculty appeared to have followed the expected progression in degree attainment of those in the armed forces where they must seek advanced education in order to move up in rank. Civilian faculty pursued advanced education more for personal interests and for advancing their credentials for employment in industry and/or higher education.

A common trait among both groups of faculty was that their performance in undergraduate education was not as good as they would have liked it to be (with one exception) due to maturity or life-status issues. However, all faculty remarked that they excelled at higher levels of educational attainment. All faculty were first exposed to education through involvement in flight instruction yet the actual decision to go into aviation higher education was different for most of those interviewed. Two military faculty did seem to be set on seeking entrance into the profession early on, but the others either fell into the profession, or took a more traditional academic route. All faculty reported that they took some kind of action to position themselves more adequately to enter the teaching world. Most commonly, these individuals sought additional credentials and education.

Families did appear to play a part in influencing the career paths of both groups of faculty. All military faculty had fathers that had served in the military which influenced the decision to follow in their footsteps. There was no apparent relationship between the occupations of civilian faculty and their fathers. Mothers of faculty seemed to be more of an influence on the realization of the importance of education. All faculty came from middle class families though none came from what could be considered a "professional" household (e.g. doctor or lawyer parents). This contrasts with previous research on faculty. Also different was the education level of the fathers of aviation faculty, as these individuals did not conform with previous research on faculty in terms of achievement of advanced education. Other family members helped influence faculty in both groups to pursue aviation such as airplane rides with uncles and family trips on airplanes. Relatives also influenced a leaning towards higher education from relatives that were admired who were in education to visits of a college campus where a relative worked.

Almost all of the interviewed faculty mentioned that they had some kind of mentoring during their career progression. Some of this was more focused on the specific requirements that would be expected of them to enter higher education while others were more generally supportive in the pursuit of such a career. It was apparent that certain individuals in the pasts of faculty were big influences in the seeking of such a career. Without the critical inputs of these mentors, it would be hard to assure that faculty would have come to the same conclusions about wanting to enter aviation higher education. Only one faculty reported open opposition along this individual's career path while another received some questioning from peers about the logic behind the decision to enter aviation higher education.

There was solely one faculty member reported being unsatisfied with the decision to enter professional pilot education. The overwhelming sentiment, however, was faculty would follow the same or similar path to reach their positions again, if given the chance, though not all agreed that aviation higher education was technically their calling in life. Faculty did state that they might do some things differently though only one made it sound as though this change would have been to avoid aviation higher education. Others responded that they would better position themselves for the career through education or timing of entrance into the field.

CONCLUSION

This study successfully identified the motivations and influences that played a role in shaping the career paths of a cohort of professional pilot educators. These were discovered through the use of a semi-structured interview based upon a literature review on human and career motivation theories. The findings were then coded and processed with the assistance of NVivo qualitative analysis software. Results were presented in a narrative format guided by the interview questions. The results from this component of the study were compared to previous related research on faculty.

It is important to note, however, that this study only scratches the surface in pursuit of identifying motivations and influences that shaped the career paths of aviation faculty. While certainly compelling, the findings of this study cannot fairly be generalized to the entire population.

In sum, the data provided by this study will be helpful to all types of aviation industry stakeholders, as well as a wide range of persons associated with higher education, as they seek to understand the professional pilot program faculty cohort. Optimistically, the findings of this study can serve as a guide to why individuals choose to enter aviation higher education which may assist in recruiting individuals into the field and insuring a constant supply of future faculty. This is made possible by improving the understanding of what individuals are most likely to enter the field and be satisfied with such a decision. Lastly, this information lays a foundation for improving retention of current aviation faculty through an improved understanding of their sentiment about their careers.

Suggestions for Future Research

While this study provides an improved understanding of the motivation of and influences on aviation faculty in their pursuit of a career in the professoriate, more research is necessary to expand upon existing data. Suggestions for future research include:

1. Further interview-based research on the job satisfaction, occupational expectations, and sentiment about the role of being a post-secondary aviation educator should be conducted so as to better understand what compels individuals to enter and stay within this realm of higher education.
2. This study should be repeated, but on a broader scale, to include faculty at all types of institutions and in all aviation subject area specialties. This will allow for the identification of subtle differences between groups so as to further improve the understanding what motivates and influences faculty.

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Guided Mental Practice:
An Instructional Strategy for Asynchronous e-Learning of Pilot Safety Skills

Suzanne K. Kearns, Ph.D.
University of Western Ontario

ABSTRACT

This investigation assessed guided mental practice (GMP), a new practice approach for online learning, within a pilot safety training program. With GMP learners view a video of a flight simulator scenario and imagine themselves as the pilot of the flight. Thirty six licensed pilots participated in the study and were randomly separated into three groups: (a) training with hands-on practice facilitated through yoke and rudder pedal-controlled flight scenarios, (b) training with GMP where participants observed a flight scenario video, and (c) a control group that did not receive any training. Post-training, pilot participants completed a cross country flight in a high-fidelity simulator. During the simulator flight, each participant's situation awareness was assessed. The results of the study suggest that training incorporating GMP can be equally effective as training with hands-on practice in improving pilot safety performance.

INTRODUCTION

To address the large number of human error accidents in aviation, most airline and military pilots are required to complete annual safety training known as *crew resource management* (CRM) (Jensen, 1995). There are several concepts included in CRM training, such as communication and coordination with crewmembers, aeronautical decision making, automation management, workload management, and situation awareness. A recent variation of CRM is *single-pilot resource management* (SRM) which adapts CRM concepts for use in single-pilot operations. Unlike CRM which is primarily designed for airline and military pilots, SRM is appropriate for general aviation pilots who may not otherwise have access to advanced safety training.

In airline and military environments, CRM concepts are taught in a classroom and followed by practice in a high-fidelity flight simulator (Helmreich, Merritt, & Wilhelm, 1999). The disadvantage to this approach is that high-fidelity flight simulators are extremely expensive to operate, large training facilities must be maintained, and pilots must be pulled from active duty to complete training. However, simulator practice of CRM concepts is important as a lack of practice opportunities can result in pilots developing declarative knowledge but lacking the procedural knowledge required to apply the skills outside of the classroom to novel situations (Salas, Rhodenizer, & Bowers, 2000). Integrating practice into SRM training is problematic, as high-fidelity simulators are prohibitively expensive or inaccessible to many GA pilots. However, since practice remains an important element of training, a method of incorporating practice within SRM is required. The delivery of CRM and SRM via e-learning can ameliorate many these issues as it provides complete temporal and geographic flexibility at minimal cost. In addition, low-fidelity simulation may be integrated into e-learning as a method of practicing CRM or SRM concepts.

Broadly, simulation can be broken down into two categories: high-fidelity and low-fidelity. A high-fidelity simulator is characterized by realistic out-the-window scene detail, avionics that are cockpit-specific to the aircraft it represents, flight controls with feedback that is representative of actual flight dynamics, and motion platforms. By comparison, low-fidelity simulators are personal computer (PC) based flight simulators that are commonly regarded as games. Low-fidelity simulators are sometimes called PC-based aviation training devices (PCATDs).

Compared to high-fidelity simulators, low-fidelity simulators are very inexpensive. Yet, investigations have found no differences in training transfer between high- and low-fidelity simulators (Koonce & Bramble, 1998; Salas, Bowers, and Rhodenizer, 1998). Research suggests that low-fidelity simulation is effective as long as it simulates the cognitive processes required in real world operations; this correspondence is called *psychological fidelity* (Bowers & Jentsch, 2001). Incorporating low-fidelity interactive simulation into a computer-based CRM or SRM training program allows for a method of practice. Low-fidelity simulators have been used for some aspects of CRM training in the past, such as practicing aircrew coordination skills. Generally, pilots consider low-fidelity simulators to be an acceptable method of practice (Baker, Prince, Shrestha,Oser, & Salas, 1993; Brannick, Prince, & Salas, 2005).

Personal-computer based low-fidelity flight simulators that incorporate peripheral yoke, throttle, and rudder pedals become more than a game and are marketed as a means for pilots to refine their skills. However, the high-bandwidth requirements and the cost of flight control peripherals associated with interactive simulation complicate wide distribution of such a program. Thus there is a need for cost-effective scenario-based practice within CRM and SRM that can be widely distributed online, without flight control peripherals.

This investigation assessed a new instructional strategy—guided mental practice (GMP)—as a means of practicing pilot safety concepts online. As an initial investigation into the effectiveness of GMP, this study assessed only one component of CRM and SRM training: situation awareness (SA). Endsley (1995) defined SA as "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" (p. 31).

Practice

Deliberate practice.

Research has determined that the amount of experience does not directly relate to the acquisition of expert performance. Rather, expert performance is attributable to the amount of *deliberate practice* accomplished by the learner (van Gog, Ericsson, Rikers, & Paas, 2005). Deliberate practice, which is carried out to refine or enhance a specific skill, is typically created by an instructor to target specific areas of a task that require improvement. To be effective, deliberate practice activities must be at a challenging level of difficulty, provide feedback, and allow for refinement (van Gog et al., 2005). This type of practice requires a high level of concentration and is effortful to maintain (van Gog et al., 2005).

Although deliberate practice is often included in CRM training programs, it is typically focused on developing conditioned responses rather than on developing higher order thinking skills (Robertson, 2005). It is necessary to design practice scenarios that allow students to practice applying the instructional concepts and to think about how they will react in a real-world situation.

Mental practice.

Mental practice is characterized by learners deliberately verbalizing or visualizing the information while imagining (Leahy & Sweller, 2005). Studies on the effect of mental practice come from various disciplines, including sport psychology, cognitive neuroscience, and cognitive psychology (Jackson, Lafleur, Malouin, Richards, & Doyon, 2001). The instructional strategy of imagining to enhance learning and performance has a long history in the research literature, although the terminology is varied. The terms *symbolic rehearsal* and *imaginary practice* originated in the 1930s (Perry, 1939; Sackett, 1934).

Since that time, the terms *mental practice, introspective rehearsal, conceptualization, covert rehearsal,* and *mental rehearsal* have been used to describe the same phenomenon (Driskill, Copper, & Moran, 1994; Leahy & Sweller, 2004). Although several studies have evaluated this phenomenon, some with inconclusive results, most indicate that mental practice improves performance (Druckman & Swets, 1988).

Leahy and Sweller (2004) explained that *mental practice* is a form of deliberate practice, as the goal of both is to "process material through working memory with the intention of strengthening schemas held in long-term memory" (p. 859). Wiley and Voss (1999) determined that the kind of practice exercise does not matter; it is the mental process it facilitates that results in enhanced learning. Similarly, Jackson et al. (2001) stated that "humans have the ability to generate mental correlates of perceptual and motor events without any triggering external stimulus, a function known as imagery" (p. 1133). This imagery, or mental practice, is a powerful instructional tool for improving performance on both cognitive and psychomotor skills (Driskill et al., 1994). In fact, learners who imagine a concept or procedure often outperform those who study or practice it (Cooper, Tindall-Ford, Chandler, & Sweller, 2001; Leahy & Sweller, 2004, 2005).

There are physiological and psychophysical similarities between movements that are physically executed and those that are imagined (Fadiga et al., 1999; Leonardo et al., 1995). Therefore, mental practice improvements are not limited to cognitive tasks but apply to performance on psychomotor tasks as well (Driskill et al., 1994).

Mental practice in education and training.

There is little published literature on mental practice investigations in the educational domain, whether in training or higher education. The present study is one of the few that addresses the application of mental practice concepts in professional training. Computer assisted mental practice, as utilized in the present investigation, is also rarely addressed in the academic literature. However, a recent investigation developed a virtual reality system to guide a stroke victim through mental practice exercises in which a virtual reconstruction of arm movement was presented. The investigation determined that the device and associated mental practice resulted in significant improvements. The study also concluded that technology-supported mental practice training programs are feasible and potentially effective for improving motor skills (Gaggioli, Meneghini, Morganti, Alcaniz, & Riva, 2006). GMP, as used in this study, is another example of technology-supported mental practice.

Mental practice theories.

Sackett's (1934) symbolic learning theory suggests that mental practice improves motor performance through a cognitive rehearsal of task components. This theory is consistent with the findings of several experiments that identify a stronger effect size of mental practice for cognitively demanding tasks (Driskill et al.,1994). However, it does not explain studies that have found an increase in muscle strength after mental practice (Yue & Cole, 1992). Paivio (1985) proposed another theory of mental practice. According to Paivio's theory, performance improvements resulting from mental practice result from both cognitive and motivational aspects of an activity at several levels. According to a third theory, the benefits associated with mental practice are similar to the benefits associated with self-explanation. Self-explanation research has found that individuals who effectively problem-solve are likely to explain the material to themselves (Renkl, 1999; Wong, Lawson, & Keeves, 2002). Cooper et al. (2001) maintained that this phenomenon is an example of mental practice occurring naturally. Self-explanation can be considered a form of deliberate practice that enhances the development of schemas (Ericsson & Charness, 1994). The literature indicates that the computer-based instructional design community has yet to capitalize on the potential of mental practice. In particular, mental practice may have the potential to expand the capabilities of computer-based distance education to enhance complex and highly technical skills.

METHOD

Training Program

For the present investigation, a 90 minute online training program was created. The training program focused on SRM safety skills, including situation awareness. Within the 90 minutes of training, several low-fidelity simulator scenarios were integrated to provide learners with the opportunity to practice SRM concepts. Two identical versions of the training program were created, with identical practice scenarios. The only difference between the two versions of training was whether students were able to control the scenario hands-on or to observe a video of the flight scenario for GMP (see Figure 1).

Figure 1. *A screenshot of the flight scenario video used for hands-on practice and GMP of situation awareness skills*

The first version of training allowed students to have complete control over the aircraft within the practice scenarios through the use of peripheral yoke and rudder pedals. The experimental group that completed this version of training was referred to as the hands-on practice condition.

The second version of training presented students with videos of flight scenarios, which they were not able to interact with or control. Students who completed the second version of training were asked to imagine themselves as the pilot of the flight as they watched the scenario video. The experimental group that completed this version of training was referred to as the GMP condition. GMP differs from traditional mental practice, which is typically an entirely internal process, in that the training course guides the learner through the mental practice exercise.

Participants

The sample comprised a total 36 of individuals. There were 32 males (88.9%) and 4 females (11.1%). The age range of the participants was 18 to 31 (mean = 22.14, *SD* = 3.04). Although most participants were at the private pilot level, flight hour experience ranged from 50 hours to 825 hours (mean = 164.8, *SD* = 166.1). All participants were required to have achieved a minimum of a private pilot certificate. Participants were recruited through an email distributed to alumni, students, and associates of the aviation program at the university and college associated with this investigation. A recruitment email was also distributed to several pilot clubs and associations in the local area.

In order to possess a pilot's license individuals must complete a medical evaluation. Therefore, physical and mental disabilities, which are important considerations in the design and development of most online learning programs, were not of significant concern in the investigation.

Procedure

This study utilized an experimental one-variable multiple condition control group design. The independent variable (IV) was SRM training. Three groups of 12 participants were formed in the study: (a) those who received training with hands-on practice, (b) those who received training with GMP, and (c) a control group that received no training. The dependent variable was situation awareness performance, as measured by the situation awareness global assessment technique (SAGAT) within a high-fidelity flight simulator post training (Endsley 1995, 2000). The SAGAT is a commonly used assessment of pilot situational awareness (Endsley 2000).

Data collection took place over a 2-week period. The involvement of individual participants was completed in a single day and was approximately 3 hours in duration. One at a time, participants arrived at the training facility and were randomly assigned to a treatment group. Participants within experimental groups then completed a 90 minute SRM training course. Hands-on and GMP training took place in separate quiet rooms. Participants in the hands-on practice condition completed training at a computer equipped with peripheral keyboard and mouse devices used to control the training program's multimedia presentation and yoke and rudder pedals to control the low-fidelity flight scenarios, as pictured in Figure 2. Participants in the GMP condition completed training at a computer with only keyboard and mouse peripherals.

Following training, participants were asked to plan a cross country flight which would be completed in a high-fidelity Cessna 172 flight simulator. Participants were provided with planning materials, including a description of the route and intention of the trip, a map, flight computer, plotter, weather, and blank paper for notes. Flight planning was also completed in isolation, in a quiet room. Participants were given an open-ended amount of time to complete their flight planning and were asked to notify the researcher when finished (the amount of time used ranged from a few minutes to over an hour). Participants in the control group did not complete any computer-based SRM training and were immediately given planning materials for the cross country trip in the high-fidelity flight simulator.

Once participants notified the researcher that they had completed flight planning they were given a SAGAT briefing, which explained how the simulator would be paused at random intervals and questions would be asked by the researcher. It was explained that the researcher would compare the participant's answers to the current state of the flight to generate quantitative data regarding situation awareness. Participants were asked to respond to all questions to the best of their ability and as quickly as possible. Following the SAGAT briefing, participants were escorted to the Cessna 172 high-fidelity flight simulator to complete their cross country exercise. The high-fidelity simulator was operated by a pilot/research assistant and observed by a researcher. Once the cross country flight was finished, the participants were debriefed.

The SAGAT queries were developed before conducting the study. To evaluate performance, the researcher compared the participant's answers to the status of the flight simulator to generate quantitative data describing the participants' performance. A score of one was given for a correct response and zero for an incorrect response.

Figure 2. *Peripheral yoke and rudder pedals used within the hands-on practice condition*

RESULTS

Performances of individuals in the sample were measured using the SAGAT (Table 1). A univariate analysis (that is, without controlling for age, gender and other variables that might have an effect on the performance measures), identified significant differences across groups at the 0.05 level for SAGAT (p = 0.001). In order to assess the nature of the group differences, a post hoc Least Significant Difference procedure was performed. This procedure allowed performing multiple pairwise comparisons in order to determine which groups had significantly higher or lower scores than others.

Table 1. Differences in Performance Measures by Group

Group		SAGAT
Hands-on practice	Mean	13.08
	SD	2.35
Mental practice	Mean	13.50
	SD	2.43
Control	Mean	10.00
	SD	2.22
Total	Mean	12.19
	SD	2.77

Note. The p value for this table corresponds to one-way ANOVA using SAGAT as the dependent variable and Group as the independent variable. p =.001

For the SAGAT variable, it was found that the control group had lower scores than the GMP (p = 0.001) and hands-on practice (p = 0.003) groups. However, no significant differences were found between the GMP and hands-on groups (p = 0.665). These findings provide evidence that safety training with GMP and safety training with hands-on practice have approximately the same degree of effectiveness in increasing SAGAT scores.

SUMMARY AND DISCUSSION

The results of this study indicate that guided mental practice was as effective as hands-on practice in improving situation awareness skills, as a component of CRM or SRM training programs. These findings promote GMP as a feasible and effective instructional strategy for computer-based training of non-technical pilot skills within CRM and SRM. In addition, the incorporation of GMP can ameliorate the problem of distributing peripheral yoke and rudder pedals for the control of low-fidelity simulators within online pilot safety training.

The findings of this investigation are relevant to the broader academic and instructional design community for two main reasons. First, the lack of significant difference between the hands-on and mental practice conditions supports the hypothesis that both GMP and hands-on practice are effective deliberate practice methods within pilot safety training. Second, the significant performance improvement demonstrated by the groups that completed training (incorporating either hands-on or GMP), compared to the group that did not complete training, supports the claim that asynchronous computer-based training is a feasible option for delivering non-technical training.

These results suggest that guided mental practice is a promising e-learning instructional strategy. However, because of the infancy of this approach, additional work is required to assess its effectiveness in delivering other CRM and SRM concepts beyond situation awareness. Finally, it is recommended that future research assess long term changes in behavior and organizational impacts associated with computer-based pilot safety training.

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Using The Table Reading Test As An Indicator For Success in Pilot Training

Anthony Mekhail, Mary Niemczyk, Jon W. Ulrich, and Merrill Karp
Arizona State University

ABSTRACT

The Table Reading Test (TRT) assesses an individual's perceptual speed, or how rapidly one absorbs and processes visual search information. The focus of this study was to determine the validity of the TRT scores as a predictor of pilot training success. A total of 116 subjects enrolled in an aviation program at a major university in the southwest were tested between the Fall 2005 and Fall 2008 semesters, inclusive. Their TRT scores were tested for correlations to one of several flight/academic performance criterion. The results of the analyses found the TRT best predicts: Time to Solo (r = -0.228, $p < 0.024$), Time to Private (r = -0.754, $p < 0.001$), and GPA (r = 0.283, $p < 0.002$).

INTRODUCTION

Many young adults pursue flight training with aspirations for careers in the military, commercial airlines, and/or with private entities. Some do so because of an interest in aviation, while others may do so because of extrinsic reasons, such as pressure from parents who may themselves be pilots. Because the pilot profession is a well respected and prestigious career path in many societies, some individuals set out to become pilots without fully realizing the many challenges that lay ahead of them.

One of the biggest challenges in becoming a pilot is the ever increasing cost of flight training. Flight training is quite expensive, potentially costing students tens of thousands of dollars over the course of their instruction. A major component of this expense is related to the fleet of aircraft that flight schools procure and maintain for training. In addition, flight schools must hire well-qualified flight instructors and may also provide ancillary facilities and services, such as hangars and computer simulators.

Not all students who begin flight training actually complete it. In the early stages of flight instruction, students may decide to discontinue training for a variety of reasons - some may lose interest, while others may determine that they cannot afford further training. In other cases, students may continue their training only to discover that they do not possess the aptitude necessary to become a pilot. This could result in frustration and disappointment along with a significant amount of debt.

To resolve this situation, it would be helpful to identify early on those individuals who possess the greatest potential to succeed in flight training. In order to properly identify pilot candidates with the greatest chances for success, individuals should be assessed before beginning training. The military, for example, uses paper-based and apparatus-type tests focusing on cognitive and psychomotor abilities. In contrast, commercial airlines hire pilots with different aviation backgrounds and experiences and, instead, test for personality and job sample measures (Goeters, 2004). While some airlines hire pilots from the military, pilots are also hired away from other carriers, while still others come directly from training schools (Carretta & Ree, 2000).

Although there are several different test instruments used for pilot selection, almost all measure cognitive ability, conscientiousness, or job knowledge. The focus of this study was to determine the validity of a paper-based assessment measure, the Table Reading Test (TRT) (Damos, 2004), to assess an individual's perceptual speed, or how rapidly one perceives and processes, in this case, visual information. Damos has previously validated the TRT for airline pilots; therefore the focus of this study was the validation of the test for *ab initio* pilots.

Statement of Purpose

For many years, the aviation industry has sought to determine the characteristics that constitute a successful pilot. This study focuses on determining the possible correlation of subject TRT scores to flight and academic performance measures, including the number of hours accumulated before solo, the number of hours accumulated prior to the FAA Private Pilot check ride, and an individual's Grade Point Average (GPA).

LITERATURE REVIEW

Pilot selection systems are designed to relate test scores to skills that are required to fly an aircraft. While selection assessment measures have been utilized for many years (Thorndike, 1949) and have included various constructs, the most essential task remains the same - to obtain suitable criterion measures to validate against performance.

Validity

Validity is the degree to which an instrument or test measures what it intends to measure (Carmines & Zeller, 1979) and is an overall evaluation of the extent by which observations and theories support interpretations derived from tests and instrument scores (Messick, 1995). However, validity is not a property of the test itself, but rather the interpretation of the test results. It is important to identify the intended purpose of the instrument, the intended subjects on which the instrument is to be used,. and the specific conditions applicable to the instrument with regards to how and what inferences can be made from the test's results (Di Iorio, 2005). If validity cannot be shown, a study has very little value regardless of the relationships between test scores and performance (Carretta & Ree, 2000).

There are three types of validity: Content, Construct, and Criterion. Content validity tests whether an experimental or observational measurement reflects a particular area of content (Carmines & Zeller, 1979). That is, content validity tests whether the *content* of a test actually assesses all of the measures the test is intended to assess. Construct validity, on the other hand, pertains to determining exactly what a specific test actually measures. It allows one to *construct* and then test a hypothesis. Construct validity is used when no criterion or content is sufficiently accepted to define a subject that is being measured. Construct validity considers the relationship between an observed measure to its supporting theories (Carmines & Zeller, 1979). Finally, criterion validity looks at test scores and predicts future subject population performances. If the correlation between scores and performance on the criterion variable is insignificant, then the test is not useful. The purpose of criterion validity is to show that scores on the criterion variable can be predicted from test scores or the predictor variable.

While all three validity tests are important, *criterion validity* is particularly important in pilot selection activities. That is, criterion validity assesses the relationship between TRT scores and the two pilot flight performance measures as well as student GPAs. In this research, *pilot performance* was defined to be flight training hours to solo and flight training hours to obtain a private pilot's certificate.

Selection Systems

Any occupational selection process involves the screening of applicants, followed by choosing the applicants based on certain methods and criteria. The purpose of selection systems are to choose those applicants that appear to have the most promise and potential to successfully perform job requirements, which allows training resources to be used more efficiently. Ideally, selection systems focus on job-relevant characteristics, when there is a discrepancy among the applicant's population, and when these characteristics cannot be trained (Goeters, 1998).

Previous Pilot Selection Studies

Pilot selection methods typically focus on cognitive and psychomotor ability. They are also designed to predict pass/fail of flight training but rarely are designed to predict operational performance (Damos, 1996). However, with the current trend of increasing crew-to-aircraft and crew-to-crew interfaces, other skills and abilities need to be investigated. Today, pilots must be able to monitor and cross-check flight parameters and aircraft systems, integrate information coming in from various channels, maintain situational awareness, communicate with crew members, and coordinate appropriate actions (Goeters, 1998). Modern selection test batteries must account not only for cognitive and motor skills but also personality and operational performance.

In the search for the ideal pilot selection system, a number of personnel measurement methods have been studied. Validation studies are required to establish the value and usefulness of tests designed to predict job performance. The current research seeks to validate the TRT; therefore, it is useful to review other pilot selection validation studies to determine what has already been completed. In this review of previous pilot selection studies, unless specified otherwise in the narrative, all reported r-values were found to be significant to the $p < 0.05$ level.

Military cognitive/psychomotor ability studies.

Henmon (1919) evaluated the Thorndike Intelligence Test in the selection of Army Air Service Pilots. The test was administered to 150 pilots – 50 who were rated as very good, 50 who were rated as very poor, and 50 pilots of unknown flying ability. Henmon found a correlation of r = 0.35 between the Thorndike Mental Alertness Test scores and instructors' ratings of flying ability.

Fiske (1947) conducted an evaluation of a mechanical comprehension test as well as the Wonderlic's Personnel Test (WPT), which measures general intelligence, used in the selection of U.S. Navy pilots. In three samples of approximately 2,000 subjects each, Fiske (1947) reported that the mechanical comprehension test revealed higher correlations than the WPT with regards to pass/fail criterion. All samples showed similar results. Mechanical comprehension characteristics had higher correlations than general intelligence. Similarly, studies by the U.S. Army Air Corps found results commensurate with the mechanical comprehension test to those obtained in the Navy study (Hunter & Burke, 1995).

Signori (1949) studied selection tests used by the Royal Canadian Air Force during World War II. Five general cognitive tests were administered and were correlated to pass/fail results in training: mechanical reasoning test (r = 0.21), practical mechanical ability (r = 0.17), and general mental ability (r = 0.06). In a study of U.S. Navy pilot selection, Bair, Lockman, and Martoccia (1956) reported correlations between intellect, spatial ability, and clerical functions and a training performance rating ranging from r = 0.10 to 0.26.

Want (1962) conducted a study of Royal Australian Air Force pilot candidates. One of the tests measured instrument comprehension, requiring candidates to understand and interpret aircraft instruments. This instrument comprehension test had the highest correlation with training criterion among all the tests he administered (r = 0.46). The other tests were dial reading, silhouette recognition, general information, mathematics, and general science, each finding similar correlations ($r \approx 0.25$).

North and Griffin (1977) reviewed naval aviator selection from 1917 to 1977 that included 2,109 pilot candidates. Individual components of the Navy's selection battery were compared to pass/fail criterion. The mechanical comprehension subtest and biographical inventory had correlations of r = 0.19 with pass/fail criterion, while the spatial apperceptions subtest had a correlation of r = 0.11 with biographical inventory.

An important component in United States Air Force (USAF) pilot selection is the Air Force Officer Qualifying Test (AFOQT). This is used to select civilian or prior service applicants and to classify commissioned officer applicants into aircrew specialties (Carretta & Ree, 1995). The AFOQT is a battery of 16 tests that assesses five ability domains: Verbal, quantitative, spatial, aircrew interest/aptitude, and perceptual speed. USAF pilot trainees must complete a 53-week flight training job knowledge and job skills program. A total of 7,563 USAF officers were part of a study conducted by Carretta and Ree (1995) to validate the prediction of the pilot training criteria based on AFOQT scores. These subjects attended undergraduate pilot training and all had been tested on the AFOQT.

Pilot training is broken down into three phases. Phase 1 consists of classroom training (ground school) in aeronautics. Phase 2 consists of initial training in a subsonic jet aircraft, while Phase 3 consists of advance training in a transonic jet aircraft. The criteria used in this study was aeronautics average (Phase 1), daily flying and check flight averages (Phase 2), and daily flying and check fight averages (Phase 3). Arithmetic reasoning (quantitative) was the best predictor for Phase 1 (r = 0.20). Aviation information (aircrew interest/aptitude) was the best predictor for Phase 2 daily flight averages (r = 0.25), while instrument comprehension (aircrew interest/aptitude) was the best predictor of Phase 2 check flight averages (r = 0.19). Scale reading (perceptual speed was the best predictor of Phase 3 daily flight averages (r = 0.08). Scale reading was again a best predictor of the Phase 3 check flight averages (r = 0.13).

Another important component in USAF pilot selection is the Basic Attributes Test (BAT). The BAT is a computerized battery of psychomotor, cognitive (speed of information processing), and personality (attitude toward risk) tests (Carretta & Ree, 1996). The BAT contributes to a pilot selection composite used by the USAF called the Pilot Candidate Selection Method (PCSM) (Carretta & Ree, 1998). PCSM scores have been shown to predict several measures of pilot training performance. Some of these include passing/failing pilot training and class rank with BAT psychomotor test scores having correlations of r = 0.15 and r = 0.16, respectively (Griffin & Koonce, 1996).

A study conducted by Bailey and Woodhead (1996) assessed the Royal Air Force (RAF) aircrew selection methods. The RAF pilot aptitude test is a computer-based test system that considers five domains: Control velocity, sensory motor apparatus, instrument comprehension, vigilance, and digit recall. Based on the results of their study, Bailey and Woodhead reported that the predictive validity of the pilot aptitude composite scores against basic flight training had a correlation coefficient of r = 0.52. The RAF system is commercially available and has been purchased by several civilian airlines and military services. This system has also been used for all military pilot selection in the United Kingdom since 1997.

A validation of a test battery via a meta-analysis of five studies between 1955 and 1998 used by the Norwegian Air Force was conducted by Martinussen and Torjussen (1998). For admission into the Norwegian Air Force, pilots must pass three stages of selection. After having completed at least twelve years of education, candidates are admitted to the first step in the selection process. In the first step candidates are given several paper-and-pencil tests designed to measure cognitive abilities, and they are also required to pass a physical examination. Candidates who pass this first step then move on to the second step during which they are subjected to cognitive and psychomotor tests. The tests are grouped into four different categories: general intelligence, technical comprehension and spatial ability, simultaneous capacity, and orientation ability. Those who pass the second stage are given a defense mechanism test and are then interviewed by a psychologist. The last step is a panel interview and a final medical examination. The meta-analysis found that the best predictors of pilot performance during basic flight training were instrument comprehension (r = 0.29), mechanical principles (r = 0.23), and aviation information (r = 0.22).

Woycheshin (2002) conducted a validation study focusing on the Canadian Automated Pilot Selection System (CAPSS). CAPSS is a computerized simulator of a single-engine light aircraft introduced in 1997. The study compared the CAPSS scores of 161 trainees to primary flight training results used to select pilot applicants. The correlation coefficients between CAPSS scores and course results were moderate (flight performance ratings, r = 0.35). There was also a moderate relationship between previous pilot experience and CAPSS scores (r = 0.35), and between previous experience and course results (flight performance ratings, r = 0.55).

Commercial cognitive/psychomotor ability studies.

Trankell (1959) studied a battery of tests used in the Scandinavian Airlines System (SAS). SAS test scores were correlated to success in training. Significant correlations were found for inductive intelligence (r = 0.33), verbal intelligence (r = 0.28), and mechanical comprehension (r = 0.21).

Lufthansa German Airlines has used pilot selection tests developed by the Department of Aviation and Space Psychology of the German Aerospace Research Establishment for more than 35 years (Gnan, Flynn, & King, 1995). Lufthansa uses an ab-initio pilot program to select most of their student pilots. These ab-initio pilots are trained at pilot schools in Bremen, Germany and in Phoenix, Arizona. Every pilot applicant is required to complete the German university entrance level (Abitur) and cannot be older than 27. The selection process includes two steps. The first step is covered over two days in which all pilot applicants must take group-administered performance and personality tests that measure: Technical knowledge and comprehension; mathematics; concentration ability; perception speed; memory; spatial orientation; and, temperament characteristics. This first step usually reduces the number of pilot applicants by 70-75%. Those who successfully pass the first step continue on to the second step, which is conducted over three days. During the first day, psychomotor coordination and multiple task capacity tests are administered, an interview in front of the selection board is conducted on the second day, and finally a medical examination is performed on the third day. At the conclusion of the second step, only about 10% of the original group is accepted. Hörmann and Maschke reported that by using these methods Lufthansa German Airlines has reduced the attrition rate of ab-initio pilot training down to 3% (Hörmann & Maschke, 1996).

Personality/Job sample studies.

Although most pilot selection studies have focused on assessing cognitive abilities, some studies have attempted to assess personality and job sample measures. In samples of United States Navy pilot candidates that ranged from 1,818 to 2,356, Fiske (1947) reported correlations between the Biographical Inventory (a list of activities and events in a person's life history) and pass/fail scores ranged from r = 0.30 to 0.35. Similarly, Taylor, Murray, Ellison, and Majesty (1971) developed two biographical inventories and an activities index that was administered to 645 USAF pilot students scheduled for training. Correlations between the biographical inventories and the activities index ranged from r = 0.22 to 0.32.

Structured interviews have also been used in pilot selection studies. Walters, Miller, & Ree (1993) investigated a structured interview for the selection of USAF pilots. A total of 223 pilot trainees were interviewed. The interview yielded ratings of subject attributes which included: Educational background;

self-confidence and leadership; flying motivation; success in training; and, success in flying various classes of aircraft. The answers to each question were rated on a 5 point scale from poor (1) to good (5). Interview scores were then compared to AFOQT and BAT scores. The structured interview was found to be valid but lacked incremental validity.

Hörmann and Maschke (1996) investigated the validity of a personality questionnaire, the Temperament Structure Scales (TSS), for the prediction of job success of airline pilots compared to validities of a simulator check flight and flying experience data. The TSS is a multidimensional personality questionnaire with eight scales: Extraversion; dominance; emotional instability; aggressiveness; empathy; achievement motivation; rigidity; and, vitality. A total of 274 applicants were graded on a simulator check flight. Pilots were classified as performing at standard or below standard levels after three years of employment with the company. A multiple-regression model showed that job success could be predicted with 73.8% accuracy based on simulator check-flight scores and flying experience. By adding the TSS to the regression equation, job success could be predicted with 79.3% accuracy.

Job sample measures have been studied in previous pilot selection studies. In most cases student pilots were assessed in simulators or light-planes. Signori (1949) studied the Royal Canadian Air Force pilot selection methods during World War II. A total of 366 pilot candidates were tested through check-rides after seven and 11 hours of training were completed. Flight instructor scores were compared to success in flight training and yielded correlations of $r = 0.44$ (7 hours) and $r = 0.39$ (11 hours). In a study of light-plane training among U.S. Navy personnel, Ambler and Waters (1967) found that 15% of students who received light-plane training failed in pilot training, while 30% of those who had not received light-plane training failed.

Perceptual Speed

The aptitude of perceptual speed is a highly valid predictor of job performance (Mount, Oh, & Burns, 2008). Perceptual speed tests measure two factors: speed of processing information and the ability to focus attention. A significant difference between perceptual speed and other aptitudes is that perceptual speed tests are “speed” tests while other aptitude tests are “power” tests. Perceptual speed test questions are fairly simple which means that all subjects should achieve perfect scores if given an ample amount of time. This means that errors on perceptual speed tests are probably a result of the inability to process the information quickly and/or the inability to focus attention to perceive the detailed stimuli.

Numerous studies have demonstrated the validity of perceptual speed as a predictor of job performance. Ghiselli (1966) found that perceptual accuracy predicted overall performance in clerical jobs. Pearlman, Schmidt, and Hunter (1980) found that perceptual speed tests predicted clerical job performance better than motor ability or spatial/mechanical ability. Ackerman and Cianciolo (2000) found that perceptual speed tests account for incremental validity in task performance over general mental ability. Mount et al. (2008) administered the Name Finding Test (NFT) to warehouse workers which measures perceptual speed. The NFT contains 32 different names and the subjects were to observe a name and remember the name well enough to identify it from a group of four names spelled in a similar manner. This test is highly relevant to warehouse workers because they must load and unload trucks quickly while reading invoices and packing lists that contain names of food items and the names of restaurants. This study found that the number of correct answers on the NFT was shown to predict task performance.

METHODOLOGY

The purpose of this study was to validate the Table Reading Test as an assessment tool to indicate potential success in flight training. Specifically, subject TRT scores were compared to the number of flight hours flown prior to each subject successfully flying solo, the number of flight hours accumulated prior to each subject successfully earning a private pilot's certificate, and the individual's most recent GPA. Analyses using Microsoft Excel were conducted to determine the correlations between the TRT and performance scores.

Subjects

Subjects were freshman enrolled in an aviation program at a university in the southwest. The test was administered between the Fall 2005 and Fall 2008 semesters, inclusive. While 277 students completed the TRT over the four-year period, criteria performance data could be collected for only 116 subjects. Valid flight criterion data were not available for some subjects for several reasons: some data collected from participants appeared to be estimated due to the non-use of a decimal place in reporting flight hours; student flight records are only required to be kept on file for the most recent two years, some students may have graduated before their data could be collected; students may have changed majors or transferred to another school before all the data could be collected.

Test Instrument

The TRT is a test of perceptual speed consisting of 50 multiple-choice (a-e) questions. Subjects are given 9 minutes to complete the test, however the test is designed so that test takers should not be able to complete it within the allotted time. Subjects are given a table sheet, a test booklet with the 50 questions, and a sheet to record their answers.

The table sheet is made up of X and Y values. The X values, or column values, scale across horizontally and range from -17 on the left side of the page to +17 on the right side of the page. The table also consists of Y values, or row values, that scale vertically and range from +17 to -17 from top to bottom. For each question, subjects are given an X and Y value which corresponds to a number on the table sheet. The student's task is to determine the number where the column and row intersect and select the correct number among the five answer options for each question. Subjects are not allowed to use a straight edge to assist in locating the values. Subjects are not penalized for incorrect answers. For example, a subject who attempts 30 questions and selects 30 correct answers earns the same score as someone who attempts 50 questions and selects 30 correct answers.

Test Administration

The TRT was administered to the subject pool over the four-year period. The instructor of the 100-level introductory aviation course administered the TRT at the beginning of each semester. At the start of a class period, the instructor would explain to the students the purpose of the test, and its role in this longitudinal investigation. Participation was voluntary. Students who participated were not compensated, and students choosing to not participate were not penalized. All materials, including test booklet, demographic/answer sheet, and table sheet would then be distributed to participants. They were instructed to not open the test booklet until told to do so. After all materials were distributed, the instructor would provide the participants three minutes to review the test directions and sample problems. At the end of three minutes, the instructor would tell them that they would then have nine minutes to work through the test. At the expiration of the nine minutes, the instructor would ask the participants to stop, and pass all test materials forward. After the class period, data from the answer sheets was input into a Microsoft Excel spreadsheet, and sent electronically to the test developer for scoring.

Flight performance data were obtained from both paper, computer-based student flight records, as well as from personal requests sent out to all current flight students. The majority of the Time-to-Solo data was collected from student flight records on file at the school, along with the Education Training Administration (ETA) program, a recently-introduced (2008) computerized logbook. The remaining Time-to-Solo data was collected from surveys that students completed. All of the Time-to-Private (certificate) data was collected from the surveys.

Academic data was obtained from university administrative personnel. GPAs were provided for each student for the Fall semesters from 2005-2008. In some cases there were students who had more than one GPA on file (Fall 2005, Fall 2006, etc.). Each subject's GPA directly after they soloed and/or earned their private pilot's certificate was not available, so the last recorded GPA for each student was used. The TRT scores were then individually matched to each subject's recorded flight and GPA data.

Data Analysis

Once the TRT was scored, all TRT scores and criterion data were tabulated and organized in Microsoft Excel. Correlation analyses were then conducted to determine whether there was a relationship between TRT scores to the number of flight hours accumulated prior to successfully flying solo, the number of flight hours accumulated prior to successfully earning their private pilot's certificate, and the most recent GPA.

When performing the analyses, only subjects that had a TRT score on record were considered. The researcher elected to adhere to the statistical community's standard of defining significant results if the test's p-value is less than 5%. Hence, any p-values greater than or equal to 5% would be considered to indicate results that are not significant.

Because this present study seeks to validate the TRT, correlation analyses were conducted in order to investigate the correlative relationship between TRT scores and the performance criterion. Regression analyses were not used in this study because the researcher did not want to give any indication of cause and effect; that is, a certain TRT score will result in a confidence interval of flight hours to soloing and/or obtaining a private pilot's certificate.

RESULTS

The results of the three correlation analyses follow. A description of the results of each individual analysis is included in detail.

Results

Three correlation analyses were conducted to determine the relationship of TRT scores to the flight and academic performance criterion. TRT scores were compared to Time-to-Solo data, Time-to-Private data, and subject GPA. All analyses yielded significant results. Table 1 presents a summary of the data and results for each analysis.

Table 1: *TRT Scores and Flight/Academic Performance Criterion Results*

Analysis	**Performance Criterion**	**n**	**Correlation Coefficient**	***p* <**
1	Time-to-Solo	99	-0.228	0.024
2	Time-to-Private	17	-0.754	0.001
3	GPA	116	0.283	0.002

Note. All *p*-values satisfy the aforementioned $p < 0.05$ rule.

The first analysis focused on the number of flight hours accumulated by each subject prior to each successfully flying solo. The results were found to be significant, $F(1, 97) = 5.295$ and $p < 0.024$. The second analysis considered the number of flight hours accumulated by each subject prior to each successfully earning a private pilot's certificate. The results were also found to be significant, $F(1, 15) = 19.837$ and $p < 0.001$. The third analysis focused on the last recorded student GPA. The results were likewise found to be significant, $F(1, 114) = 9.973$ and $p < 0.002$.

Summary of Results

Three significant correlations ($p < 0.05$) were found between the TRT scores and the performance criteria data:: Subject Time-to-Solo, Time-to-Private, and GPA. The data indicate that the strongest correlation is between the TRT scores and number of hours each subject accumulated prior to earning his or her private pilot's certificate (r = -0.754, $p < 0.001$). This is particularly important insofar as resources for training new pilots are becoming increasingly more scarce, both for students and schools. Hence, the TRT could be a means to better screen students before they fully embark down the path of either becoming a licensed private pilot, or needlessly pursuing a costly dream.

DISCUSSION

This section includes discussion and explanation of the correlation analyses performed. In addition, future recommendations for administering the test, collecting data, as well as other procedures are included along with a discussion on how these results may be utilized. This section concludes with recommendations for future research.

Significant Findings

The result of the first analysis (time-to-solo) was $r^2 = 0.052$ and $p < 0.001$. This implies that 5.2% of the variation in the TRT scores due to the different subject abilities is in common with a like amount of variation in subject hours prior to soloing. This is not the same as cause and effect, as there is no evidence that this exists between these metrics. Nonetheless, the metrics do share a common data source, the student subjects and the r^2 values are an indication of a common source of performance variation.

The result of the second analysis (time-to-private) was $r^2 = 0.569$ and $p < 0.001$. This implies that 56.9% of the variation in the TRT scores due to the different subject abilities is in common with a like amount of variation in subject hours prior to earning his or her private pilot certificates. In other words, nearly 57% of the variability in the number of hours prior to earning a private pilot certificate is attributable to the variability of TRT scores. Again, note that this is not the same as cause and effect.

The result of the third analysis (GPA) was $r^2 = 0.080$ and $p < 0.001$. This implies that 8.0% of the variation in the TRT scores due to the different subject abilities is in common with a like amount of variation in subject GPAs. This means that 8% of the variability in subject GPAs is attributable to the variability of TRT scores.

Results Applications

As stated previously, all three correlation analyses yielded significant results, most notably TRT vs. Time-to-Private. These results seem to indicate that the TRT could be used to recruit middle school and high school students to consider a career as a professional pilot. While many students have never considered becoming a pilot, they could be encouraged to pursue a career as a pilot, if they perform well on the test. Conversely, a student's score may also indicate that they may have some difficulty in successfully completing pilot training, so they may then wish to consider other career options in and out of the aviation industry.

Future Considerations

With so many factors and variables that affect the outcome of each analysis it is important to limit their effects in order to get a clear understanding of the results of the test and how those results can help predict future pilot performance. There are a few things that should be considered in the future when conducting a study similar to this, one of which is the data collection. It was clear when collecting the data from student flight records that flight data, in particular number of hours to solo, was inconsistent. This can be resolved by possibly acquiring flight data from a computerized logbook that students use (the ETA program), or personally verifying recorded flight hours in each subject's logbook.

In the future, students upon successfully soloing and earning their private pilot's certificate should record the exact number of hours prior to completing each task as well as report their current GPA. They should also take the TRT again in order to compare their previous test score to their scores after completing each task. By requiring students to take the TRT again, researchers can further assess the reliability of the test.

After interacting with some of the subjects, it should be noted that some flight times might have been affected due to a change in flight instructors. Some subjects reported that they had two and even three flight instructors, which may have caused them to fly additional hours with their new flight instructor to get acclimated with each other. Future studies should note when subjects have more than one flight instructor when analyzing flight times.

Future researchers should conduct a predictive study to find the degree to which TRT scores can predict future pilot performance. This study only considered flight performance up to the private pilot certificate rating. Future researchers should also focus studies up to the flight instrument rating, where pilots are required to read flight instruments in the cockpit, which is a more visually demanding task for pilots.

This study as well as most studies in the past focused on the number of correct answers. Future researchers may wish to focus on analyzing the number of incorrect answers as well as a looking at scores as a percentage of right/wrong answers vs. the total number of questions attempted. Mount et al. (2008) suggest that the number of wrong answers on perceptual speed tests may predict inattention or lack of rules compliance such as accidents, safety violations, and tardiness.

Summary

With rising flight training costs, pilot selections studies are needed to select individuals who have the greatest potential to become successful pilots. In the past the U.S. military, various airlines, and other aviation entities have tried to determine and assess the qualities required to become a successful pilots. In an attempt to determine these qualities, most pilot selection studies have focused on cognitive abilities while others focused on personality and job sample measures. The focus of this study was to assess and validate the Table Reading Test, which was designed to measure perceptual speed. With cockpits becoming more sophisticated and visually interactive, perceptual speed is becoming a more critical skill for pilots.

This correlative study has been able to demonstrate some degree of validity with regards to the TRT. This study shows that higher TRT scores are associated with better flight training results, most notably the number of hours accumulated prior to earning a private pilot certificate. The TRT can help determine the success or flight performance of a student who may be unsure in their pursuit in becoming a pilot. It can also encourage students to pursue becoming a pilot who may not have even considered becoming a pilot. A longer, more in-depth predictive study might further validate the test and show it to be a strong predictor of future pilot performance.

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Perceptions of Stress among Collegiate Aviation Flight Students

Michael F. Robertson and Lorelei E. Ruiz
Southern Illinois University Carbondale

ABSTRACT

The purpose of this study was to identify student perceptions of stress caused by stressors unique to flight training. The study population consisted of students currently enrolled and actively flying in Aviation Flight courses. Students were administered a survey consisting of three general parts. The first part asked students to rate stressors that they faced and what effect they believe these have on their flight performance. The second part asked respondents to identify stress coping strategies that they employ. The third part requested basic demographic data. Analysis of the data was performed using SPSS version 17.0. Basic descriptive statistics were run, including frequencies, means, and standard deviations. The study found that students in the flight training program at Southern Illinois University Carbondale perceive checkrides/practical tests as the most stressful. This was followed by financial concerns. Other stressors that ranked as moderately stressful included written exams, flight course workload, checkride scheduling, and time management.

INTRODUCTION

Stress among college students has been a subject of interest for many years. Every student experiences stress throughout the course of a semester. According to Misra and McKean (2000), there are predictable times when stress levels can be higher than others, often caused by academic commitments and financial pressures. If a student perceives the stress negatively or the stress becomes extreme, a student's academic performance can suffer or they can experience adverse health effects (Misra & McKean, 2000). Studies have identified sources of stress for college students (Ross, Niebling & Heckert, 1999; Hirsch & Ellis, 1996; Hudd, Dumlao, Erdman-Sager, Murray, Phan, Soukas, & Yokozuka, 2000; Misra & McKean, 2000). These stressors include but are not limited to academic work load, scholastic achievement, financial pressures, employment needs, time management and social readjustment as they transition to college life. Other studies related to stress have been conducted with commercial and military pilots (Stokes & Kite, 1994). This study attempts to identify student perceptions of stress caused by stressors unique to flight training. The findings from this study may be used to identify which of these perceived stressors causes the greatest stress, and to recommend possible interventions or stress management programs for future flight students. The study answers the following research questions:

1. What aspects of a Collegiate Aviation Flight Training Program do students find most stressful?
2. How do Collegiate Aviation Flight Students believe stressors affect their flight performance?
3. What coping techniques do Collegiate Aviation Flight Students employ to deal with these stressors?
4. Are the coping techniques employed perceived by the Collegiate Aviation Flight Students to be constructive?
5. In what ways do the Collegiate Aviation Flight Students feel the program, department or university could help them with these stressors?
6. What effect, if any, does flight course level have on the perceptions of stress levels among students?

LITERATURE REVIEW

Stress can be defined as the body's normal response to something that disturbs its physical, emotional or mental balance (Bruno, 2007). Stress is also described as a physiological or psychological reaction to a perceived threat that requires some action or resolution (Kottler & Chen, 2008). Everyone experiences some form of stress on a regular basis. According to Karren, Hafen, Smith, and Frandsen (2002), while early research suggested that all stress was negative, it is now understood that a stressful situation can be from a positive or a negative experience. Having stress in your life can be healthy and positive; however, stress in excess can have negative effects physically and psychologically (Hall, n.d.). Stress is not limited to what goes on in our minds. Stress is a biological process that starts in two main systems in the body: the nervous system, which reacts to stress immediately, and the endocrine (hormone) system, which takes a longer period to react and can affect the body for longer periods of time causing exertion on the immune system (Karren, et al., 2002).

Many people think of stress as being a negative term. Hans Selye, an early stress researcher, introduced the terms eustress and distress to differentiate between positive and negative stress (Rice, 1992). Eustress can be defined as an experience that is pleasurable, satisfying, heightens awareness, increases mental alertness and promotes cognitive and behavioral performance, while distress is defined as an experience that is unpleasant, negative and painful that may cause anxiety, fear, worry or agitation and lead to a loss of productivity or health problems (Rice, 1992). Selye also recognized that having hyperstress, an excessive amount of stress that can overload the body, in one's life, was unhealthy, while having hypostress, not enough stress to keep one's body sharp and ready for action, was also unhealthy (Kottler & Chen, 2008).

Stress can also be broken down into two main categories, short term (acute) and long term (chronic) stress. Short term stress is activated by a sudden threat or danger (Kottler & Chen, 2008). An example of short term stress could be anything from an engine failure in flight to having to give an impromptu presentation in a college class. Short term stress does not usually cause any long term physical or psychological problems; often it is necessary to keep the body and mind in good working order (Kottler & Chen, 2008). Long term stress, however, could cause the mind and body to break down over time. Long term stress would occur if a perceived threat or danger occurred over a longer period of time. An example of long term stress could sometimes be associated with a major life change such as changing of a major, new job or dealing with medical problems (Kottler & Chen, 2008).

Karren, Hafen, Smith, & Frandsen (2002) identify three types of stress: physical, psychological and psychosocial. Physical stress involves stressors in the environment such as noise, vibration, temperature extremes, prolonged exercise or an inadequate supply of oxygen. Psychological stress involves attitudes, feelings and our reaction to anything that we perceive as a threat. Flying could be an example of psychological stress, as one person may react to flying in a calm manner, whereas another may become stressed with the idea. Psychosocial stress involves relationships with people. This type of stress could involve conflicts with family or friends or a perceived threat to identity or self image.

College students, as a group, are particularly prone to stress. There have been studies concerning stress among college students (Ross, Niebling & Heckert, 1999; Hirsch & Ellis, 1996; Hudd et al. 2000; Misra & McKean, 2000). These studies have identified sources of stress including academic workload, scholastic achievement, financial pressures, employment needs, time management and social readjustments as they transition to college life.

Ross, Niebling & Heckert (1999) found that intrapersonal sources of stress were the most frequent source of stress among 100 college students surveyed. These included change in sleeping and eating habits, vacation, new responsibilities, increased workload, financial difficulties and change in social activities. Hudd et al. (2000) completed a study at Yale University using 145 students who were randomly selected. A relationship between stress and other health behaviors was one of the topics addressed in this study. The study concluded that students that perceived higher stress levels were less likely to practice healthy behaviors to deal with their stress.

Misra and McKean (2000) published a study with 249 undergraduate students. The students were asked about distinct areas such as, academic stress, time management, leisure satisfaction and anxiety. The authors found that the biggest source of academic stress was time management. The authors suggested that time management training be recommended by faculty and counselors more often.

It has been suggested that pilot performance can be affected by three different types of stress, which includes environmental stress, acute reactive stress and life stress (Stokes & Kite, 1994). Life stress studies have been researched in the context of medical diagnosis since 1934. Holmes and Rahe of the U.S. Navy made initial attempts in the 1960's to develop a standardized quantitative approach in the evaluation of life stress events (Stokes & Kite, 1994). Holmes and Rahe conducted scaling studies to determine the effects of various events on individual's lives. Holmes and Rahe developed a questionnaire called the Schedule of Recent Experiences (SRE), which contained forty-two questions concerning life changes, includeding subjects such as finances, health and domestic life. Each life event was given a weighting expressed in Life Change Units (LCUs). The SRE gave a total combined life change score based on the total number of LCUs tallied for any given year (Stokes & Kite, 1994). In this study, health changes to the study population lagged behind the reported life crisis by about a year. In one study, four out of five people with scores over 300 reported injury or illness. Inversely, one in three reported injury and illness with scores between 150 and 199. This approach is overly simplistic given that it assumes that a life changing event has the same meaning for everyone (Stokes & Kite, 1994). This study led to the Recent Life Change Questionnaire (RLCQ), which is a modified version of the SRE. Not only did this give a total score to the LCU but also to a Subjective LCU (SLCU), which allows the subject to rate the personal impact of the events. For example, a high value of LCUs with a low value of SLCUs indicates efficient coping by the individual (Stokes & Kite, 1994).

In 1977, a US Navy psychologist, Dr. Robert Alkov and colleagues developed a 50 item questionnaire based on the work of Holmes and Rahe. Dr. Alkov suggested that life changes that affected the health of naval aviators could also result in aircraft accidents (Stokes & Kite, 1994). In 1983, Dr. Alkov continued his research studies about life events in naval aviators, focusing on how these pilots were able to cope with stress and accidents. The results from these studies suggested that pilots that made more mistakes also were more likely to be having marital difficulties, personal relationship problems and were having trouble with their superiors and colleagues.

According to the Flight Safety Foundation (2006), in 1985 Dr. Alkov conducted a study of 700 U.S. Naval aviators who were involved in major aircraft accidents. Alkov found that 381 pilots that were involved in and at fault in major aircraft mishaps were more likely to have had problems with interpersonal relationships, which is a symptom of not coping well with stress. The other 356 aviators were not at fault in their aircraft mishaps (Flight Safety Foundation, 2006). Alkov found that there may be some personality factors that leave some pilots more susceptible to the negative effects of stress. Lack of maturity, inability to assess troublesome situations and having no sense of their limitations are all factors that are more prevalent in those who have been at fault in an aircraft accident (Flight Safety Foundation, 2006).

Other research has been done studying the effects of life stress and job related performance. Fiedler, Della Rocco, Schroeder, & Nguyen (2000), conducted a study whereby they administered a questionnaire to 19 U.S. Coast Guard helicopter pilots. They found that as home stress increased, job stress also increased. “Pilots indicated that as the home stress experienced at work increased, self perceptions of flying performance decreased, especially the sense of not feeling ahead of the game.” (p.7)

According to Fiedler, et al. (2000), Sloan and Cooper conducted a 1986 study of British commercial pilots looking at various sources of stress and coping mechanisms. They concluded that home stress has an effect on work through mental and cognitive consequences, such as, decreased concentration, recurring thoughts during periods of low workload and a tendency not to listen. They also concluded that actual flying performance was less affected by home based stress. Stress management for college students is very important. It is well documented that psychological stress and physical illness are related. Hall (n.d.) suggests that maintaining balance between social, personal and intellectual development are important for college students. Some of the stress coping strategies that Hall suggests are scheduling regular exercise, setting long term and short term goals, managing time and finding 20 minutes each day to relax. Meditation, self hypnosis, deep breathing exercises, deep muscle relaxation and massage are useful relaxation techniques. It is also helpful to think positively, add laughter and humor in your day and be communicative with your friends and family (Hall, n.d.).

When stress coping strategies appear to be inadequate, the result is more stress. Ultimately, this added stress can lead to self destructive behaviors such as, over eating, alcoholism, smoking and increased risk taking (Hall, n.d.). The Federal Aviation Administration (FAA) (1987) offers several techniques as well in managing long term life stress. These include implementing a physical fitness program, having a realistic assessment of yourself (knowing your limitations), avoiding stressful situations when possible and trying relaxation techniques as mentioned previously.

The stress coping strategies discussed by Hall (n.d.) and the FAA (1987) are universally accepted methods for handling stress. Because everyone experiences stress to some degree, it is important that the stress is channeled in healthy ways, before it affects your personal or professional life (Edkins & Fowler, 2000).

METHODOLOGY

The study population consisted of students currently enrolled and actively flying in Aviation Flight courses at Southern Illinois University Carbondale. A total of 182 students, 168 male (92%) and 14 female (7%), were identified. A total of 83 surveys were returned to the researchers 76 male (92%) and 7 female (8%). This yielded a response rate of 43.9%.

All flight instructors in the program were given enough cover letters and surveys for all of their flight students. The flight instructors were asked to distribute a cover letter and survey to each of their students. Students were to be instructed to fill out the survey and return it to the researcher’s mailbox at the airport, or place it in one of two envelopes placed on the researchers’ office doors.

The survey consisted of three general parts. The first part of the survey listed a variety of stressors that students in a collegiate aviation flight program could face. These were accompanied by a five-point Likert scale that the students were to use to gauge their perception of the amount of stress each stressor causes them, with 1 = no stress to 5 = severe stress. The survey allowed for respondents to add their own perceived stressors to the list and rate them also. Additionally, this portion asked students what effect they believe the stress has on their flight performance, and whether they believe there is anything the program/department/university can do to alleviate the stress.

The second part of the survey asked the students to identify stress coping strategies that they employ. They could choose from an existing list and indicate Y for yes or N for no. This portion of the survey allowed for respondents to add other coping strategies. Respondents were also asked whether they believe their stress coping strategies are constructive.

The final part requested basic demographic data. These included gender, age, current flight course, total flight time, number of lessons completed, and school year. Analysis of the data was performed using SPSS version 17.0. Basic descriptive statistics were run, including frequencies, means, and standard deviations.

RESULTS AND ANALYSIS

A total of 76 male flight students (91.6%) and 7 female flight students (8.4%) responded to the survey. Respondents ranged in age from 17 to 27, with a median age of 20 years and a mean age of 20.4 years. Of the 83 respondents, 25 are in their first year of college, 16 are in the second year, 19 are in the third year, 20 are in the fourth year, and 2 reported having attended 5 years or more. One respondent did not indicate school year. The greatest percentage of respondents (37.3%) indicated that they were in pre-solo primary training course. Of the remaining respondents, nine indicated post-solo primary training (10.8%), nine indicated instrument training (10.8%), 16 indicated commercial training (19.2%), four indicated multi-engine training (4.8%), and 11 indicated flight instructor training (13.2%). One respondent did not indicate a flight course. See Table 1 for a further breakdown of respondents by course.

Flight time totals varied widely with respondents reporting as few as one flight hour to as many as 450 flight hours. Only two respondents did not report an estimation of their total flight time. The mean total flight time reported was 108.5 hours and the median total flight time reported was 70 flight hours.

Table 1: *Breakdown of Respondents by Flight Course*

Flight Course	**n**
AF 199-Intermediate Flight/Program Transition	2
AF 201A-Primary Flight I	31
AF 201B-Primary Flight II	9
AF 203-Flight-Basic	8
AF 204-Flight-Intermediate	4
AF 206-Flight-Instrument	9
AF 207A-Flight Advanced	4
AF 207B-Flight Multi-Engine Operations	4
AF 300-Flight-Instructor (Airplane)	10
AF 301-Flight-Instructor (Airplane-Multi-Engine)	1

Note. Total number of respondents was 83. One respondent did not indicate a flight course.

Research Question 1. What aspects of a Collegiate Aviation Flight Training Program do students find most stressful?

A total of 28 sources of stress were provided and students were asked to indicate on a 5 point Likert scale the magnitude of stress caused by each. The 5-point scale was anchored by the values 1 = no stress, 3 = moderate stress, and 5 = severe stress. The two most stressful factors appear to be checkrides (*M* =

3.76) and financial factors (M = 3.39). These were the only two provided factors that were rated as more than moderately stressful. Other listed factors that were generally considered to be moderately stressful (mean rating greater than M = 2.5) included written exams (M = 2.92), flight course workload (M = 2.86), checkride scheduling (M = 2.67), and time management (M = 2.5). See Table 2 for complete rating rankings.

Table 2: *Flight Student Ratings of Selected Stressors*

Stressor	**Responses**	***M***	***SD***
Checkrides/Practical Tests	77	3.7	1.23
Financial Resources	83	3.39	1.38
Written Exams	80	2.92	1.18
Flight Course Workload	83	2.86	.96
Checkride Scheduling	77	2.67	1.19
Time Management	83	2.54	1.15
Family Expectations	82	2.43	1.26
Completion Agreements	81	2.39	1.26
Peer Performance/Pressure	82	2.30	1.02
Flying the Airplane	83	2.27	.99
Work	81	2.27	1.22
Responsibility of Operating Equipment	83	2.21	1.03
Aircraft Availability	83	2.15	1.15
Flight Training Expectations (out of slot)	82	2.12	.93
Flight Slot/Scheduling	83	2.09	1.06
Flying the Simulators	80	2.00	1.00
ATC Interaction	81	1.98	.96
Program Policies/MOS	82	1.93	.92
Advisement and Registration	81	1.93	1.02
Social Readjustment	82	1.93	.94
One on One Instruction	82	1.89	.94
Flight Instructor personality	83	1.80	1.12
Certification Paperwork	83	1.78	.91
Transportation to/from airport	83	1.57	.87
Flight Instructor capability	83	1.53	.83
Housing	82	1.46	.74
Flight Instructor availability	83	1.45	.68
Support Staff	83	1.36	.61

Eleven respondents also listed and rated at least one other stressor. Stressors listed by more than one respondent included Sports (n = 2, M = 4.5) and Weather (n = 2, M = 2.5). Other stressors included both personal and flight program-related factors. See Table 3 for a listing of these ratings.

Table 3: *Other Stressors Reported by Flight Students*

Stressor	**Responses**	***M***
Adapting to workload in bird	1	5
Flight instructor flexibility	1	5
Homework	1	5
No show fees	1	5
Recent loss in family	1	5
Time constraints	1	5
Sports	2	4.5
AF 206 (instrument training)	1	4
Getting enough sleep	1	4
Relationship	1	4
Timely completion of program	1	3
Weather	2	2.5
Afternoon weekend flying	1	1

Research Question 2. How do Collegiate Aviation Flight students believe stressors affect their flight performance?

The survey asked respondents the following question: "Do you think that the stressors you face as an Aviation Flight Student have a positive or negative effect on your flight performance? Explain."

Thirty-five respondents (42.2%) indicated that they believe the stressors have a positive effect while 15 (18.1%) indicated that they believe the stressors have a negative effect. Twenty-four respondents (28.9%) indicated that the effect depends on the stressor. Three (3.6%) respondents indicated that the stressors have no effect on their flight performance. One respondent (1.2%) was unsure of the effect that the stressors have on their flight performance. Five respondents (6%) did not indicate an answer for this item.

Research Question 3. What coping techniques do Collegiate Aviation Flight Students employ to deal with these stressors?

A total of 22 activities were listed and respondents were asked to indicate, by circling Y or N, whether they engaged in each of the activities to relieve stress. They were also provided the opportunity to list two other stress-relieving activities. Respondents indicated that they are most likely to listen to music (n = 78), talk to friends or family (n = 70), engage in outdoor activity (n = 69), watch television (n = 67), or sleep (n = 64). They indicated that they are least likely to smoke (n = 11), write in a journal (n = 11), meditate (n = 8), do yoga (n = 3), or abuse drugs (n = 0) to relieve stress.

Sixteen respondents also listed at least one additional stress-relieving activity, and several of these reported more than one. These included specific outdoor sports or activities (12), organization techniques (3), playing a musical instrument (2), physical or emotional outbursts (2), drinking not to excess (1), and adult entertainment (1).

Research Question 4. Are the coping techniques employed perceived by the Collegiate Aviation Flight Students to be constructive?

The survey asked respondents the following question: "Would you consider the methods you choose to relieve stress to be constructive?" Fifty-five respondents indicated that they do believe their stress coping strategies are constructive, while nine indicated that they do not believe they are constructive, and 16 indicated that it depends. Three respondents did not answer the question.

Research Question 5. In what ways do the Collegiate Aviation Flight Students feel the program, department, or university could help them with these stressors?

Survey respondents were asked to reply to the following question: "Is there any way that the program/department/university could help alleviate any of these stressors? If so, how?" Students had a wide range of comments. Twenty-three respondents indicated that there was nothing more that the university could do to alleviate the stresses. Fourteen of the students did not respond to the question. Of the remaining responses, the majority of comments revolved around financial concerns (9), the stress of checkrides (5), the need for study groups (5), course completion concerns (4), and aircraft availability (4). Some of the responses seem to provide suggestions for general program or course improvement, rather than specific stress-relieving options/interventions. Table 4 lists the general responses to this question.

Table 4: *Suggestions for Organizational Changes to Reduce Flight Student Stress*

Suggestion	Responses
No change needed or Nothing	23
No response	14
Do more to address students' financial concerns	9
Reduce checkride stress	5
Provide study groups	5
Resolve course completion issues	4
Acquire more airplanes	4
Instructor personality issues	3
Provide more flight time/slots	3
Review Master Operations Syllabus policies	3
Improve communications/information dissemination	3
Hire more instructors	2
Require less weekend/out of slot flying	2
Require more weekend/out of slot flying	2
Provide other transportation options to airport	2
Improve flexibility regarding Talon/TCO	2
Improve checkride scheduling	1
Allow breaks during lessons	1
Improve counseling/advisement provided to students	1
Arrange commercial airline rides for students to observe	1
Improve relations with ATC	1
Start coursework more slowly	1
Address alcohol/substance abuse issues among some	1

Research Question 6. What effect, if any, does flight course level have on the perceptions of stress levels among students?

As the greatest percentage of respondents have only just begun their collegiate flight training at SIUC, the researchers were interested in what effect their responses have on the findings overall. Breaking down the data by flight course might also yield information that could lead to programmatic improvements for certain groups of students. For that reason, the researchers looked first at all respondents in aggregate, then at subgroups of respondents based on their reported current flight course. The MEI course is not considered for this analysis as there was only one student in the course at the time the survey was disseminated.

The more noticeable differences occurred in the responses from the AF199 (n = 2) and AF201A (n = 31) students. These are all students who are new to the flight training program; AF199 students are entering the program with a private pilot certificate, and AF201A students have a student pilot certificate.

Combined, the AF199 and AF201A students all tended to rate Checkride Scheduling and Completion Agreements as less stressful than did the other students. This may be due to the fact that these students have not had to deal with these issues while at SIUC. It should be noted that six AF201A students did not provide a rating for Checkride Scheduling, and two did not provide a rating for Completion Agreements.

Only two AF199 students responded to the survey. It is of interest to note that these students rated Family Expectations as the most stressful (M = 4.5) factor. This was followed by Checkrides/Practical Tests (M = 4.0), Peer Pressure (M = 3.5), and Social Readjustment (M = 3.0). While the Checkrides/ Practical Tests rating falls in line with the responses from the more advanced students, the rating for Peer Pressure and Social Readjustment was much higher than the other courses.

The AF201A students indicate a much lower stress level (M = 2.8) for Checkrides/Practical Tests than all other classes of students. One obvious reason for this could be that they have not yet been exposed to a checkride, and may not have a full grasp of what a checkride entails. It should be noted that six of the pre-solo primary students actually did leave this particular item blank.

There were also some differences in stress factor ratings reported by AF203 and AF204 students. AF203 and AF204 are the first and second stage of Commercial Pilot training. CFI capability was rated as causing more stress by students in AF203 (M = 2.25) and AF204 (M = 2.5), but the variations in responses were also higher among these groups (SD = 1.16 for AF203, SD = 1.73 for AF204). Flight Slot/Scheduling was rated as more stressful by AF204 students (M = 3.5). No other remarkable differences based on flight course alone were noted.

RECOMMENDATIONS

The purpose of this study is to identify student perceptions of stress caused by stressors unique to flight training. A further objective is to recommend possible interventions or stress management programs for future flight students.

From the students' comments, the researchers concluded that there are several things the program may want to consider to assist students in the future with their stress. Offering formal study groups and informal checkride question-and-answer sessions could help alleviate checkride stress. To address students' financial concerns, the program should continue to seek out new scholarship opportunities as well as increase the advertising of opportunities that currently exist. The program should also explore scheduling changes to improve aircraft availability.

The Social Readjustment scores for students transferring in to the program with a Private Pilot certificate indicate that some sort of initial indoctrination program may help. This type of program may also help incoming freshman students as well. Further discussion with these students may help determine whether the program can help with this, as no comments addressed this specifically. Possible topics that could be discussed in this program could include, but not be limited to, expected workload, course completion expectations, scheduling, time management and constructive stress coping techniques. These recommendations will be shared with the Department Chair, Chief Flight Instructor, and members of the senior faculty.

Future studies similar to this should be conducted, increasing the size of the study population to facilitate investigation of gender differences concerning stressors and coping techniques. Future studies should also focus on determining which specific stressors students perceive to have a negative effect on performance, as well as which coping techniques they perceive to be constructive.

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