UNIVERSITY AVIATION ASSOCIATION

COLLEGIATE AVIATION REVIEW

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UNIVERSITY AVIATION EDUCATION: AN INTEGRATED MODEL

Merrill R. Karp
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ABSTRACT

As indicated at the Regional Air Transport Training Convention and Tradeshow (RATS 2000) at Daytona Beach, FL, on February 8-9, 2000, the United States regional airlines fully recognize that the frequently-discussed shortage of regional airline pilots is now a fact rather than a forecast. The regional airline conference attendees also felt that potential pilot shortages in the major airlines are probably not far behind. Over the past few decades, the airline industry has relied upon the military for its primary source of experienced pilots. However, with increased commercial airline expansion, coupled with the Vietnam era trained pilots approaching retirement age and the recent low military pilot training production, the United States now faces a shortage of highly experienced pilots in both the military and the commercial airline industry. While flight programs have been developed to meet these shortfalls with increased training, consideration should also be given to improving the *aviation education process* itself, which is the foundation of flight training. University aviation training programs, because of their comprehensive academic environments, offer excellent opportunities to develop and deliver state-of-the-art aviation curricula and become the new primary resource for commercial airline pilots. A key question to help resolve the impact of the commercial pilot shortage should be: *Can an enhanced aviation academic education and flight training program help accelerate university-trained pilots into airline cockpits.* This paper draws upon research conducted in the Aeronautical Management Technology Department at Arizona State University (Karp, 1996) and addresses potential educational enhancements through the implementation of an integrated aviation learning model, the *Aviation Education Reinforcement Option (AERO)*. The AERO model is a learning strategy that incorporates elements of the adult education paradigm, learning style theory, cooperative and collaborative learning techniques, and personal computer-based aviation training devices (PCATDs), to span the long-term retention and application gap that can occur between the classroom and the flight line. This paper suggests that the AERO model, when combined with flight training that emphasizes airline procedures from the very beginning, has the potential to reduce the pilot training time required between the universities' academic classrooms and flight training environments, and the commercial airline cockpit.

BACKGROUND

A United States Department of Transportation Federal Advisory Committee study in 1993, directed by Congress, projected a shortage of qualified airline pilots which could impact the future availability of commercial air transportation in the United States. This study indicated that expansion of airline capacity, in combination with retirements from the airline pilot force and a reduced pool of former military pilots, would result in a national shortage of qualified pilots through 2010 unless positive actions were taken. Shortages in the major airlines, and the decreased resource of military trained pilots, has, in fact, created an *increased flow-through demand* on the regional airlines for pilots, further impacting the regional airlines' training loads and experience levels.

A pertinent commercial pilot supply issue to consider is that of the depth and quality of the aviation academic education, as well as the flight training, of those future airline pilots. Because of the increasing sophistication of modern aircraft and high technology equipment, this issue underscores a need to examine, and restructure where necessary, the training options for potential airline pilots. This action is required to ensure that the aviation education process is an in-depth, effective transfer of knowledge across a broad spectrum of aviation academic subjects. When considering aviation education, the *academic component* of the flight training plays a critical role in providing the knowledge base for a new pilot. This academic education has the potential to build an exceptionally solid foundation for ensuring the high standard of technical and flying knowledge needed for future airline pilots.

One factor affecting the available commercial pilot pool is the length of time it takes an aviation flight school graduate to attain the number of flying hours to apply for employment in the airlines. The typical "flight-time building path" for a new pilot involves flying first as an instructor pilot and then as regional pilot; this path could take 6 to 8 years to build the required flight time prior to being eligible to apply to the major airlines. This historical emphasis on *flight hours* as an airline pilot selection criterion may be efficient when there is an adequate source of commercial pilots; however, an alternative approach that should be considered, in light of the current pilot shortages, is that of a *proficiency-based flight training program*. This is similar to what the U.S. military and a number of foreign air carriers, such as Lufthansa German Airlines, employ (Karp, 1996).

However, in spite of forecasted commercial pilot shortages and the rapid increase in the sophistication of modern aircraft and the complexity of the flight and navigation environment, *the aviation education process itself* has changed very little over the years to meet the challenges of proficiency-based flight training. This situation suggests the need to revisit the current aviation education process and develop a new aviation learning model which helps accelerate pilots, who have the required long-term knowledge retention and airline focused flight training, into regional airline cockpits.

ACADEMIC UNDERPINNINGS

Prior to suggesting an aviation learning model to enhance the knowledge transfer retention and increase knowledge application from the classroom to the flight line, it is important to consider the academic underpinnings that could be used in the development of such an aviation learning model.

Adult Learning

While the term "adult learner" is often thought to only include persons seventeen or older who are not enrolled full-time in high school or college, the term adult learner in its broadest sense applies to every adult participating in organized education

(Cross, 1979). While entry-level university students are technically "adult learners," those new university students' educational background most likely was not under the adult learning model, but rather under the adolescent learning model. In this case, university educators must move the students into the adult, or self-directed learning, model as soon as possible.

Adult Motivation

An important area to take into consideration in planning adult education programs is the learners' motives. The most important perspective in adult learning motivation is that adults are voluntary, practical learners who pursue education for its use to them. If education is to serve this voluntary learning force, then educators need to understand what to do to motivate their particular learners (Knowles, 1980). Studies indicate that adult learners appear to be very responsive and motivated to action-oriented learning, that is, learning while doing (Cross, 1979). Adults who are motivated, and see a need to learn something new, are quite resourceful -- and successful. The key to using adults' natural motivation to learn is tapping into their most teachable moments: those moments in their lives when they believe that they need to learn something different. The idea of this window of opportunity for learning applies not only to peoples' motivation to learn, but also to their ability to retain what they do learn. In contrast, if the learners acquire a new skill or knowledge, but then have no opportunity to use it or are delayed in using it, the skill or knowledge will fade (Zemke & Zemke, 1995).

Adult Education Facilitation

Noted adult educator Stephen Brookfield (1989) maintains that there are six principles of adult education facilitation which should be considered: First, adults voluntarily participate in the educational activity, and as such, the decision to learn is the learners' -- they cannot be forced to learn. Second, there must be a mutual respect between the learner and the educator. Third, there must be a collaborative spirit in determining the course objectives, learning methods, and the evaluative process. Fourth, there must be a continuous process of investigation and exploration of the subject matter. Fifth, time must be allotted for critical reflection. And sixth, the education must be self-directed by the learners, with the facilitator assisting the adults to reach their educational goals.

Although much of adult learning is self-directed, the classroom learning environment is still the critical link. Lecture alone is effective and essential when the learners have little or no knowledge of the subject matter. However, facilitation is more effective than lecture when the goal is to engage learners in setting objectives, to tap into their prior experience and knowledge, or to help the participants reach a consensus. Breaking participants into small learning groups to exercise new skills and knowledge in relative safety is critical to understanding and retention. Participants in an adult learning process are normally hesitant to try out new knowledge and skills in front of others. Small "praxis" teams that practice and reflect can overcome the reluctance to risk (Zemke & Zemke, 1995).

Cooperative and Collaborative Learning

In parallel with praxis teams and adult education, cooperative and collaborative learning techniques appear to be particularly applicable for aviation students. In cooperative learning, the students participate in small, structured group activities as they work together to solve problems assigned by the educator. By contrast, in collaborative learning the students are asked to organize their joint efforts and negotiate, among them, who will perform which task. The instructor does not always actively monitor the groups and refers all substantive questions back to them for resolution (Bruffee, 1995; Matthew, Cooper, Davidson, & Hawkes, 1995).

Computer-Based Training

With the increased access to computer-based tutoring programs, students are moving away from passive reception of information to more active engagement in the acquisition of knowledge (Kozma & Johnston, 1991). Computer programs for tutoring technical subjects can be particularly useful in aviation education. Computer-Based Training (CBT) programs can be used extensively for pre-class preparation, as well as post-class review and reinforcement. CBT programs allow the student to accomplish self-paced learning in a non-threatening environment. In addition to supporting the CBT programs, the same basic computer equipment for aviation education can be augmented with a control yoke and throttles to be used with personal computer-based aviation training devices (PCATDs) with flight simulator programs. These personal computer-based flight simulator programs are relatively low-cost training vehicles that can be easily and effectively integrated into an aviation education curriculum. They are well suited as an educational bridge between the basic, traditional aviation classroom and the advanced, high technology aviation flight environment (Karp, 1996).

Learning Style Theory

Learning style theory, that is, the way people learn best, is of considerable importance in developing and delivering aviation academic programs. One model suggests that there are three recognized primary, or dominant, learning styles: First, visual learners, who learn best by reading or looking at pictures. Second, auditory learners, who learn best by listening. And third, hands-on, tactile, or kinesthetic learners, who need to use their hands or whole body to learn (Filipczak, 1995). If knowledge transfer is to take place within the entire classroom population, all of these dominant learning styles should be addressed in the academic environment.

Gender also plays a role in learning style differences between students in the classroom, in a laboratory, or on a flight line. Research has shown that women learn in many different ways than men (Turney, 1995). For example, while men often prefer debate-like situations in which they pursue knowledge, women most frequently like to share and learn by interacting with each other (Tannen, 1990). Additionally, Females often are very participatory in their learning styles, while men tend to be more independent (Emanuel & Potter, 1992). Aviation curriculum development and delivery should take into consideration those learning styles that are both unique as well as common to men and women in order to maximize their retention, and their success, in the aviation career field.

In developing educational programs, it is important for the instructor to understand how his or her students learn the best and why they succeed. Because of the depth and complexity of the subject matter, aviation academic instructors must present the course material in ways that satisfy the different needs and styles of the aviation learners. Likewise, each student must understand his or her dominant learning style and maintain more focused attention to the information when it is being presented in a teaching style which is not easily compatible with their learning style.

Learning Style Research

To examine a representative sample of pilots' dominant learning styles (visual, auditory, or hands-on), qualitative research interviews were conducted with 117 pilots (ranging from private pilots to F-16 pilots) to identify the respondents' dominant learning styles, as well as to explore potential enhancements and restructuring to aviation academic programs (Karp, Turney, & McCurry, 1999; Karp, Condit, & Nullmeyer, 1999). The learning style assessment of the 117 pilots revealed that over 44% were hands-on learners, and almost 60% were either hands-on, or hands-on/visual learners (Table 1). In contrast to the majority of the pilots being predominantly hands-on or hands-on/visual learners, the research indicated that most classroom instruction environments were auditory in nature, with visual supplementation, and very little, if any, hands-on learning.

Learning Style	Number	Percentage
Visual	38	32.5%
Auditory	8	6.8%
Hands-on	52	44.4%
Hands-on/Visual	16	13.7%
Visual/Auditory	3	2.6%

Table 1. Dominant learning styles (n = 117).

Screening and Selection for Training

Screening individuals prior to entering training could also play an important factor in selecting potentially successful candidates for training programs that require a high capital investment. The selective screening of individuals has always been a major factor used by the military, which places pilots with limited flying hours in demanding flying positions. One of the reasons that former military pilots have historically occupied a high percentage of the airline cockpits is because the military has maintained high pilot selection and training standards. Almost all military aviators have a 4-year college degree. Additionally, applicants have to be screened to meet related physical and psychological requirements. The pilot selection and testing process is considered a key to the success of military pilot training and includes tests for general cognitive abilities, personality, psychomotor skills, and physical fitness to eliminate individuals who are less likely to succeed (Karp, 1996).

Lufthansa Airlines has been using comprehensive screening programs since the 1950s with tremendous success. Their screening programs have resulted in an exceptionally high pilot training completion rate of more than 90% (Dr. Karsten Severin, Director of Psychology, Lufthansa German Pilots School, personal interview, Bremen, Germany, March 3, 1995). The German Aerospace Research Institute (DLR) has been responsible for the screening of pilots for Lufthansa Airlines for over 40 years. This screening has resulted in selection criteria such that less than 10% of the applicants who pass the screening fail to complete the flight training. In addition to the physical examinations for entry into pilot training, the DLR screens for knowledge, ability, and personality. "Knowledge" test areas include school grades, English language, mechanical and technical subjects, and numeral facility. "Ability" testing looks at numerical reasoning, memory (auditory and visual), perception and attention, psychomotor coordination, and multiple task capacity. "Personality" screening, on which Lufthansa places a high importance, explores achievement motivation, rigidity, mobility, risk taking, vitality under stress, extroversion, emotional stability, and stress resistance. The DLR contends that if the total profile of knowledge, ability, and personality is at or above their normative group in all areas, the individual has an extremely high probability of being a successful airline pilot (Dr. Klaus-Martin Goeters, Director, Aviation and Space Psychology Department, German Aerospace Research Institute, personal interview, Hamburg, Germany, April 2, 1996).

THE INTEGRATED AVIATION LEARNING MODEL

Considering the academic underpinnings, an initial integrated aviation learning model, the Aviation Education Reinforcement Option or AERO model© was developed to increase long-term knowledge retention and enhance application of aviation education (Karp, 1996). This AERO model (Figure 1) has been instituted at Arizona State University and was recently further refined to key on accelerating university aviation-trained pilots into the regional airlines (Karp, McCurry, & Harms, 2000).

Integrated Learning Model Components

Inputs. While pilot candidates in a first officer training program can have varying levels of experience, university-age individuals, with little or no flying experience, make excellent candidates because they have minimal "bad flying habits" or misconceptions.

Pre-Training Screening Program. A key element of a first officer training program should be to test and screen candidates for physical condition, and psychomotor, personality, and cognitive skills, to help identify those who have the potential for succeeding in flight training and fitting the "airline model."

Integrated Aviation Classroom. Since university-age students are in a transition from adolescent learning to adult learning, beginning aviation students must be "focused" toward self-directed learning to attain their maximum potential. This includes *motivating* the learners by stressing the need to acquire the knowledge and to recognize that this is the time to learn it. While a *lecture* alone is effective when learner has little or no knowledge of subject, it is important to recognize that *facilitating* the knowledge transfer is a more effective format to increase knowledge by engaging learners in an exchange of ideas in *problem-centered discussions* and tapping into their prior experiences.

Adult Education Principles. In line with the adult education model, goals for learning objectives and the methods for knowledge transfer and evaluation are important details for the educator to explain, in order to assure a "buy-in" by the learners to the "*what*" and "*when*" of the aviation learning process. Additionally, in adult-focused aviation education, the extensive amount of technical material that must be covered for the course and the limited time available in the classroom, requires that almost every moment of class time be used to expand on, or to integrate, the foundational knowledge. This requires extensive preparation by the students prior to each class or laboratory. Since adults cannot be "forced" to learn, it is important to emphasize that the students, themselves, must make that decision, and then help "self-direct" the process.

In-depth Theory. In order for pilots to apply recently acquired knowledge to new situations, they must have an in-depth understanding of systems and procedures. That is, a detailed comprehension of the *why*, and not just the *what.* Lecture on foundational information should be delivered in the classroom using a video projector to display computer presentation programs and personal computer-based flight simulator programs, to reinforce the lessons.

Immediate Application. Application of acquired knowledge immediately after the classroom experience is critical for adult learning and reinforcement to take place. Following each classroom lesson (for example, magnetic compass operations), learners should go to a laboratory for immediate application of the lesson components (for example, magnetic dip-error lead-points) to reinforce the knowledge transfer by flying specific lessons in PCATDs, flight training devices (FTDs), or flight simulators. PCATDs can provide this immediate application at a low cost and are very flexible for different curricula. Additionally, the immediate application in the PCATDs helps provide the educational components in multiple learning styles, thereby meeting more individuals' learning needs (hands-on, tactile; visual; and auditory learning) than are provided by classroom lecture alone. *It is important to note that this paper stresses the use of PCATDs as a component of the academic classroom, and not necessarily as a component of the flight training program.*

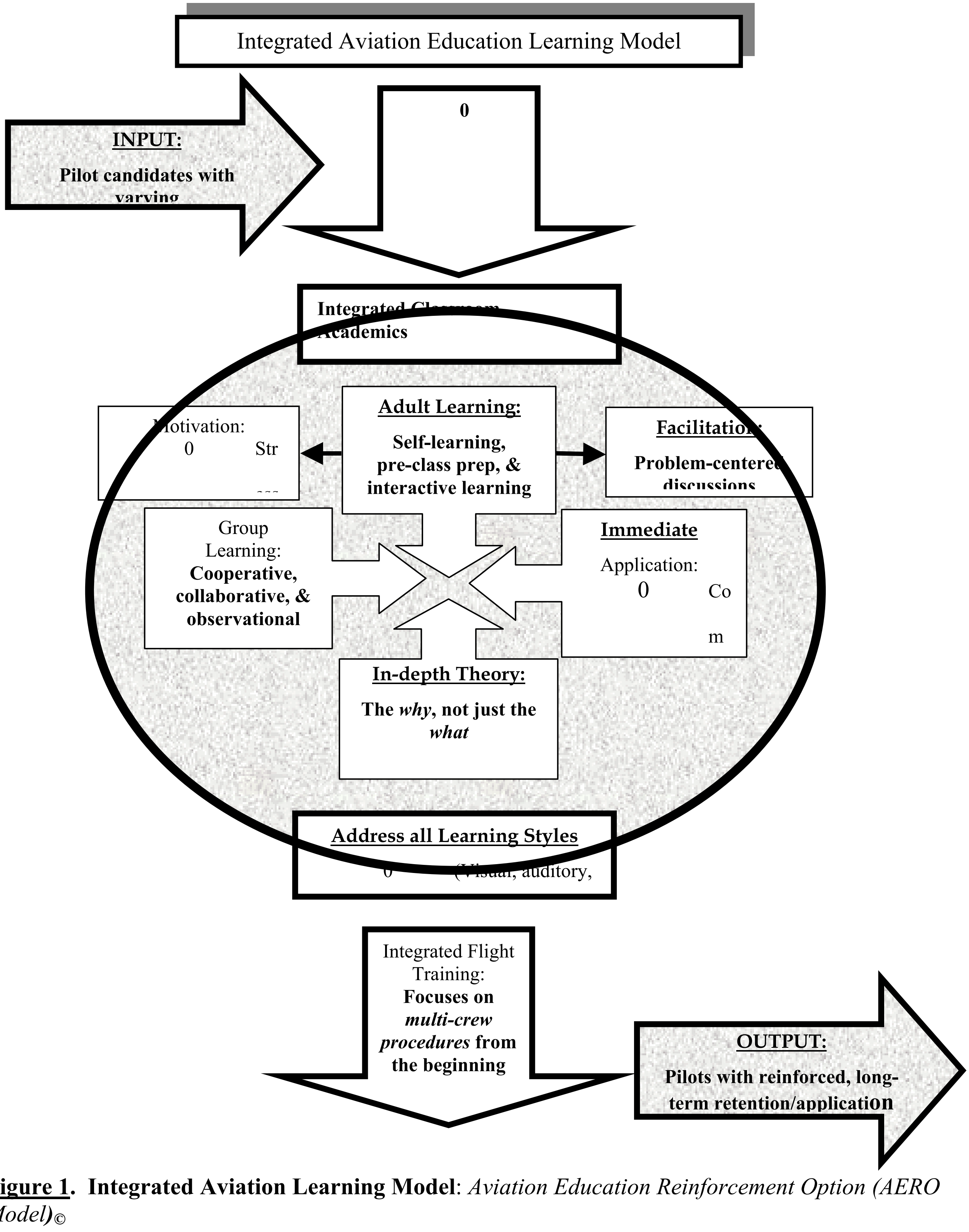

Figure 1. **Integrated Aviation Learning Model**: *Aviation Education Reinforcement Option (AERO Model)*©

Group Learning. Group learning in small "praxis teams" is particularly applicable for aviation students. Group learning includes cooperative, collaborative, and observational learning. *Cooperative learning* takes place when the learner teams give presentations and fly simulator missions as assigned by the educator. In contrast, c*ollaborative learning* takes place when the educator makes an overall assignment to the group for presentations or flight simulator missions, and the group itself determines who will do what, and how. In the collaborative learning laboratory, the teams "fly" approaches or Line-Oriented Flight Training (LOFT) profiles on the PCATD, using "pilot-flying / pilot-not-flying" procedures early in their training to reinforce multi-crew concepts, as well as the airline oriented challenge-and-response type checklists and procedures. Collaborative learning has proven to be an especially reinforcing process for aviators. The *observational learning* element in group learning includes a non-flying team observing the team that is flying in the collaborative flight simulator laboratory. The observational team then provides a post-flight assessment. This group learning component provides direct peer feedback for the team who is flying, and objective observational learning for the non-flying team.

Learning Style Theory. Throughout the various stages of aviation learning (for example, educator lecture, learner cooperative and collaborative PCATD flight simulator missions), the material should be delivered in visual, auditory, and hands-on learning styles to address all students' dominant learning styles. Learning style theory is a major component of the AERO model.

Integrated Flight Training. Integrated flight training focuses on multi-crew procedures from almost the beginning of flight training. While initial pilot training may have to be single-pilot oriented, moving quickly to airline-type procedures and checklists should help pilots minimize "procedure" transition issues when going to the airlines.

Output. The goal of this aviation learning model is to produce a pilot who has long-term retention of the knowledge, and can successfully apply that knowledge to new situations without having previously encountered the new situation.

RECOMMENDATIONS

1. Aviation education and training institutions should adopt an integrated aviation learning model, such as the AERO Model in Figure 1, which uses the adult education paradigm and cooperative and collaborative learning techniques, in concert with PCATD flight simulator programs for immediate classroom hands-on application of airline multi-crew cockpit procedures.

2. The U.S. airlines should recognize proficiency-based training, in addition to experience-based training, in their criteria for pilot employment application eligibility. With the projections of shortages of qualified, commercial airline pilots in the U.S. airline industry, the timing is favorable now to make a bold change in employment criteria. This major change need not be addressed by individual regional and major airlines alone, but rather should be considered by a coalition of the airline industry, universities with aviation programs, and the federal government.

3. Create an aviation industry, university, and government aviation education and training coalition. This joint coalition would, in an on-going forum, define commercial pilot needs, develop training standards, furnish aviation education and training concepts to provide the industry with the best trained

and the safest pilots in the world.

4. Develop a standard screening program that predicts an individual's potential for success as an airline pilot and assists interested applicants with their decisions on whether or not to pursue careers as airline pilots, prior to making the required capital investment for the training.

5. Establish relationships between university and regional airlines for participation in the pre-training selection process, training program development, internships, and early identification for employment.

CONCLUSIONS

As aviation technology and the international airspace structure become more complex, aviators must acquire, on a high retention and application level, a large amount of information. An integrated learning model applied to modern aviation education should improve understanding, efficiency, effectiveness, and safety in aviation education and training programs. The incorporation of an integrated aviation learning model would also potentially help ease the projected shortage in the commercial airlines by substituting in-depth, long-term knowledge retention and proficiency for some of the airlines' current flying hour hiring requirements. Affiliations between major airlines, regional airlines, and universities must be established to bridge the gap in the current training and experience pipeline from the university classroom to the regional airlines' cockpits.

The recruitment and retention of women in aviation programs are additional factors to consider in meeting future commercial pilot requirements. The full utilization of female resources, as well as male resources, is important. Women constitute only a small percentage of the commercial pilot force, yet they comprise a very large resource pool from which the commercial aviation industry can draw. In order to attract and retain the best people in aviation academic programs, aviation academic providers must design their curriculum and delivery vehicles to meet their students' specific learning styles, whether they are male or female.

The investment in time for curriculum development in a structured, integrated aviation education model such as the AERO model should pay high dividends in expanding the learners' knowledge base, enhancing their flexibility to address new situations, increasing their productivity and effectiveness, and accelerating pilot production into the airlines.

REFERENCES

Brookfield, S. (1989). Facilitating adult learning. In Merriam and Cunningham (Eds.), Handbook of adult and continuing education. San Francisco: Jossey-Bass.

Bruffee, K. (1995, January/February). Sharing our toys: Cooperative learning versus collaborative learning. Change, 27, 12-18.

Cross, K. (1979). Adult learners: Characteristics, needs, and interests. In Peterson, R. and associates (Eds.), Life learning in America. San Francisco: Jossey-Bass.

Emanuel, R. & Potter, W. (1992). Do Students' style preferences differ by grade level, orientation toward college, and academic major. Research in Higher Education, 33, 395-414.

Filipczak, B. (1995, March). Different strokes: Learning in the classroom. Training, 32, 43-48.

Karp, M. (1996). Theoretical aviation training for future airline pilots. Doctoral Dissertation, Walden University, Minneapolis, MN. UMI 9713644.

Karp, M, Condit, D., Nullmeyer, R. (1999). F-16 Cockpit/Crew Resource Management. (AL/HE-AZ-TR-1999-0253). Mesa, AZ: Air Force Research Laboratory.

Karp, M.R., Turney, M.A., & McCurry, W.K. (1999). "Learning Style Theory and Aviation Education." Proceedings of Tenth International Symposium on Aviation Psychology, May 3-6, 1999, Columbus, OH.

Karp, M.R., McCurry, W.K., & Harms, D. (2000). "Aviation Education and training for future regional airline pilots: An integrated process. Proceedings of the Regional Air Transportation Training Convention & Tradeshow, February 8-9 2000, Daytona Beach, FL.

Knowles, M. (1980). The modern practice of adult education: From pedagogy to andragogy (2nd Ed). New York: Cambridge Books.

Kozma, R. & Johnston, J. (1991, January). The technological revolution comes to the classroom. Change, 16-18.

Matthew, R., Cooper, J., Davidson, N., & Hawkes, P. (1995, July/August). Building bridges between cooperative and collaborative learning. Change, 27, 35-40.

Tannen, D. (1990). You just don't understand: women and men in conversation. New York: Ballentine Books.

Turney, M. (1995). Women's learning and leadership styles: Impact on CRM. Proceedings of the 21st Conference of the European Association for Aviation Psychology, Volume 1, Applications of Psychology to the Aviation System. Brookfield, Vermont: Ashgate Publishing Company.

United States Department of Transportation Federal Advisory Committee (1993, August). Pilots and aviation maintenance technicians for the twenty-first century: Assessment of availability and quality. Washington D.C.: U.S. Government Printing Office.

Zemke, R. & Zemke, S (1995, June). Adult learning: What do we know for sure? Training, 32, 31-40.

Zemke, R. & Zemke, S (2000). Proceedings of the Regional Air Transportation Training Convention and Tradeshow (RATS 2000), February 2000, at Daytona Beach Florida. Farnborough, UK: Civil Aviation Training (CAT) Magazine, Halldale Publishing.

THE FAA: A TOMBSTONE AGENCY? PUTTING THE NICKNAME TO THE TEST

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ABSTRACT

The purpose of this research was to investigate Federal Aviation Administration (FAA) activity before and after six catastrophic airline accidents to examine the alleged reactive policy-setting reputation of the FAA. Actions reviewed were regulatory, inspection, and enforcement activities. The study revealed that change in agency activity does occur following an accident. The location of the event appears to influence the direction of change. When accidents occurred within the United States, FAA activity increased following the accident. The opposite occurred for airline accidents outside the U.S. The increase in FAA activity following U.S. based events, supports the reactive, "tombstone agency" reputation the FAA has acquired.

In addition, the research revealed nine FAA activities judged by industry experts as having the ability to improve safety in the airline industry. Inspections and certificate actions are considered activities that will improve safety. Regulatory actions, fines, warning notices, and letters of correction were judged as non-safety enhancing activities. The result of this research was an increased understanding of how the FAA responds to airline accidents and the consequences of the response.

THE REPUTATION OF THE FAA

The Federal Aviation Administration (FAA) is the agency charged with safety oversight in the aviation industry. The organization is under fire in the media for not taking actions to meet this goal. The FAA has been criticized for being overly responsive to external actors. Some believe responsiveness to media, following the ValuJet accident, played a role in the airline's shut down and subsequent resignations of several key FAA officials (Shifrin, 1996a). During ValuJet hearings, Former Senator Cohen told the subcommittee, "the FAA's problems are much deeper than ValuJet and its troubled safety program. The agency's continuous refusal to acknowledge its shortcomings is indicative of a managerial culture that denies problems exist, defends the status quo and uses public relations spins to deflect criticism" (Phillips, 1996, p. 31). Criticism exists over the amount of influence the industry, particularly airlines, has over the FAA (Ullmann, 1996; Bryant, 1996; Gleckman, 1996). In fact, the FAA admits it "works slowly because it needs to balance the benefits of safety changes with airlines' and crews' interests" ("FAA's snail's-pace", 1999). Critical of the industry influence over FAA policy, an assistant U.S. attorney, after several investigations of FAA positions on safety policies, said to former

FAA official, Anthony Broderick, “You are supposed to regulate, not represent, the airlines” (Cary, Hedges, & Walsh, 1996, p. 50).

Others have gone so far as to say that the FAA itself is a safety problem (Glieck, 1996). The organization was described by one author (Ullmann, 1996) as “secretive FAA management, whose military mind set, industry sympathies, and resistance to change give critics fits” (p. 39). A <u>Newsweek</u> article also presents the claim that the FAA is unresponsive. “Thanks to inept management, bureaucratic inertia, and the constant tugging of powerful economic interests, the FAA remains one of the government’s least adaptive agencies” (Levinson, Underwood, & Turque, 1996, p. 46). The agency has been accused of possessing a “tombstone mentality of acting only after a tragedy” (Ullmann, 1996, p. 39). In the past few years, the FAA has come under fire for being reactive and not proactive, responding to safety concerns only after a catastrophic accident has occurred (Phillips, 1995; Shifrin, 1996b).

RESEARCH QUESTIONS

While criticism of the FAA certainly exists, surprisingly, no previous research has been located that addresses these claims. This research provides the first step toward examining the reputation the FAA has developed for their alleged reactive policy-setting practices. An exploration of FAA actions before and immediately after a tragic event, such as an airline accident, will address these issues. Furthermore, why study crises at all if not to reduce the occurrence of future events? Perhaps more critical than knowing whether policy change occurs following a crisis is knowing what consequences, if any, such policy action brings. Take for example the following scenario. A crisis occurs, the crash of an airliner. The FAA responds by increasing inspections of airlines. Do industry experts believe such activity (increased inspections) will enhance the safety of the airline industry? To explore FAA policy practices, the following research questions were developed.

1. Does a change in agency activity occur following a crisis event?
2. Is agency activity perceived to improve safety in the airline industry?

METHODOLOGY

To address the research questions, a method was required that would allow for analysis of FAA activity variables and for establishing the importance of these variables to improving safety. The appropriate method should (a) provide comparable measures of agency activity before and after an accident, (b) result in determination of relative importance of variables regarding ability to improve airline safety, and (c) be congruent with publicly available data.

Given the criteria, the method selected was a weighted average. Weighted average development begins with the use of expert opinion (Clark & Friedman, 1982; McMeniman, 1990; Bowen, Headley & Luedtke, 1992) to determine importance weights. Each weight is then applied to the associated data. These values are added together and the total is divided by the sum of all the weights. The standard formula for the weighted average (×) is:

$$\times = \frac{w_1X_1 + w_2X_2 + ... + w_kX_k}{w_1 + w_2 + ... + w_k} = \frac{\sum wX}{\sum w}$$

where w represents the associated weight for variable X (Spiegel, 1996, p. 59). The weighted average has been used in the field of aviation to develop the now well-known and highly-publicized Airline Quality Rating (Bowen, et.al., 1992). Using this methodology would provide the aviation industry with a measure of FAA response to accidents. The methodology would, as noted by Bowen, et. al (1992), provide such information in a timely manner using publicly-available data. The FAA has expanded public access to airline safety data. The release of information about individual carriers is in response to a call by the public and members of Congress for more safety information (Phillips, 1997). The move to release information was prompted by a deadly year for U.S. airlines, the crashes of ValuJet 592 and TWA 800 in 1996.

The standard weighted average formula can be calculated using FAA activity. Weights, indicating the perceived importance of each FAA activity to improving airline safety can be associated with publicly available FAA data. The end result is a single value indicating FAA agency activity as shown below.

$$SAR = \frac{w_1A1 + w_2A2 + w_3A3 + ...w_nA_n}{w_1 + w_2 + w_3 + ...w_n}$$

In this equation, (SAR) refers to safety activity rating, (w) refers to the weight assigned to each FAA activity (A). A separate value, or SAR, can be calculated for the time frame before and after each accident, allowing for comparison of agency activity.

To address question two, frequency distributions can be presented. The SAR is composed of factors that have been judged by industry experts, for importance in improving the safety of the airline industry. A discussion of the weight assigned to these factors, indicating the importance of the activity to improving safety, along with examination of the level of activity using frequency distributions, will address question two. For example, if unannounced ramp inspections of flight operations are judged to be an important agency activity for the purpose of increased safety, the frequencies of this activity prior to and after accidents will be presented and discussed.

Selecting the Variables for the SAR

FAA activity was defined as policy outputs of the regulatory agency. Those policy outputs are regulatory, inspection, and enforcement activity. Safety experts consider fines and administrative actions important elements to consider when evaluating airline safety (Stoller, 2000). The regulatory category includes two measures of activity: number of Notice of Proposed Rulemakings (NPRMs) and number of new Federal Aviation Regulations (FARs). The inspection category includes en route inspections, facility inspections, record/log inspections, and spot/ramp (no notice) inspections. The inspections refer to activity or inspections of the following operations areas: flight operations and maintenance. The terms used here are derived from the FAA Enforcement Information System (EIS) code list (Department of Transportation, 1998). The enforcement category includes three measures of activity: occurrence of fines against airlines, occurrence of certificate actions (suspension or revocation), and written notifications of safety concerns and/or violations (warning notice or letter of correction).

The SAR was applied to an equal time frame before and after six accidents between 1988-1999. Accidents, as defined by the National Transportation Safety Board

(NTSB), which involved United States based, Part 121 scheduled airlines and which resulted in 100 or more fatalities were selected. Not surprisingly, data show that most fatal airline accidents result in few lives lost or many lives lost. For example, from 1988 to 1999, (a) 13 accidents, each of which resulted in one to 25 fatalities, occurred; (b) three accidents, each of which resulted in 26 to 99 fatalities, occurred; and (c) six accidents, each of which resulted in 100 or more fatalities, occurred (National Transportation Safety Board, 2000). The purpose of using these years (1988-99) is to provide an adequate amount of accident data. Although accidents of this magnitude are rare, the time span will result in six accidents to review (see Appendix A).

DATA COLLECTION & ANALYSIS

Expert opinion was gathered to determine the relative importance of each item to improving the overall safety of the airline industry. To gather the expert opinions, a questionnaire was constructed. The subject selection process resulted in a nonprobability, purposive sample. Subjects included airline safety department personnel from U.S. based, part 121 airlines, pilots from the primary pilot organizations including Allied Pilot Association (APA), Airline Pilots Association (ALPA), and International Association of Continental Pilots (IACP). FAA inspectors from regional and local FAA offices, investigators from NTSB regional offices, and university researchers with knowledge and research experience in areas including aviation safety, FAA activities, and airline operations were also included. Researchers were identified with the assistance of University Aviation Association (UAA). To minimize bias, no group was systematically under represented or over represented (Folz, 1996). A pre-test, considered a critical quality-control device (Folz, 1996, p.120), was conducted. Additionally, a test for scale reliability, Cronbachs Alpha (Cronbach, 1951) was calculated. According to Carmines and Zeller (1979), this test is an excellent technique for assessing reliability (p. 50) and therefore should be computed for any multiple-item scale (p. 51). The values of coefficient alpha typically range from zero to one; the higher the value, the greater the internal consistency (Spector, 1992). Generally, a value of .6 or higher is acceptable but .8 or higher is preferred (Bowen, Headley, Kane, & Lutte, 1999; Carmines & Zellar, 1979). This research resulted in an alpha of .87. The mail questionnaire occurred in two phases and resulted in a usable response rate of 48%, an acceptable rate according to the literature (Czaja & Blair, 1996; Dooley, 1995; Folz, 1996). Questionnaire results are presented in Appendix B.

Once the results from the questionnaire were recorded, the mean response for each question was tabulated. The purpose of calculating the mean was to establish weights for each variable in the SAR formula. To continue building the formula, the activity data were entered. For each accident, FAA data were gathered for a period of 12 months prior to and 12 months following the accident. Birkland (1997) concluded that two years is an adequate time frame to monitor activity related to a crisis. Additionally, since the FAA has the ability to quickly initiate the variables described for this study, and as Kingdon (1995) points out, the window of opportunity for change following an aviation accident is short lived, a 12 month period is an appropriate length of time to gauge agency activity. Collection was conducted through the use of documents search, World Wide Web, and FAA database searches. Since the research resulted in a large amount of data, the FAA activity data have been summarized in two tables. The first, Appendix C, lists the activities that were judged by the experts as having the ability to enhance safety in the airline industry (mean response score of 5.0 or higher). Appendix D displays the same information for those activities judged as not having the ability to enhance safety.

With all the data collected, the SAR was applied to each of the six accidents. Research question one can be answered by comparing the SAR prior to each accident (to be known as SAR_0) to the corresponding SAR following the accident (SAR_1). This was accomplished by using a simple ratio as seen below.

$$\text{Change in SAR} = \frac{SAR_1 - SAR_0}{SAR_0}$$

The SARs for each accident for the year prior to (base year) and the year following the accident and the change in SARs are summarized in Table 1.

As the data in Table 1 reveal, patterns in agency activity do exist. Increases occurred following four of the accidents under review. All four of these accidents occurred in the United States.

Table 1
Change in SAR Scores (indicating FAA activity) From the Twelve Month Period Before the Accident (SAR_0) to the Twelve Month Period After the Accident (SAR_1)

Accident	SAR_0	SAR_1	Change in SAR
PanAM 103	124.3	110.0	- 11.5 %
United 232	477.3	618.8	+ 29.6 %
USAir 427	370.1	388.6	+ 4.9 %
American 965	426.7	384.3	- 9.9 %
ValuJet 592	47.3	173.9	+ 267.6 %
TWA 800	240.9	349.9	+ 45.2 %

The SAR following the USAir crash increased by only 4.9%. United 232 and TWA 800 resulted in larger changes of 29.6% and 45.2%, respectively. The largest change occurred following the ValuJet 592 accident. The SAR increased by 267.6% in the twelve months after the DC-9 crash. In the two cases where decreases occurred, both accidents happened outside the United States. The PanAM 103 bombing over Lockerbie, Scotland and the American 965 crash in Cali, Colombia both resulted in a decrease in the Safety Activity Rating.

To answer question two, those activities perceived as having the ability to improve safety in the airline industry must be identified. This is accomplished by a review of the expert opinions. Industry experts were asked their opinions as to whether certain FAA activities will result in improved safety in the airline industry. The results of the questionnaire were used to identify the safety enhancing FAA activities.

Based on the mean scores from the industry expert responses, nine activities were identified as having the ability to improve safety in the airline industry. The nine activities are listed in Figure 1. The activities are rank-ordered, starting with those activities with the highest score for ability to improve safety in the airline industry.

1. Ramp/spot inspections - maintenance (5.5)
2. Facility inspections ¥ maintenance (5.5)
3. Certificate suspension (5.4)
4. Certificate revocation (5.3)
5. Facility inspections ¥ flight operations (5.3)
6. Enroute inspections ¥ flight operations (5.2)
7. Ramp/spot inspections ¥ flight operations (5.2)
8. Record/log inspections ¥ maintenance (5.2)
9. Record/log inspections ¥ flight operations (5.1)

Figure 1. FAA activities identified as safety enhancing.

Comparing the list of activities judged as safety enhancing, to the actual activity levels, is revealing. Increases in activity occurred in five of the nine activities judged as safety enhancing (see Appendix C). The greatest increase occurred in the highest ranked activity. Ramp/spot inspections of maintenance had the highest score for improving safety and had the largest overall increase in activity level following an accident. The overall post-accident increase in the number of maintenance ramp/spot inspections was 2,229. No change occurred in two of the nine activities judged as safety enhancing; certificate suspensions and revocations. No such FAA actions took place during any time period under review. The two activities that experienced an overall decrease in activity, facility inspections of flight operations and enroute inspections, also experienced the smallest amount of change.

It is useful when answering question two, to also examine the data related to activities that were not perceived to improve safety. A summary of change in activity levels is provided in Appendix D. According to the data displayed for regulatory activities, issuance of FARs following accidents increased at a higher amount than issuance of post-accident NPRMs. FARs were rated by the industry experts as having a greater ability than NPRMs to improve safety. The enforcement categories that were judged as not having the ability to improve safety in the airline industry included fines, warning notices, and letters of correction. Three categories of fines were reviewed. The category of fine judged as least effective in improving safety was the type of fine imposed most often. Warning notices were issued more often than letters of correction although they were judged equally by industry experts.

After reviewing all activity levels, the answer to question two is yes, with one major exception. Agency activity is perceived to improve safety in the airline industry. Out of nine identified safety- enhancing activities, two experienced no change in activity, two decreased, and five increased. The exception is enforcement activity in the area of fines. One category of fines, those below $10,000, showed an overall increase in activity following accidents. The enforcement activity received not only the lowest score for ability to improve safety in the airline industry of all three categories of fines, but also received the lowest score of all sixteen FAA activities. The type of fine most often enacted following an accident is the type of fine, and the FAA activity, judged as least effective in improving safety.

CONCLUSIONS

Based on the study, numerous conclusions regarding agency activity can be drawn. Below is a summary of these conclusions.

1. A change in FAA agency activity does occur following an accident. The location of the accident appears to influence the direction of change. When the event occurred outside the United States, the FAA activity levels decreased. Agency activity increased following accidents that occurred in the United States.

2. The increase in FAA activity levels, following catastrophic accidents in the United States, supports the reactive policy or "tombstone agency" reputation the agency has acquired. In every case where an accident occurred in the United States and resulted in more than 100 fatalities, a rise in agency activity was displayed.

3. Nine FAA activities were judged by industry experts as having the ability to improve safety in the airline industry. Inspections and certificate actions are considered activities that will improve safety in the airline industry.

4. Regulatory actions, fines, warning notices, and letters of correction were judged by experts as non-safety enhancing activities.

5. With the exception of fines, FAA post-accident activity is perceived to improve safety in the airline industry. The majority of the nine identified safety enhancing activities displayed an overall increase following a crisis event.

6. The FAA enforcement activity judged as least effective in ability to improve safety, was the most often used method of enforcement following accidents. Fines in an amount less than $10,000 were the only category of fines to experience an overall increase following accidents.

THE FAA: REPUTATION DESERVED

What we know now is that the six cases examined here support the claim that FAA activity is driven not only by accidents, but by the location of those events. Another result of this study is the discovery that FAA agency behavior is perceived to improve safety. Inspections and certificate actions were activities judged as having the ability to improve safety. The majority of the safety enhancing activities displayed an overall increase following a catastrophic airline accident.

The FAA, however, should reconsider use of fines. Following accidents, the type of fine most often imposed by the FAA was a fine below $10,000. These fines were judged as least effective of all FAA actions in ability to improve safety. Additionally, since large fines (those above $100,000) are rarely imposed, perhaps such fines should serve as a "red flag" to the FAA. A fine of such a substantial amount may be a signal of a growing safety problem. Case-in-point, the only such fine imposed during the period under review for this study was a one-time $200,000 fine against ValuJet in the 12 months *before* the crash of Flight 592. Perhaps the FAA and airline managers should consider such enforcement actions as cause for concern.

TAKING IT TO THE NEXT LEVEL

Results here prompt many new questions. For example, why the change in action following crashes occurring elsewhere in the world? The FAA still has control over the carriers involved in those accidents. Why not exercise it? Perhaps it relates to investigation jurisdiction or information access? Additionally, why did such a large increase in FAA activity (276%) occur following the ValuJet crash? Perhaps intense media coverage played a role. Does the size of the carrier prompt differences in action? Another question can be raised regarding the FAA use of fines in small amounts. Why would the FAA focus on actions that are not perceived to improve safety? One may assume that FAA personnel are not aware of or do not agree with the experts' evaluation of these non-safety enhancing activities. This study took the first step in exploring FAA accident related activity. Additional research should be conducted to explore these and other related research questions.

Appendix A

Airline Accidents (Scheduled, Part 121) Resulting in 100 or More Fatalities for the Years 1988 – 1999

Date	Flight	Location	Fatalities	Description
12/21/88	PanAM 103	Lockerbie, Scotland	270	747 terrorist bombing
7/19/89	United 232	Sioux City, IA	111	DC-10 loss of hydraulics
9/8/94	USAir 427	Aliquippa, PA	132	737 roll over
12/20/95	American 965	Cali, Columbia	160	757 controlled flight into terrain
5/11/96	ValuJet 592	Miami, FL	110	DC-9 hazardous materials fire
7/17/96	TWA 800	Moriches, NY	230	747 mid-air explosion

Source: (National Transportation Safety Board, 2000)

Appendix B

Summary of Questionnaire Results (reported by frequency of responses) Indicating Level of Agreement Regarding Ability of Activity to Improve Safety in the Airline Industry

	Str. Disagree	Mod. Disagree	Slt. Disagree	Ntrl	Slt. Agree	Mod. Agree	Str. Agree
Regulatory							
1: FARs	6	5	1	13	15	13	5
2: NPRMs	8	7	5	16	10	10	2
Enforcement							
3: fines < 10K	15	13	11	5	7	6	2
4: fines 10K - 100K	7	9	13	9	14	7	0
5: fines > 100K	6	2	9	6	18	13	5
6: suspension	3	3	4	4	9	15	21
7: revocation	5	4	4	2	10	11	23
8: warning	4	8	4	4	26	9	4
9: correction	6	5	6	8	16	12	6
Inspection							
10: enroute	1	3	5	4	16	19	11
11: ramp/flt	1	3	5	4	20	14	12
12: ramp/mx	0	0	5	2	21	18	13
13: fac/flt	1	4	1	4	21	19	9
14: fac/mx	0	1	3	3	20	21	11
15: records/flt	1	1	4	7	23	18	5
16: records/mx	1	0	4	5	23	21	5

Appendix C

Change in FAA Activity Levels (activities judged as having the ability to improve safety in the airline industry) From the Year Before the Accident to the Year Following the Accident

	Inspection Activity						
	Ramp: Maint.	Facility: Maint.	Facility: Flight	Enrt. Insp.	Ramp: Flight	Records: Maint.	Records: Flight
Accidents							
ValuJet 592	953	100	(1)	54	48	102	8
United 232	1,522	127	71	(459)	431	146	127
USAir 427	(70)	8	(47)	500	(127)	29	(18)
American 965	(192)	(21)	(36)	(186)	(100)	(62)	(13)
TWA 800	127	16	3	99	26	55	(16)
PanAM 103	(111)	46	(26)	(25)	(53)	(21)	(14)
Airlines Increased	3	5	2	3	3	4	2
Airlines Decreased	3	1	4	3	3	2	4
Overall Change in Activity	**2,229**	**276**	**(36)**	**(17)**	**225**	**249**	**74**

Note. Parentheses ( ) indicate a decrease in activity levels.

Appendix D

Changes in FAA Activity Levels (activities judged as not having the ability to improve safety in the airline industry) From the Year Before the Accident to the Year Following the Accident

	Regulatory		Enforcement				
	FARs	NPRMs	Fines < 10K	Fines 10Kto 100K	Fines > 100K	Warning Notices	Letters of Correction
Accidents							
PanAM 103	3	1	(1)	0	0	4	(8)
United 232	6	(1)	4	(2)	0	1	3
USAir 427	2	(2)	1	(4)	0	0	1
American 965	4	3	4	(3)	0	1	(4)
ValuJet 592	5	1	0	1	(1)	0	0
TWA 800	(5)	(1)	4	(1)	0	1	1
Airlines Increased	5	3	4	1	0	4	3
Airlines Decreased	1	3	1	4	1	0	2
Overall change in activity	**15**	**1**	**12**	**(9)**	**(1)**	**7**	**(7)**

Note. Parentheses ( ) indicate a decrease in activity levels.

REFERENCES

Birkland, T. A. (1997). After disaster: Agenda setting, public policy, and focusing events. Washington, DC: Georgetown University Press.

Bowen, B. D., Headley, D. E., & Luedtke, J. R. (1992). A quantitative methodology for measuring airline quality. Journal of Aviation/Aerospace Education and Research, 2, 27-33.

Bowen, B. D., Headley, D. E., Kane, K. D., & Lutte, R.K. (1999, October). Enhancing global competitiveness: Benchmarking airline operational performance in highly regulated environments. Collegiate Aviation Review, 17, 1-14.

Bryant, A. (1996, June 19). Conceding a conflict: Roles of watchdog and cheerleader can no longer co-exist at the FAA. New York Times, pp. A20- A23.

Carmines, E,G, & Zeller, R.A. (1979). Reliability and validity assessment. Thousand Oaks, CA: SAGE.

Cary, P., Hedges, S. J., & Walsh, K. T. (1996, July 1). The FAA's about-face. U.S. News & World Report, p. 48-50.

Clark, A., & Friedman, M. J. (1982). The relative importance of treatment outcomes: A Delphi group weighting in mental health. Evaluation Review, 6, 79–93.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16, 297-334.

Czaja, D., & Blair, J. (1996). Designing surveys: A guide to decisions and procedures. Thousand Oaks, CA: Pine Forge.

Department of Transportation. (1998). Compliance and enforcement program. Washington, DC: U.S. Government Printing Office.

Dooley, D. (1995). Social research methods (3rd ed.). Upper Saddle River, NJ: Prentice-Hall, Inc.

FAA's snail-pace response to safety threats adds risk. (1999, October 25). USA Today, p. 18A.

Folz, D. H. (1996). Survey research for public administration. Thousand Oaks, CA: Sage.

Gleckman, H. (1996, July 15). A hard truth about deregulation. Business Week, 34.

Glieck, E. (1996, July 1). Can we ever trust the FAA? Time, 48-49.

Kingdon, J. W. (1995). Agendas, alternatives, and public policies. New York: Harper Collins.

Levinson, M., Underwood, A., & Turque, B. (1996, July 1). A new day at the FAA? Newsweek, 46.

McMeniman, M. (1990). The use of judgmental data in developing an index for the quantification of learner needs. Evaluation and Program Planning, 13, 145-156.

National Transportation Safety Board. (2000). Accidents Involving Passenger Fatalities U.S. Airlines (Part 121) 1982 - Present. [On-line]. Available: http://www.ntsb.gov/aviation/paxfatal.htm.

Phillips, E. H. (1995, September 25). FAA offers proactive safety concept. Aviation Week & Space Technology, 42.

Phillips, E. H. (1996, July 1). ValuJet hearings focus on FAA oversight. Aviation

Week & Space Technology, 29-31.

Phillips, E.H. (1997, February 3). FAA to expand airline safety data. Aviation Week & Space Technology, 47-48.

Shifrin, C. A. (1996a, August 5). Ex-FAA official urges agency autonomy. Aviation Week & Space Technology, 40.

Shifrin, C.A, (1996b, December 16). Safety experts seek data sharing. Aviation Week & Space Technology, 25-27.

Spector, P. E. (1992). Summated rating scale construction. Newbury Park, CA: SAGE.

Spiegel, M.R. (1996). Statistics. (2nd ed.). NewYork: McGraw-Hill.

Stoller. G. (2000, March 13). Most fines get watered down: Airlines pay an average 25 cents on dollar. USA Today, p. 3B.

Ullmann, O. (1996, July 1). Wanted: A new flight plan for the FAA. Business Week, 39.

THE RELATIONSHIP OF DOCUMENT AND QUANTITATIVE LITERACY WITH LEARNING STYLES AND SELECTED PERSONAL VARIABLES FOR AVIATION UNIVERSITY STUDENTS

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ABSTRACT

The purpose of this study was to determine the extent to which university student scores on a researcher-constructed quantitative and document literacy test were associated with learning style, program of study, cumulative grade point average, and year in school. Instruments used for the study were the 35 question Aviation Documents Delineator (ADD) and the Learning Type Measure (LTM). Data collected were analyzed using a step-wise multiple regression analysis technique. The ADD was designed to identify a student's ability and preference for interpreting and using graphic or tabular data. Study results reveal that year in school and GPA were significant predictors of literacy scores on the ADD while learning style and the student's program of study were not.

INTRODUCTION

The department of aerospace technology at Indiana State University offers two programs of study: aerospace administration and professional pilot. Students' success in the professional pilot and aerospace administration programs depends upon their ability to read and interpret documents. The curriculum content of the professional pilot and aerospace administration programs involves the use of airplane performance tables and graphs, thematic weather maps, sectional navigation charts, instrument reference maps, weight and balance tables and graphs, take off and landing graphs, etc. In addition, both curricular areas include concepts involving airport operations, planning, and management which require interpretation of financial reports, break-even analysis graphs, aviation industry forecast tables and graphs, and economic ordering quantity graphs. Learners are also expected to be able to calculate throughput and practical capacity of airports and interpret probability distributions of aircraft delays. The ability to use written documents and to apply mathematical operations to such documents constitutes an important part of the aerospace technology's curriculum.

The ability to extract relevant information from tables, graphs, and maps (*document literacy*) and to perform mathematical calculations related to print embedded in tables and graphs (*quantitative literacy*) is useful to the aviation major for the following reasons:

1. Pilots are required by Federal Aviation

Regulations (FARs) 91, 121, and 135 to know the performance characteristics of the aircraft they fly. Aircraft manufacturers display performance data in two primary formats (Taylor, 1991, p. 67). Some present the information in graphic form; others primarily utilize tables to depict relevant aircraft performance data. Additionally, preflight planning activities required by the pilot require interpretation of tables and graphs.

2. Ability to interpolate is often required in exercising flight decisions because not all the values for the infinitely possible combinations of varying conditions that exist in aviation industry tables and graphs are listed.

3. Pilot safety depends upon the pilot's ability to read and interpret performance tables and graphs. Many accidents have resulted because of pilots' failures to understand the effect of the various flight conditions on airplane performance. Misinterpretation of essential airplane weight and balance data has also contributed to hazardous flight operations.

4. Students' difficulties with quantitative literacy are as much a problem of being able to analyze and interpret the relationships of the related data provided in the document as they are a problem with simple arithmetic calculations. Success at arithmetic operations on the job was often associated with the ability to appropriately extrapolate needed information from documents (Mosenthal & Kirsch, 1993).

5. Competence in utilizing both graphic and tabular document formats with ease may help contribute to an individual's success (Quilty, 1996). Guthrie, Seifert, and Kirsch (1986) noted that the use of documents played a major role in the daily lives of Americans on and off the job; regardless of occupational type, gender, or education, subjects reported reading documents more than other types of material. Mosenthal and Kirsch (1989, p. 58) noted, "In elementary schools, we 'learned to read' using narratives. In secondary and post secondary schools we 'read to learn' using exposition. But in life beyond school, we 'read to do' using documents."

This author has been teaching aviation management and professional pilot ground school courses for the past ten years. During this time, it was observed that regardless of the aviation students' major program of study, those who appeared to do well at interpreting and utilizing documents in graphic format seemed to possess learning style preferences that were distinctly different from those aviation students who were more skilled at utilizing documents presented in a tabular format. It was also noted by this researcher that some of the same students who were more competent at extracting relevant information from graphs appeared to be more skillful at performing mathematical calculations related to print embedded in tables and graphs. Desiring to learn more about how to assist the students who were experiencing difficulty with tables and graphs and with math calculations related to such documents, the author designed the Aviation Documents Delineator (ADD). Using the ADD, the present study was conducted to determine if students had greater difficulty with interpreting information presented in graphs versus information presented in a table format, to assess the students' document and quantitative literacy, and sought to answer the following questions: Are grade point average (GPA), year in school, and program of study associated with students' abilities to read and interpret documents, graphs, tables, and maps, or with their quantitative skills in using these materials? Additionally, the study investigated whether skill in utilizing the documents was associated with an individual's learning style, as defined by the Learning Type Measure (LTM), developed by Bernice McCarthy (1995).

BACKGROUND

Direct measurement of literacy skills using the refined categories of document and quantitative literacy are relatively new (Barton, 1994). In a review of the literature regarding locating information from documents, Sticht and Armstrong (1994) reported that the first reference to the terms document and quantitative literacy initially appeared in a 1986 NAEP study of young adults in the U.S. Miller (1982) observed that a lot of the occupational-related reading tended to involve documents, was more complex, and demanded more inferential thinking and problem solving. Miller also contended that a challenge to educators in post secondary education would be to help the students bridge the gap in skills using documents.

Guthrie and Mosenthal (1986, p. 284) observed that "despite its apparent pervasiveness, locating information is rarely taught either in textbooks or by teachers." They reiterated Armbruster and Gudbrandsen's research findings (1986) which indicated that though students were expected to use information-seeking skills, they were given little guidance or instruction on how to locate information embedded in documents. In Mosenthal and Kirsch's (1989) study on document literacy, they concluded that teachers did not often examine how the more adept students navigated the documents differently from those that were more disadvantaged with documents. Using the ADD, this author sought to obtain insight into aviation students' skills at using documents and into the various factors that enable some students to perform better with documents than other students.

In the ADD the two constructs, document and quantitative literacy, were treated as two separate but related skills. Various researchers have reported that the strategies involved with document and quantitative literacy were cognitively different from the strategies used in narrative and expository forms of reading (Kirsch & Mosenthal, 1990; Sheehan & Mislevy, 1990). Researchers addressed the need for considering both document and quantitative literacy as they pertain to individuals' lives on the job (Mikulecky, 1985; Phillipi, 1988). The need to examine more fully the ergonomic issues of document and quantitative literacy was also suggested by the military in the 1970's, (Sticht & Armstrong, 1994), by industry (Chisman, 1990), by the FAA (General Aviation Manufacturers Association [GAMA], 1975), and by other governmental agencies (Mosenthal & Kirsch, 1993). In their studies, each of the above agencies pursued strategies to re-design and simplify documents to facilitate improved document literacy.

The importance of distinguishing the specific skills of document and quantitative literacy is currently supported by the growing attention given to assessment of document and quantitative literacy skills. Contemporary literacy definitions share an emphasis on document processing, computational skills, and problem solving within a particular document context. Support for future studies in quantitative literacy were made by Edward Tufte (1986) in his book, *The Visual Display of Quantitative Information*, where he emphasized that quantitative literacy is an important construct that needs further investigation. Corroborative findings were suggested by Head and Moore (1991). Their investigation focused on graphic format and interpretation of numerical data by students who were identified by their cognitive type (field dependent and field independent). Although they only found a weak relationship between the cognitive types of field dependence/independence and graphical forms, they indicated further investigations into the significance of cognitive type and document literacy skills might be warranted. Lawrence (1988) also examined learning styles as it related to individuals learning mathematics. He concluded that an adult's learning style affected his/her approach to learning mathematics and that knowledge of a student's learning style was useful in planning successful teaching strategies for individual students who exhibited difficulties with learning specific tasks or concepts in math.

Quilty's study (1996) also supported the existence of a relationship between learning styles and interpretation of various graphic formats of quantitative data. In his study involving aviation students, corporate pilots, and airline pilots, he suggested that individuals having a cognitive bias for sequential learning were more adept at using tables than graphs, whereas those with a cognitive bias for relational patterns interpret data better that is presented in a graphic format. His data supported the belief that in order for aviation students to succeed, instructional techniques used in the classroom should take into consideration the various cognitive preferences of each of the students. Because document and quantitative skills are so widely used in aviation preparatory programs and in the aviation profession, the question of how to improve document and quantitative literacy has relevance for improved flight safety of pilots and for improved efficiency of aerospace administrators on the job. Aviation industry preparatory programs may be improved if instruction is tailored to the needs of the students.

The concept of learning styles builds upon the individual approach to learning that Taba (1962), Bloom (1976), and Goodlad (1984) advocated. Quilty's study (1999) echoed the notion that in curriculum planning, if equality of opportunity for students' learning is to be realized, educators must first ask which individual differences of the learners were significant. Additional studies by Dunn and Dunn (1993) and McCarthy and St. Germain (1996) focused on accommodation of students' learning styles to improve students' learning and grade point average. Furthermore, Sternberg (1990) and Quilty (1996) both warned that because the educational setting and the different occupations reward distinctly different cognitive styles, potential capable workers whose chosen careers do not suit their preferred cognitive style may be unnecessarily screened out of the future candidate pool.

Over the years, many cognitive/ learning styles models for understanding these differences have been developed. Each of the models provides explanations for the many alternative ways in which individuals perceived, processed, and approached problem solving. For assessing learning styles in the present study, this author chose to use the Learning Type Measure (LTM) based upon research conducted by Bernice McCarthy (1996). Unlike many of the learning style instruments currently on the market, it is relatively easy for the subjects to comprehend, easy to administer, and relatively short in length. Another important aspect of her instrument is that although it builds upon the theoretical work done by Jung and Kolb, her research differs distinctly from previous personality type research in that she provided a practical application for using the information for designing curriculum.

In developing the LTM, McCarthy noted that there were four primary learning styles that could be used to categorize learners' comfortable way of knowing about their world. She explained that individuals had distinctive and consistent ways of interacting with the world; these characteristic differences she labeled learning styles. McCarthy based her assessment of cognitive type upon two basic dimensions of learning that represented the learner's typical mode of perceiving, thinking, problem solving and organizing information: perception and information processing. She described two ways of perceiving and the two ways of processing information, which resulted in a four-quadrant model of learning styles. McCarthy explained that the resulting four learning style types actually represented a continuum between opposite extremes of the two dimensions because each individual's innate preferences for one side or the other along the continuum helped to characterize one's learning type. At one end of the dimension of perception were individuals who perceived through concrete experiences; at the opposite end were individuals who perceived through abstract conceptualization.

METHODOLOGY

Participants

This study investigated the relationship of document and quanti-tative literacy with learning styles and selected personal variables for aerospace technology students at Indiana State University. The sample was a non-random, intact group that included 143 aerospace technology department students who were present in class on both days of testing. The demographic make-up of the sample consisted of 15 females and 128 males. The sample included 46 freshmen, 25 sophomores, 32 juniors, and 40 seniors. Ninety-four of the students were declared professional pilot majors, 32 were aerospace administration majors, 10 were double majors (professional pilot and aerospace administration), and 8 were majoring in programs outside of the school of technology (music education, economics, social studies education, criminology, computers science, physics, and mathematics).

Survey Instruments

The Aviation Documents Delineator (ADD)

Document and quantitative literacy were assessed using the Aviation Documents Delineator (ADD). The ADD required subjects to complete document literacy tasks which included the ability to (a) locate information embedded in the documents, (b) integrate, interpret, and compare information across the different segments of the documents, and (c) demonstrate understanding of the documents. For quantitative literacy tasks, subjects were additionally required to (a) demonstrate logical and analytical skills in interpreting tables, graphs, and maps, using single and/or sequential multiple arithmetic operations, and to (b) interpolate or interpret scaled relationships on tables, graphs, or maps.

The tasks in the ADD included (a)

marking a point on the document that represented the answer, (b) locating, interpreting, and describing specific data displayed in the document, (c) determining data for a specified point on the table through interpolation, (d) comparing data for a string of variables representing one aspect of aircraft performance to another string of variables representing a different aspect of aircraft performance, (e) describing how data in a particular column of a table were calculated, (f) comparing information in two separate documents, (g) using information in the documents to make predictions about future trends regarding specific variables displayed in the documents, (h) interpreting the documents to make decisions regarding emergency situations, (i) calculating different percentages for data given, and (j) performing single and/or sequential mathematical operations on a specified set of data. All items reflected tasks that were associated with the aviation industry.

The ADD was field tested with two groups of students: aviation students at the University of Illinois and non-aviation students at Indiana State University. An odd-even reliability test and an item analysis were conducted on the field-tested instrument. The instrument was subsequently revised using the information obtained from preliminary administration of the instrument. The answer guide was re-constructed and checked for accuracy by a five-member test panel consisting of three pilots and two professionals working in aerospace administration. The internal reliability of the final form of the instrument was also checked by the same test panel. Reliability of the ADD was further strengthened by administering the test on two separate test days and by having 3 separate 20-minute sections for comparison. In addition, using a pre-made form for analyzing the ADD, the content validity of the individual test items was examined by three experienced pilots and two local literacy program instructors. An odd-even reliability test was also used on the final administration of the instrument.

<u>The Learning Type Measure (LTM)</u>

The Learning Type Measure (LTM) was a fifteen item self-report instrument designed to delineate each student's preferred learning style into four principal types: imaginative, analytic, common sense, and dynamic (McCarthy, 1996). St. Germain, Lieberman, and Cohen (1995) investigated the reliability and validity of the Learning Type Measure (LTM) that was developed in 1993 by McCarthy. From Florida's Community college system, 106 students enrolled in Introduction to Education courses were selected. The LTM was used to assess their personality style at the beginning of the semester and six weeks into the semester. A Kappa test was applied to check for the agreement between the two tests. The authors concluded that the LTM was a reliable tool for assessing one's learning style preference.

Reliability of the Learning Type Measure was assessed using both an internal consistency and a test-retest procedure. Internal consistency was determined using the Cronbach alpha statistic which was found to be 0.86. This statistic was judged to be well within acceptable internal consistency reliability measures which had an alpha between 0.80 and 0.90. Test-retest reliability was also calculated and found to be 0.71 which was reported to indicate a "high level of stability" (St. Germain, 1996).

HYPOTHESES

The researcher advanced the following null hypotheses for use in this study:

H_{01}: Learning style, grade point average, year of study, and program of study, either step-wise or collectively, did not significantly predict document literacy as measured by a subtest score on the ADD when tested at the 0.05 level of significance.

H_{02}: Learning style, grade point average, year of study, and program of study, either step-wise or collectively, did not significantly predict quantitative literacy as measured by a subtest score on the ADD when tested at the 0.05 level of significance.

H_{03}: Learning style, GPA, year of study, and program of study, either step-wise or collectively, did not significantly predict document and quantitative literacy as measured by a global score for total literacy on the ADD when tested at the 0.05 level of significance.

RESULTS AND ANALYSIS

A split halves Spearman Brown Coefficient of correlation was calculated for the ADD. The value of "r" was found to be .645. The Spearman Brown Prophesy formula for split halves reliability correction was applied with the formula: [2 × r] ÷ [1 + r] An application of this formula revealed a reliability of .78. The probability that this coefficient was different from zero was calculated to be 0.00. The reliability of the ADD was therefore, statistically confirmed.

Results of the step-wise multiple linear regression statistical analysis for predicting document literacy, quanti-tative literacy, and total literacy scores that were measured by the ADD, were tabulated in Tables 1, 2, and 3. Table 1 reveals the extent that the four independent variables (year in school, GPA, program of study, and learning style) were used to predict the criterion variable of document literacy. Tables 2 and 3 represent the effect the same four predictor variables had on predicting quantitative and total literacy, respectively. The variance (R^2) in Tables 1, 2, and 3 reflects the proportion of the three dependent variables (document, quantitative, or total literacy, respectively) that was explained by the four predictor variables, as shown in each of the respective tables. The effect of the predictor variables on the students' document, quantitative, and total literacy, was shown in rank order of proportion of additional explained variance in the three respective tables. (i.e. in all three tables, *year in school* is shown first to reflect that variable as having the most significant effect on the respective dependent variables.) SPSS was used to run the data for the analysis, so Sig T was used to determine if the independent variables were significantly related to the dependent variables. (i.e. where the Sig T is greater than the .05 alpha level, the predictor variable was considered to not have a significant effect on the dependent variable.)

Table 1 indicates that the predictor variables, *year in school* and *GPA*, were found to be significantly predictive of document literacy by the step-wise regression analysis. The combination of year in school with GPA accounted for 44 per cent of the explained variance in students' document literacy score. The magnitude of the R^2 indicated that the predictor variables of year in school and GPA provided unique information about the criterion variable that was not provided by the other two variables in the equation. The significance of 0.00 for year in school and GPA, respectively, revealed a statistically significant predictive value for document literacy.

The document literacy score (Y_i) was predicted by the following regression equation:

Y_i = 9.77 + .20 (Year in school) + .57 (GPA). The size of the Sig T for the two independent variables of learning style and program of study indicate that the additional variance explained by those variables were so negligible that they were not significant for predicting document literacy scores. The hypothesis that learning style, GPA, program of study, and learning style either step-wise or collectively did not significantly predict document literacy as measured by a document literacy score on the ADD when treated at the 0.05 level of significance was rejected.

Table 2 shows *year in school* and *GPA* to be significantly predictive of quantitative literacy by the step-wise regression analysis. The combination of year in school and GPA accounted for 33 per cent of the explained variance in students' quantitative literacy score. The magnitude of the R^2 indicated that the predictor variables of year in school and GPA provided unique information about the criterion variable, quantitative literacy that was not provided by the other two variables in the equation. The significance of 0.00 for year in school and for GPA revealed a statistically significant predictive value for quantitative literacy.

The quantitative literacy score (Y_j) was predicted by the regression equation:
Y_j = .68 + .38 (Year in school) + .33 (GPA).
The size of the Sig T for the other two independent variables indicate that the additional variance explained by those variables were so negligible that they were not significant for predicting quantitative literacy.

The hypothesis that learning style, GPA, year in school, and program of study, step-wise or collectively, did not significantly predict quantitative literacy as measured by a quantitative literacy score on the ADD when tested at the 0.05 level of significance was rejected.

Table 1
Step-wise Multiple Linear Regression Analysis for the Prediction of Document Literacy From Year in School, GPA, Program of Study, and Learning Style (N=143)

Variable	B	SE B	Beta	T	Sig T
Step 1					
Year in School	1.20	.40	.20	8.0	.00
GPA	1.5	.18	.57	4.39	.00
(Constant)	9.77	1.13		8.67	.00
Step 2					
Learning style	-.01	-.01	.86	-.17	.87
Prog of study	.08	.10	.89	1.18	.24

Note. R Square = .44 for step 1. An alpha level of .05 was used for all statistical tests.

Table 2
Step-wise Multiple Linear Regression Analysis for the Prediction of Quantitative Literacy From Year in School, GPA, Program of Study, and Learning Style (N=143)

Variable	B	SE B	Beta	T	Sig T
Step 1					
Year in School	1.90	.43	.33	7.98	.00
GPA	.98	.19	.38	4.39	.00
(Constant)	.68	1.20		.56	.57
Step 2					
Learning style	.01	.01	.86	.17	.99
Prog of study	.10	.12	.89	1.49	.14

Note. R Square = .33 for step 1. An alpha level of .05 was used for all statistical tests.

Table 3
Step-wise Multiple Linear Regression Analysis for the Prediction of Total Literacy From Year in School, GPA, Program of Study, and Learning Style (N=143)

Variable	B	SE B	Beta	T	Sig T
Step 1					
Year in School	2.50	.31	.53	7.98	.00
GPA	3.08	.70	.29	4.39	.00
(Constant)	10.48	1.98		5.28	.00
Step 2					
Learning style	.00	.00	.86	.02	.99
Prog of study	.099	.13	.89	1.56	.12

Note. R Square = .45 for step 1. An alpha level of .05 was used for all statistical tests.

Table 3 indicates that the predictor variables, *year in school* and *GPA*, were found to be significantly predictive of total literacy by the step-wise regression analysis. The combination of year in school with GPA accounted for 45 per cent of the explained variance in students' total literacy score. The magnitude of the R^2 indicated that the predictor variables of year in school and GPA provided unique information about the criterion variable, total literacy, that was not provided by the other two variables in the equation. The significance of 0.00 for year in school and GPA, respectively, revealed a statistically significant predictive value for total literacy.

The total literacy score (Y_k) was predicted by the regression equation: Y_k = 10.48 + .53 (Year in school) + .29 (GPA). The size of the Sig T for the other two independent variables of learning style and program of study indicate that the additional variance explained by those variables were so negligible that they were not significant for predicting total literacy scores.

The hypothesis that learning style, GPA, year in school, and program of study, step-wise or collectively, did not significantly predict total literacy as measured by a total literacy score on the ADD when tested at the 0.05 level of significance was rejected.

CONCLUSIONS

The student's score for document literacy on the ADD was designed to measure the ability to locate, interpret, and process information that pertained to graphs, tables, and maps. Many of the examples used in the test were similar to those required in professional pilot and aerospace administration classes. Collectively and separately, GPA and year in school correlated positively with document literacy. The results suggested that students who persevered and who had a history of doing well in school performed better on the ADD. Although year in school and document literacy were positively correlated, the strength of the change in R^2 suggested that year in school and GPA represented separate qualities.

Years of formal education demonstrated the strongest main effect for performance of document literacy ability. This researcher concluded that the most likely explanation for improved performance of document literacy correlating with years of formal education was due to students' cumulative exposure to tables, graphs, and maps in aerospace technology department courses. Additionally, exposure to tables, graphs, and maps in other parts of the university curriculum could also have influenced students' improved ability in document literacy. Furthermore, year in school would likely measure such personal qualities as experience, maturity, and/or persistence.

The finding that GPA correlated positively with students' document literacy score on the ADD might be explained by the fact that GPA and document literacy measured many of the same traits that enabled students to do well in school--improved metacognitive strategies, test-wiseness, more developed vocabulary and skill in reading, and more efficient/effective reading and study skills.

The fact that the findings associated with document literacy were echoed in the investigation of quantitative and total literacy may also be a matter of years of exposure and accumulated experience. Aerospace technology students at Indiana State University were required to take three quantitative gateway courses that emphasized quantitative skills used in aviation courses: physics, statistics, and algebra. Many students took these courses during their sophomore year or after. The fact that year in school correlated with quantitative literacy may have been explained by the fact that some students who were unable to pass those courses or who had difficulty with such courses had dropped out of the program altogether by their junior or senior year. Those that did poorly in the gateway courses but did not drop out of the aviation programs would have had additional exposure, since they would have had to repeat the courses to graduate.

This researcher also contends that the significant effects of GPA and year in school on quantitative literacy may also result from the fact that students who were skilled at inferential thinking tend to do well in both GPA and quantitative literacy. Quantitative literacy was defined as the knowledge and skills necessary to apply math operations, either singly or sequentially, to data embedded in printed tables and graphs. Underlying the ability to perform well in quantitative literacy is the ability to make inferences when some of the information provided was implicit. Kirsch and Mosenthal (1993) stated that students who were able to recognize and discern patterns tended to do well in school and in quantitative literacy. Because quantitative literacy required the respondent to compare features within and between documents and to detect patterns, this might account for the effect of GPA on quantitative and total literacy.

Because professional pilot students would tend to have more frequent exposure to aviation related graphs, tables, and maps in their aviation academic curricula it was expected that the professional pilot major would have higher scores than the aerospace administration major. However, program of study was not demonstrated to be a significant predictor of document, quantitative, or total literacy. One confounding problem with using program of study for a predictor variable in the aerospace technology department was the large number of students that changed their majors each year. Several of the freshman and sophomores who were uncertain of which program of study to pursue upon entering ISU changed their majors or ended up as double majors by their junior year.

Other students changed their majors during their junior or senior year from professional pilot to aerospace administration due to the high cost of flight training.

Finally, this study attempted to investigate whether the skills of utilizing documents and quantitative reasoning were associated with individual learning styles. Although some research supports the notion of a significant correlation between learning styles and ability to perform well in certain academic areas over others, results of the study did not significantly support that relationship. There was no indication that any of the four specific individual learning styles enabled students to perform better in document, quantitative, or total literacy.

RECOMMENDATIONS

Although not fully explored in this investigation, the relationship of learning style with year in school and academic performance should be investigated. Data from the LTM in this study indicate that students categorized as having learning styles one and four were well represented in the freshman and sophomore groups but low in numbers in the junior and senior categories. Quilty attributes this attrition to possible "instructional selection bias" (Quilty, 1999, p. 11) and suggests that a longitudinal study might reveal whether students classified with particular learning styles were dropping out of aviation programs because of problems in academic performance or if, indeed, the students modified their learning styles in order to succeed in the aviation instructional setting.

The validity of the criterion variables investigated in this study, document, quantitative, and total literacy, also need further refinement and exploration. Document and quantitative literacy are complex constructs that pose enormous research difficulties. Venezsky (1992) argued that, "Document literacy is difficult to define empirically due to the limited amount of research done on it." Research on these variables in specific career areas is still scarce.

Aviation employers have expressed concern about the lack of math, critical thinking, and problem-solving skills of university graduates that are entering the aviation industry. An investigation of math skills, confidence in math ability, and academic performance of aviation students should be conducted. In the prologue to the ADD, students indicated their comfort level with math by selecting one of two choices: "I feel comfortable about doing most math problems" or "I feel uncomfortable about doing most math problems." Although the reliability of the wording of the question was not statistically tested, with 46 out of 143 aerospace technology students choosing the selection that conveyed that they felt uncomfortable with most math problems, further investigation into students' math skills, students' confidence in their own math abilities, and their subsequent academic performance seems warranted.

Because aviation management and professional pilot programs generally require competence in certain quantitative skills, further research into the relationship of success in the aviation programs, SAT math scores, and success in mathematics might also be warranted. Aviation students in general, are often required to take algebra, physics, calculus and statistics. Courses such as these can open the gates or block the way for students interested in technical careers. According to Seymour and Hewitt, each year about one third of the talented pool of freshmen who select engineering, science, and technical career programs requiring gateway math courses switch to other fields (Seymour and

Hewitt, 1994, p. 37). Similar attrition rates are also common in many aviation programs; by their sophomore year, aviation students switch to other majors in disproportionately high numbers. The notion that students who leave such programs requiring quantitative skills are not cut out to be pilots or administrators in the technical field of aviation might be challenged. There may be a need to reexamine how aviation educators can successfully improve students' math deficiencies.

REFERENCES

Armbruster, B. B., & Gudbrandsen, B. (1986). Reading comprehension instruction in social studies programs. *Reading Research Quarterly*, *21*(1), 36-48.

Barton, P. E. (1994). *Becoming literate about literacy*. Princeton, NJ: Educational Testing Service. (Eric Document Reproduction Service No. ED 372 114)

Bloom, B. S. (1976). *Human characteristics and school learning*. New York: McGraw-Hill Book Company.

Chisman, F. (1990). *Leadership for literacy*. San Francisco: Jossey Bass publishers.

Dunn, R. & Dunn, K. (1993). *Teaching students through their individual learning styles*. Boston: Allyn and Bacon.

General Aviation Manufacturers Association. (1975). *Specification for pilot's operating handbook: GAMA specification No. 1*. Washington, DC: General Aviation Manufacturers Association.

Goodlad, J. I. (1984). *A place called school*. New York: McGraw Hill.

Guthrie, J. T., & Mosenthal, P. (1987). Literacy as multidimensional: Locating information and reading comprehension. *Educational Psychologist*, *22*(3 & 4), 279-297.

Guthrie, J. T., Seifert, M., & Kirsch, I. S. (1986). Effects of education, occupation, and setting on reading practices. *American Educational Research Journal*, *23*(1), 151-160.

Head, J. T., & Moore, D. M. (1991). The effects of graphic format and cognitive style on the immediate and delayed interpretation of complex quantitative data. *Canadian Journal of Educational Communication, 20*(1), 3-15.

Kirsch, I. S., & Mosenthal, P. B. (1990). Exploring document literacy: Variables underlying the performance of young adults. *Reading Research Quarterly, 25*(1), 5-30.

Kirsch, I. S., & Mosenthal, P. B. (1993). Integration strategies: Higher order thinking applied to documents. *Journal of Reading, 36*(4), 322-327.

Lawrence, B. H. (1988). Mathematical myths and adult learners. Cincinnati, Ohio: Paper presented at the conference *"Teaching adults: Myths and realities."* (Eric Document Reproduction Service No. ED 300 672)

McCarthy, B. (1995). *Introduction to the 4MAT system: Teaching to learning styles with right/left mode techniques.* Barrington, IL: EXCEL Inc.

McCarthy, B. (1996). *About learning*. Barrington, IL: EXCEL Inc.

McCarthy, B., & St. Germain, C. (1996). *The 4MAT research guide*. Barrington, IL: EXCEL Inc.

Mikulecky, L. (1985). *Literacy task analysis: defining and measuring occupational literacy demands*. Chicago, IL: Paper presented at the National Adult Educational Research Association. (Eric Document Reproduction Service No. ED 262 206)

Miller, P. A. (1982). Reading documents in a high-technology industry. *Journal of Reading*, *26*(2), 109-115.

Mosenthal, P. B., & Kirsch, I. S. (1989). Lists: The building blocks of documents. *Journal of Reading, 33*(1), 58-60.

Mosenthal, P. B., & Kirsch, I. S. (1993). Profiling students' quantitative strategy abilities. *Journal of Reading*, *36*(8), 668-674.

Phillipi, J. W. (1988). Matching literacy to job training: Some applications from military programs. *Journal of Reading*, *31*(7), 658-666.

Quilty, S.M. (1996). Cognitive learning bias of university aviation students in an aviation program. *Journal of Air Transportation World Wide* (on-line journal), http://unomaha.edu/~himbergr/aviation.html.

Quilty, S. M. (1999). Analysis and comparison of cognitive learning preferences among airline pilots, corporate pilots, and aviation students. *Journal of Air Transportation World Wide*, *4(1),* 1-13.

Seymour, E., & Hewitt, N. M. (1994). Talking about leaving: Factors contributing to high attrition rates among science, mathematics, and engineering undergraduate majors. Final report to the Alfred Sloan Foundation. Boulder: University of Colorado Bureau of Sociological Research.

Sheehan, K. M., & Mislevy, R. (1990). Integrating cognitive and psychometric models to measure document literacy. *Journal of Educational Measurement*, *27*(3), 255-272.

Sternberg, R. J. (1990). Intellectual styles: Theory and classroom implications. In R. McClure (Ed.), *Learning and thinking styles: Classroom interaction* (pp. 18-42). Washington, DC: National Education Association.

St. Germain, C. (1996). The *Learning Type Measure (LTM) manual*. Barrington, IL: EXCEL, Inc.

St. Germain, C., Lieberman, M, & Cohen, M. (1995). *Reliability and validity study of the Learning Type Measure (LTM)*. Barrington, IL: EXCEL, Inc.

Sticht, T. G., & Armstrong, W. B. (1994). *Adult literacy in the United States: A compendium of quantitative data and interpretive comments.* San Diego, CA: San Diego Community College District.

Taba, H. (1962). *Curriculum development: Theory and practice*. New York: Harcourt, Brace, and World, Inc.

Taylor, R. (1991). *Aircraft performance: The forces without*. Greewich, CT: Belvoir Publications.

Tufte, E. (1986). *The visual display of quantitative information.* Cheshire, CT: Graphics Press.

Venezky, R. L. (1992). *Matching literacy testing with social policy: What are the alternatives?* Philadelphia, PA: University of Pennsylvania, National Center on Adult Literacy.

MEMORY STRATEGIES FOR THE PILOT

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ABSTRACT

Theorists have studied the problem of forgetting for a number of years; however, very little application has been made to the general aviation pilot. This paper considers some concepts for understanding the processes involved when important tasks are forgotten and/or certain "actions-not-as-planned" are executed. While there are numerous ways suggested by memory specialists, a few may be particularly applicable to flight. Forgetting can be explained as an activation issue as defined in the concepts of action theory. A structural model of three stages is used to explain some psychological processes of the memory system. Finally, some suggestions for the practical enhancements of memory are offered along with recommendations for further memory research.

INTRODUCTION

In the United States there is, on the average, one gear up landing each day (Trollip and Jensen, 1990). According to AOPA's 1991 General Aviation Accident Analysis Book, this very common accident may not always be fatal, but it is costly. This type of accident can be attributed to a class of mistakes called "slips of action." The pilot neglects to use the landing checklist and subsequently experiences an incident or accident. Degani and Weiner (1990), in one survey of accident/ incident occurrences, found three significant accidents in a fifteen month period that could have been attributed to a misuse of the checklist (p.2). A recent ASRS Database Report on Checklist Incidents (1999) indicates that action errors are common. This report is a sampling of incidents from all different aviation areas and includes many negative results from the neglect or misuse of the normal checklist. Of all reports identified, 86 % noted problems that resulted from action errors.

Another common mistake made by pilots that can result in embarrassment and considerable expense is the failure to close one's flight plan upon arrival at the destination. This is also the result of forgetfulness or action slips on the part of the pilot. Why do pilots fail to use the checklist properly? Why do pilots forget to close a flight plan upon arrival at the destination? Memory research may provide some insight into the cause of these lapses and suggest some recommendations for solving the problem.

ACTION SLIPS AND MEMORY

There are several ideas that attempt to explain what happens when one neglects to do a particular act or accomplishes an act different from the intended. Action slips may be classified as absent-mindedness and defined as actions "not as planned" (Reason and Mycielska, 1982). Hawkins (1987) summarizes these ideas in three areas. First, a person may forget simply because of the passage of time. If the information is not used regularly, it may decay and not be available for recall. A second idea about forgetting explains that the process of losing information relates to interference from other more memorable information. This conflicting information likely was presented to the pilot at a different time than the replaced data, but due to various factors exhibits a stronger influence. A third possibility described by Hawkins is that some forgetting is motivated. The information may have presented painful or anxious feelings and was then blocked from the conscious memory.

Action Theory

Forgetting may be classified as a type of breakdown as described by action theory. Norman (1981) considers human mistakes and defines certain of them as action errors. Pilots may perform a particular action regularly, but inadvertently neglect that same action at another time and commit an action slip. According to Norman, there are three stages of action slips:

1. the formation of intentions;
2. activation; and
3. triggering.

Errors may occur in each of these three stages and may be related to the problems of remembering. Action slips may occur when activation occurs unintentionally as when a pilot inadvertently selects a switch and trips it when it should not have been turned on. Action slips may also occur when activation to perform a particular task is lost. Neglecting to lower the landing gear when approaching to land may be an error caused by cues not being activated at the appropriate time.

Faulty Activation

A slip resulting from faulty activation of a schema is also called forgetting. A schema represents an element that triggers a memory. There is something that triggers the thought for a pilot to look at a checklist. If the pilot does not remember the checklist, he/she will not check it to make sure everything is completed for the accomplishment of an activity. Loss of activation describes the situation in which appropriate actions fail to be accomplished. Norman (1981) suggests that this creates a memory failure. Memory failure occurs when events intercede between preparing an intention for action and the accomplishment of the actual act. This explanation relates to the interference theory of forgetting. For example, when an airplane approaches a destination airport, the pilot is preparing to land. As the preparation for landing begins the pilot intends to lower the landing gear. Unexpected things may happen. ATC may give additional vectors or other instructions, and suddenly the workload increases. If the checklist is not used properly no verification will be made that the important items have been accomplished. The landing may occur with the gear retracted. On this occasion the checklist has been “forgotten” because the cue that leads the pilot to accomplish the checklist was not activated.

Structural Model

<u>Three Stages.</u>

Telfer and Biggs (1987) define memory systems with three stages, using a modification of the structural model defined by Atkinson and Shiffrin (1968). The first stage of this model is the sensory register. It is during this stage that a precoding of stimuli occurs. Based on the decision of the receiver, the physical properties of the stimuli, and the physiological state of the receiver, all information received is either accepted, precoded and sent to the working memory, or filtered out and ignored. Also important in the precoding process are one's background, beliefs, and other preconditioning. All this activity occurs within one second. After a second has passed, the stimulus has either been sent on with precoding or filtered out and ignored.

In stage two the stimuli that are precoded are transferred to the working memory. This process lasts about one minute. To illustrate this process of working memory, try this simple activity. Cover your eyes while someone writes a set of random digits on a chalkboard (e.g., 5,8,3,4,1,7,2,6). At a cue, look at the numbers for approximately 15 seconds and then have them erased. According to Miller (1956), a typical adult will be able to retain about seven digits, plus or minus two. There are ways to rearrange the digits to have more remembering success. If a similar number of digits are arranged sequentially in a pattern they can be remembered more easily. If the sequence of digits were 1,3,5,7,2,4,6,8 they could be remembered easily. This is because you are actually remembering only 2 units (1,3,5,7) and (2,4,6,8) as if it had been 1,2,1,2. This widely accepted principle is called "chunking" (Nairne, 1996). When stimuli can be associated together and connected with past experiences, it can be held in working memory more effectively. This process encompasses about one minute of time.

The third and final stage in the memory process, as defined by Telfer and Biggs, is "storage." A properly processed stimulus is transferred to long-term memory where it remains properly coded for a lifetime. One only has to activate the proper cue to return it to consciousness.

Activation Errors

Activation errors typically occur when the information is being transferred to the working memory. When the pilot is flying the enroute section of a trip, he/she is performing various tasks and planning the approach at the destination airport. The working memory is being used to get everything ready for the approach and landing. As was noted previously, the working memory maintains awareness for approximately one minute. As each cue is activated, the necessary tasks are accomplished. The radios are appropriately tuned and the pilot begins receiving vectors to the final approach course. A common problem that may occur at this point in the flight is distraction. Distraction can lead to forgetting to accomplish an important task, such as lowering the landing gear. He/she may activate the cue to review the pre-landing checklist. As the checklist review is initiated, the controller gives an additional unexpected vector. That new stimulus interferes with the current activation by energizing a new set of cues. The pilot responds to this new set of cues, but loses the first activation and forgets to complete the checklist. Edwards (1990) says that most of these gear up accidents "seem to involve some piece of distraction…an unusual stress situation or an unexpected event" and this diverts his attention from the checklist (p.79). Morrison, Etem, & Hicks (1993) studied one hundred fifty reports of landing phase incidents as reported in the ASRS data base. They found that 45% of the human and environmental factors underlying incidents involved distraction. This was almost twice the next closest factor.

The following quote from the October, 1991, Callback illustrates this problem.

> "I was conducting a biennial flight review in a light aircraft. The pilot was asked to… make a short field landing…The pilot did not do a pre-landing cockpit check which I…noted and intended to remind him of, later… The subsequent approach was hurried, low, with flaps coming down late and (the aircraft) off-centerline approaching the runway…I was distracted by watching the poor approach and failed to catch the fact that the gear was not down before the actual contact with the ground…"

Morrison, Etem, and Hicks (1993) conclude, "Many gear-up incidents and accidents could be prevented through a use of a written pre-landing checklist or reliable application of memory aides such as 'GUMP'." Pilots have, for a long time, used these types of mnemonics to create the required cue activation.

Another possible explanation for this error is that the pilot has simply forgotten to use the checklist. This occurs because of a different kind of action slip. In this situation the cue is not activated at all. A checklist is good only if remembered and there must be something to activate the "pre-landing checklist" cue. Researchers (Edwards, 1990; Hawkins, 1987; Trollip and Jensen, 1991) have suggested that the use of these aids is beneficial when dealing with the problem of "simply forgetting". Mnemonics, however, require activation so that they will not be forgotten.

<u>Enhancing Memory</u>

These activation problems typically are centralized in the working memory. For this reason, one should begin seeking solutions to "actions-not-as-planned" in the working memory. A number of researchers (Biggs and Telfer, 1987; Biggs and Telfer, 1988; Edwards, 1990; Trollip and Jensen, 1991; Wickens and Flach, 1988) have suggested that rehearsal, the repeating of information over and over aloud, is a useful technique. This places the information firmly into long term storage. When dealing with the problem of numerous consecutive events near the approach phase of a flight, the pilot may recite a pre-rehearsed sequence of activities. For example, "Approach charts reviewed-check; navigation frequencies tuned and identified-check; communication frequencies set - check; pre-landing checklist performed – check," may be recited aloud. Rehearsal may help the pilot get through this very busy time without forgetting the details.

Wickens and Flach (1988) suggest that rehearsal is an excellent way to deal with the problem of "associative interference," their description for this theory of forgetting. They also propose that three steps may be required to assure that the appropriate cues are activated at the proper time.

1. Distribute the information over time. Similar stimuli may be confused if less than 10 seconds are allowed between the processing.
2. Reduce similarity and redundancy among the items.
3. Minimize the coding interference.

Coding interference occurs when the activation codes for one set of stimuli conflict with those of another. A pilot may attempt to remember the checklist, but an interfering cue takes its place and the use of the checklist is forgotten. Wickens and Flach (1988) define the coding process as either spatial or verbal. Spatial activation will more quickly interfere with other spatial cues and in the same way verbal activation will most likely interfere with other verbal cues. It would be to the pilot's advantage to note the type of information that is likely to interfere with remembering the pre-landing checklist and use the other to activate the appropriate cues. Distractions in the cockpit occur during the approach and landing phase of flight, so if the pilot can precode the activation cues for remembering the pre-landing checklist in spatial coding, there will be less interference. Edwards (1990) calls this loci and imaging. He suggests that something visual be connected with the task to be remembered. For example, the pre-landing checklist may be normally used as the pilot is descending from the enroute phase of flight to the approach phase. A visual picture would be created of a checklist floating down from the top of a room (the enroute) to a doorway (the beginning of the approach). The mental image is then rehearsed until it is incorporated into storage. The descent phase will then activate the imaging and the checklist will come into mind.

This process will become more effective if learning is related to knowledge already acquired. Biggs and Telfer (1987) describe this as the coding of learning to a particular knowledge base, and suggest that this makes the learning more meaningful. They describe it as "more economical, more stable and usually more enjoyable than rote learning" (p. 51). Hawkins (1987) carries it a step further by including in his list of memory enhancements "over-learning." The effective use of the checklist will more likely occur if the student is trained thoroughly. Over-learning occurs when the student knows the material so well that it becomes automatic. This requires an instructor to provide the required material then review it as many times as necessary for it to become automatic. In the case of flight instruction, as in any other skill training, a part of the process is practice. So, providing the information; emphasizing the importance of it; regular review, and regular practice can create the automatic response. If this is applied to learning the importance and necessity of using the checklist, the proper use will be entrenched. Even though distractions may occur at the most inopportune time, the use of the checklist will be automatic and will not be forgotten.

CONCLUSION AND RECOMMENDATIONS

A gear up landing is only one of many errors that may occur as a result of forgetting important piloting tasks. Many aviation errors can have serious consequences, so it is important to provide ways to assist the pilot during these situations. Concentration on remembering the important tasks during a flight can be enhanced with certain strategies. This paper has suggested that forgetting or performing "actions-not-as-planned" may result from a task as simple as neglecting the proper use of the checklist. A quality checklist will always include those necessary items, so the pilot must assure its proper use.

Two items that have definite implications for the training environment are over-learning and rehearsal, both of which have been substantiated through scientific inquiry. These are items that can be easily emphasized in the training environment, and further exploration regarding ways to emphasize and teach them would be in order for future inquiry.

Boer (1997) suggests an additional emphasis that may support the pilot's education. He recommends that pilots be trained to understand when they are at risk of forgetting a particular task. It is understood and emphasized by the FAA that during certain periods of the flight, i.e., the approach and landing phase, skill and concentration demands are greater for the pilot. If the flight requirements are greater the chance of a distraction is increased. The pilot could then direct more attention toward remembering to do the essential tasks. Proper checklist use would be one result of this emphasis. Flight training device scenarios could be useful when teaching this pilot awareness; however, more investigation needs to be conducted on this training issue.

Finally, more research needs to be conducted on the concept of mental imagery. This approach to memory enhancement has potential for providing more effective strategies for remembering time-critical piloting tasks.

REFERENCES

Biggs, J. B. & Telfer, R. (1987). The Process of Learning. Sydney, Australia: Prentice-Hall.

Biggs, J. B. & Telfer, R. (1988). The Psychology of Flight Training. Ames, Iowa: Iowa State University Press.

Boer, L. C. (1997). Remembering to do a task: An element of cockpit management. In H. Soekkha (Ed.), Aviation Safety: Proceedings of the International Aviation Safety Conference (pp. 455-464). Utrecht, Netherlands: VSP

Degani, A. & Wiener, E. L. (1990). Human Factors of Flight-Deck Checklists: The Normal Checklist. Moffett Field, CA.: Ames Research Center, National Aeronautics and Space Administration.

Edwards, D. C. (1990). Pilot: Mental and Physical Performance. Ames, Iowa: Iowa State University Press.

Hawkins, F. H. (1987). Human Factors in Flight. Brookfield, Vermont: Gower Publishing Company.

Kelly, W. P. (1989). Checklist use and abuse. 1989 Pilot's Safety Handbook.

Miller, G. A. (1956). The magical number seven plus or minus two: Some limits on our capacity for processing information. Psychology Review, 63, 81-97.

Morgan, L. (1990). Lights, horns, bells, and whistles. Flying, March, 1989, 108, 110.

Morrison, R., Etem, K, & Hicks, B. (1993) General aviation landing incidents and accidents: A review of ASRS and AOPA research findings. In The Ohio State University Seventh International Symposium on Aviation Psychology. Aviation Safety Reporting System publication.

Nairne, J. S. (1996). Short term/working memory. In E. L. Bjork& R. A. Bjork. (Eds.)Memory (pp 101-123). San Diego: Academic Pressd3

National Aeronautics and Space Administration (1991). Much to be said on both sides. Callback, No. 149.

National Aeronautics and Space Administration (1990). Checklist reminders. Callback, No. 138.

National Aeronautics and Space Administration (1990). Human Factors and the Normal Checklist: Part 1. Callback, No. 136.

National Aeronautics and Space Administration (1990). Human Factors and the Normal Checklist: Part 2. Callback, No. 137.

Nelson, J. L. (1991). Checked and set? Don't let routines become routine. Flight Training, 3, 42-43.

Norman, D. A. (1983). Design rules based on analyses of human error. Communications of the ACM, 26, 254-258.

Norman, D. A. (1981). Categorization of action slips. Psychological Review, 88, 1-15.

Trollip, S. R. & Jensen, R. S. (1991). Human Factors for General Aviation. Englewood, CO.: Jeppesen Sanderson, Inc.

Wickens, Christopher D. and Flach, John M. (1988). Information Processing. In E.L. Weiner and D.C. Nagel (eds.) Human Factors in Aviation. (pp. 111 - 155). New York: Academic Press, Inc.

A FOLLOW-UP SURVEY OF 1985 - 1996 GRADUATES OF THE AVIATION MANAGEMENT PROGRAM BACHELOR OF SCIENCE DEGREE AT SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

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ABSTRACT

During 1997 and 1998, researchers conducted a follow-up study of graduates earning a Bachelor of Science Degree in Aviation Management (AVM) from the College of Applied Sciences and Arts (ASA) at Southern Illinois University Carbondale (SIUC). The purpose of the study was twofold: (a) to determine a demographic, educational, and occupational profile of the graduates and (b) to obtain an evaluation of the program in terms of the degree to which it helped graduates achieve their occupational and/or life goals.

The follow-up study population was composed of students who graduated from the aviation management degree program between 1985 and 1996. A population of 2,663 graduates was identified. A mail-in survey instrument was used to gather data for the follow-up study. Three mailings were conducted, resulting in 806 usable returns and a 31% response rate.

Key findings of the study were: (a) eighty-six percent indicated that the degree was an asset that assisted them in achieving their occupational and/or life goals, (b) ninety percent indicated that they would recommend the program to others, (c) fifty-nine percent reported that they are employed within the aviation industry, (d) sixty-eight percent reported earning annual salaries in excess of $35,000.00, and (e) sixty-three percent indicated that they were satisfied with their current levels of employment.

INTRODUCTION

Southern Illinois University Carbondale, through the College of Applied Sciences and Arts, currently offers the Bachelor of Science degree in Aviation Management. The AVM course curriculum consists of a set of major courses and a set of core courses in various aspects of aviation management.

The AVM program is offered at the SIUC campus and at various off-campus locations, mostly military bases, across the United States. On-campus, the AVM program has its own office, teaching, and administrative staff. The Office of Off-Campus Academic Programs (OCAP) provides administrative support for the AVM off-campus program through staff assigned to each location. However, all academic matters are left to the chair and faculty of the AVM program.

In the fall of 1994, OCAP began preparations to conduct a follow-up study of graduates of the AVM program at both on- and off-campus sites. At that time, the director of OCAP organized preliminary discussions with the AVM department chair to set the scope and purpose of the study. Eventually, a mail survey questionnaire, reflecting the issues of greatest interest to the OCAP director and the AVM chair, was developed. A pilot study was conducted resulting in several revisions. Finally, in the spring of 1997, the first of three mailings consisting of questionnaire packets were mailed to 1985 through 1996 graduates of the AVM program. The following report deals specifically with the presentation of the data gathered from those graduates who responded to the questionnaire.

PURPOSE OF THE STUDY

The main purpose of the study was to determine the degree to which AVM baccalaureate graduates at SIUC on- and off-campus sites perceived the usefulness of the program in the demographic/ educational/occupational profile of the graduates.

The population selected for this study was composed of those who graduated from the program between 1985 and 1996.

SIGNIFICANCE OF THE STUDY

Administrators and educators generally agree that graduate follow-up surveys provide valuable information for program evaluation and improvement. The significance of this study was that it arose out of the specific needs of a program that has a wide range of topical coverage and reaches a large population of students over a substantial geographical area across the United States. The content of the survey instrument was derived from the suggestions of administrators and instructors in the AVM program. These suggestions were discussed in meetings that took place over a number of months, thus providing ample time for reflection between meetings. The content and purpose of the study reflects the issues and needs of the program as identified by the AVM faculty and staff. For example, the questionnaire item dealing with employment status listed general categories and specific segments within the management fields derived from the experience of the AVM administrative and educational staff members.

The previous considerations are related to the internal needs of the AVM program. There are also important external issues. For example, the Department of Defense-sponsored Military Installation Voluntary Education Reviews (MIVERS) conducted at military sites provide regular evaluation of SIUC off-campus AVM programs. That such an assessment, or graduate follow-up had not been taken at these locations was pointed out as a matter of “concern” by the 1995 MIVER revisit team (The American Council on Education, 1998, March 8-10). The revisit team, however, was informed that, at the time of their visit, the assessment project presented in this paper was underway. The team noted this project as a positive response to their previous recommendation. They viewed the direction of the assessment as an appropriate one, and made recommendations as to some of the ways the results could be used.

Another important use for the data collected in the present survey concerns the establishment of programs at new locations. Demographic and occupational data can provide critical justification for setting up a program at a particular geographical location. For example, an appropriate match between the occupations held by previous graduates of a program and the occupational resources of the proposed new educational site must be established to justify the institution of the program at the new site.

LITERATURE REVIEW

The literature discussed can be arranged into three categories: (a) administrative guidance on graduate follow-up studies from state of Illinois and university sources, (b) prior, unpublished graduate follow-up studies of Aviation Management graduates, and (c) graduate follow-up studies done outside of SIUC.

Administrative Guidance on Graduate Follow-up Studies

In 1990, IBHE adopted a set of policies designed to improve the quality of undergraduate education (State of Illinois Board of Higher Education [IBHE], 1993, July 13). As part of the implementation of these policies, in 1993 the IBHE conducted its first baccalaureate graduate follow-up survey. Its rationale for the follow-up survey was that "information obtained from periodic surveys of graduates provides an important perspective in evaluating the effectiveness of the education provided by colleges and universities" (IBHE, 1993, July 13, p. 3). This first survey was intended to provide a baseline against which universities could evaluate the quality of their programs and identify areas for improvement. The IBHE planned to conduct two sets of 1-year out, 5-year out, and 10-year out surveys. Its purpose was to identify trends in employment, further education, and satisfaction of graduates. This information was then to be used by institutions in making program improvement decisions. The IBHE also intended to use the information as part of their state university review and program approval processes.

The Office of the Vice-President for Academic Affairs, in collaboration with the SIUC Foundation, completed two follow-up surveys of baccalaureate graduates: (a) a 1-year out survey of the class of 1991, (Southern Illinois University at Carbondale, 1994) and (b) a 5-year out survey of the class of 1994 (Southern Illinois University at Carbondale, 1998). The surveys were administered to graduates from university-wide programs. These surveys were conducted in compliance with IBHE policies previously discussed. The results available were not presented as studies but as sets of data tabulations compiled for inclusion in a statewide study undertaken by IBHE. The 1991 data set included personal characteristics of the graduates, further education, employment, and satisfaction with undergraduate education. The 1994 data set included attitudes toward the university campus, bachelor degree major, academic department, general education experiences, and academic and student support services.

Prior Unpublished Graduate Follow-up Studies of Aviation Management Graduates

In 1993, a follow-up study of AVM graduates from 1983 to 1990 was completed to fulfill the requirements of a master's degree (Skyles, 1993). The survey included both on-campus and off-campus graduates. The primary purpose of the study was to gather data that could be used to assess the program and lead to recommendations for improvement. The program assessment dealt with the major courses only. A secondary purpose was to develop an occupational and economic profile of the graduates. A few of the questions were similar to those in the instrument used in the present study, but the focus of the 1993 study is more general and less evaluative in design. Of particular interest to the present study were the questions on employment in various segments of the aviation industry, selection of the most and least valuable major courses, and salary level.

In 1981 and in 1987, the office of Off Campus Academic Programs conducted surveys of graduates from off-campus degree programs. The designs of the studies were virtually identical. Their purpose was twofold: (a) to develop a demographic profile of the graduates, including career directions and advancement since graduation and (b) to gather data useful in assessing whether the goals of the program were being met. Analysis of the data gathered consisted of the tabulation of frequencies and percentages.

All three of these studies share the same overall structural design: (a) development of a demographic/career profile and (b) program evaluation. This structure influenced the design of the current study. The main differences between the previous and present studies were in the scope of the design and the detail of the items in the survey instrument. The present study, like the 1993 AVM study, but unlike the OCAP studies, surveyed both on-campus and off-campus graduates. The present survey addressed several issues in the previous AVM study and similar issues in the OCAP studies but went into more detail in presenting options for subject responses. An important difference is that the present survey instrument asked respondents to identify their specific primary purposes for enrolling in the aviation management program and then stressed that program and course evaluations be made in consideration of their primary purpose for enrolling in the program.

Graduate Follow-up Studies Done Outside of SIUC

Two Ph.D. dissertations, both relevant and available, were examined. One was a follow-up study of elementary education graduates (Lippincott, 1981). The purpose of this study was to develop an instrument to collect data concerning the graduates' own perceptions of certain competencies and their perceptions of the effectiveness of the teacher training program at Missouri State University. Questions dealt primarily with teaching skills such as developing instructional objectives, motivating students, etc. Data analysis consisted of the tabulation of frequencies and percentages. Study conclusions resulted in the recommendation that the Elementary Training Program at Southwest Missouri State University should provide their students with more training in discipline, rapport with students, communicating ideas to children, and human relations.

A follow-up survey of graduates of arts and sciences was undertaken at the University of Arkansas to provide an employment profile of occupational progress, involvement in career planning, use of job search strategies, and completion of undergraduate and graduate education (Turner, 1991). A secondary purpose was to determine if additional programs and services were needed to assist students in gaining employment. Although most of the data was tabulated in the form of frequencies and percentages, an interesting, and appropriate, procedure was the use of chi-square analysis to determine the relationship between academic major and employment sector. The study made general recommendations for strengthening career-planning activities and for additional educational experiences.

Although these two doctoral dissertations were not concerned with research in the domain of the present study, they are discussed here for two main reasons: (a) they offer additional support for the value of graduate follow-up surveys in the assessment and improvement of academic programs and services and (b) they indicate, to a degree, the diversity of approaches and methods in survey analysis that might influence future procedures.

RESEARCH METHODOLOGY

General preparations for the project included a number of meetings among affected SIUC program elements to set the parameters of the study and the general direction the study was to take. Over a period of several months, meetings were held to determine what questions would best serve the program's current and future needs. When the AVM faculty and staff were satisfied with the direction the survey was to take and with the specific questions that were to be asked, a survey instrument was devised. This instrument was tested in a pilot study.

Pilot Study

For the pilot study, a list of AVM program graduates from 1985 to 1996 was obtained from the Alumni Records Department of the SIUC Alumni Services. A survey packet consisting of a cover letter, survey questionnaire, comment sheet, and postage-paid reply envelope was sent out to each graduate in the pilot survey sample.

Survey Instrument

The questionnaire consisted of 22 items that asked for information in the following areas: (a) gender identification and race/ethnic background, (b) age at enrollment, at various stages of completion of the program, and now, (c) educational background and future interests, (d) occupational status, (e) prior and current salary levels, (f) evaluation of employment level, (g) future employment plans, (h) relationship between the baccalaureate degree and military advancement, (i) primary purpose for enrollment in the baccalaureate program, (j) evaluation of achievement of the primary purpose, and (k) evaluation of specific courses and the program in general in their usefulness in the attainment of the primary purpose.

Reply card

Since the respondents were anonymous, a way to know who returned the questionnaires was required, so that their names could be deleted from follow-up mailing lists. This was the purpose of the reply card.

Subjects and Response Rate

The subjects for this survey were identified in the Alumni Records Department of the SIUC Alumni Service, which keeps the most complete and current list of SIUC graduates. Alumni Services/SIUC Alumni Association sent a list of 2,663 on- and off-campus graduates of the AVM program from 1985 to 1996 to the SIUC Printing and Duplicating Services. Survey questionnaires were printed and mailed in May 1997. Second and third mailings were sent out in June 1997 and February 1998 to those who had not returned the reply card. The result for all three mailings was 841 returns, representing a 32% return rate, however 35 returns were unusable, resulting in a 31% usable return rate. Total mailed minus the undeliverable questionnaires gives the "sample frame," or the number of people who actually had the chance to participate in the study: 2663 – 52 = 2611. The response rate was calculated by dividing the number of returns by the sample frame: 841/2611 = .33. Similarly, the usable response rate was calculated by dividing the number of usable returns by the sample frame: 806/2611 = .31. It is not known how many of the undeliverable questionnaires were sent to on- or off-campus graduates. Thus a comparison between response rates for on- and off-campus graduates is not available. However, it is known that 332 of the respondents were from off-campus locations. See Figure 1.

FINDINGS

Interpretation of the Data

With the diversity of the AVM program graduate population: (a) on- and off-campus, (b) military and non-military, and (c) traditional and non-traditional, interpretation of the survey data collected was difficult. This difficulty was compounded by the 10-year time frame upon which the survey was conducted. For example, due to this extended time period, some respondents did not remember the courses they had taken and/or could not associate them to the present program curriculum. Three of the program's major courses were not offered at off-campus locations. These factors coupled with the anomalies unique to this survey, i.e., some respondents did not answer all questions, some respondents provided multiple responses to some questions, there were incorrect addresses, some surveys were not responded to, etc., increased the complexity of data interpretation.

Demographic, Educational, and Occupational Profile

The demographic profile is made up of: (a) gender, (b) race/ethnicity, and (c) economic characteristics of the survey respondents. The largest proportion of respondents was male (93%) and white, non-Hispanic (88%). A further breakdown reflecting the racial/ethnic make up of respondents is provided in Table 1.

The average age reported by respondents at enrollment was 25 years with an average age of 34 years at the time the survey was completed. The age span at enrollment, as reported by respondents, was 17 to 55. At the time of the survey the age span was reported at 21 to 64. The majority of respondents (54%) reported attending the AVM program on-campus at SIUC. Although less than half of the respondents reported attending the program at off-campus locations it is interesting to note the geographic distribution of the off-campus program (see Figure 1). The data gathered indicated a 28% drop in military service over the period surveyed, with a majority of respondents distributed almost equally among the Air Force (29%), Marine Corps (29%), and Navy (38%).

The AVM degree is awarded predicated upon the completion of, and often in concert with, an associate degree, or equivalent technical military coursework, or work experience. The AVM program has a requirement for 48 credit hours consisting of "core" and "major" coursework. The survey sought to determine how closely completion of the AVM program requirements coincided with completion of the baccalaureate degree requirements. To that end the data gathered indicated that the largest number of respondents reported completing the AVM program requirements coincidentally with the baccalaureate degree requirements between 1989 and 1992 (see Table 2).

When asked about current degree(s) held 802 of those participating provided a response to the categories offered: (a) Bachelors, (b) Masters, (c) Doctoral, and (d) Other. When asked about future academic plans, 465 participants responded. The majority of respondents indicated that they would be pursuing a masters degree. Table 3 illustrates these responses.

To determine the effectiveness of the AVM degree it was necessary to track student occupations "Prior to Enrollment", "During Enrollment", and in the "Now" category of the survey. Respondents were questioned on their employment status across the spectrum of the aviation industry. They were also asked if their employment status would be categorized as "Other Areas Outside the Aviation Industry". Table 4 shows the results of the data gathered from this question.

Prior to enrollment data indicate that the top three aviation industry employers were: (a) the Military (45.0%), (b) Fixed Base Operators (6.3%), and (c) Other Areas Within the Aviation Industry (3.9%). Respondents indicated that these three sectors were the top three sources of employment during enrollment as well. However, the military employment figures decline by 5.8%, while Fixed Base Operator numbers increase by 30%, as do other areas within the aviation industry by 74%. This shift in employment numbers from the military across the other sectors of the aviation industry is further emphasized by significant gains, during the enrollment period, in the following sectors: (a) Non-Profit State or Local Agency by 350%, (b) Airports by 150%, and (c) Federal Government Agency by 73.9%.

From the data gathered, 68% of those respondents indicated that it took an average of seven months after graduation to get a "degree-related" job. Some graduates (4.5%) indicated that this was their first "aviation" job.

At the time of the survey, as is indicated by the "now" category of Table 4, the significance of the shift in employment is further emphasized. Survey data indicates that the top three employers within the aviation industry at this point were (a) the Airlines at 25.3%, (b) the Military at 17.3%, and (c) Other Areas Within the Aviation Industry at 15.0%. Three sectors of the industry that showed a decline in employment numbers when comparing the "during enrollment" to the "now" responses were: (a) the Military by 59.2%, (b) Fixed Base Operators by 43.1%, and (c) Non-Profit State or Local Agency by 18.5%. When comparing the same periods, these numbers are overshadowed by the increases in employment numbers in the following three sectors of the industry: (a) the Airlines by 857.1%, (b) the Manufacturers by 273.3%, and (c) Other Areas Within the Aviation Industry by 120.3%. As noted in Table 4 there were multiple responses in these categories.

Overall these data indicate that as the graduates entered the program and continued through the enrollment period, their primary source of employment was the military. During the enrollment period, a shift in employment began that culminated with the airlines as the major employer, as is reflected in the "now" category of Table 4.

The "Other Area Outside the Aviation Industry" must be addressed due to the numbers employed in this sector. Employment numbers prior to enrollment (9.2%) and during enrollment (8.3%) would place this sector of employment in the number two position for each of these enrollment categories. In the "now" category, respondents reported this sector as the number three employer of graduates. Prior to enrollment the difference between those employed by the military and those employed in other areas outside the aviation industry was 35.8%. At the time the survey was completed this difference in sources of employment had dropped to 0.7%.

Salary levels are always an important facet of an occupational profile. Respondent data indicated a shift in salary levels prior to graduation as related to salary levels after graduation. Salaries were reported to have increased by the majority of respondents after graduation. See Table 5. The relatively low salaries of respondents prior to graduation may be attributed to:

1. Traditional and on-campus students entering the program without employment or with part-time, supplemental, and minimum wage employment.
2. Non-traditional and off-campus students, predominantly military non-commissioned officers at the lower echelons of rank and pay.

For example, 55% of the respondents indicated they were in the lowest salary level prior to graduation. And, 87.7% indicated annual salary levels prior to graduation below $34,000, with the balance (12.3%) indicating a salary level in excess of $34,000. These numbers change significantly after graduation.

Respondents indicated that 33.3% of the AVM program graduates in the "after graduation category" were earning less than $34,000 annually. This reflects a 54.4% drop in this salary level from the "prior to graduation" figures. As indicated by the survey 66.7% of the respondents reported "after graduation" salary levels in excess of $34,000 for an increase in this category of 54.4%.

Culminating the demographics, educational, and occupational profile was a question relating to student rationale for enrollment in the AVM program. Of the 801 responses to this question 44% indicated securing employment in the private sector of the aviation industry, 27% indicated career advancement in the private sector of the aviation industry, and 17% indicated career advancement in the military. See Table 6.

Evaluation of the AVM Program

For an evaluation of the AVM degree respondents were given an opportunity to evaluate core courses and major courses that make up the 48 credit hour program. Questions were formatted so that responses would indicate which courses were "most valuable" and "least valuable".

Core Courses

There were eight core courses in the AVM program curriculum evaluated by respondents. Survey data gathered indicated that, in descending order, respondents rated the following core courses as the top three most valuable: (a) Professional Development, (b) Labor-Management Problems, and (c) Work Center Management. A point to be made regarding the consistency of the data is that the first and second most valuable core courses, Professional Development and Labor-Management Problems, were also rated the lowest and next to lowest least valuable core courses. The top three least valuable core courses, in descending order, were: (a) Legal Aspects, (b) Data Interpretation, and (c) Independent Study and Work Center Management, reflecting a two way tie for third least valuable core course. Here again the data are consistent, reporting that Data Interpretation and Legal Aspects, selected as the first and second least valuable core courses, held down the lowest two positions in the most valuable core course category. However, the data reported were not always consistent. As can be seen in Table 7, Work Center Management was rated as the third most valuable and the third least valuable core course.

Major Courses.

The AVM program curriculum consists of ten major courses. Three of these, The Air Traffic Control System, Aviation Safety Management, and National Airspace System, are not offered at off-campus locations. The most valuable major courses, in descending order, as reported by the respondents, were: (a) Airline Management, (b) Aviation Maintenance Management, and (c) Airport Management. The top three least valuable major courses, as reported, were: (a) Airport Planning, (b) General Aviation Operations, and (c) Aviation Maintenance Management. A similar trend in consistency from the core course evaluations pervades the major courses as well. For example, Airline Management and Airport Management, rated number one and number three most valuable major courses, respectively, were in the lower half of least valuable major courses. Airport Planning and General Aviation Operations, rated number one and number two, least valuable major courses, respectively, fell into the lower half of the most valuable major course category. However, Aviation Maintenance Management, the number two most valuable major course, was also rated as the number three least valuable major course. This finding may be explained by the demographic differences inherent to the on- and off-campus student populations. Due to on-campus fight training, the majority of these students are typically geared toward a flight operations curriculum. In contrast, off-campus students report greater diversity in occupational interests. See Table 8.

Lastly, the participants were given an opportunity to answer three questions: the first was regarding their attitude towards the AVM degree, the second was whether or not they considered the degree an asset in achieving their employment goals, and the third was would they recommend the degree to others?

Regarding their attitude towards the AVM degree, and on a scale of 1 to 3 (1 being negative, 2 being neutral, and 3 being positive), a mean response of 2.65 was reported with a standard deviation of .6. This data reflects a decidedly positive respondent attitude toward the AVM degree.

The AVM degree was considered an asset in achieving employment goals by a predominant number of respondents. Of the 732 respondents providing input to this question 85.7% indicated the degree was an asset. An even larger number of the 794 respondents (89.8%) indicated that they would recommend the degree to others.

CONCLUSION

Graduates of the B. S. in Aviation Management program at SIUC indicated that they highly valued the AVM degree program. For example, 85.7% considered the degree an asset towards achievement of their employment and career goals. Additionally, 89.8% would recommend the Aviation Management degree to others. The data gathered provide insight of the value of the curriculum and employment within the civilian aviation industry. This is significantly illustrated by the huge increase in airline industry employment from prior to enrollment (2.0%) to the time of the survey (25.3%). Further indication of the program's success is that 43.8% of the respondents indicated employment within the private aviation industry was the primary purpose for enrollment; 46.9% indicated private aviation sector employment at the time of the survey. Another indication of the value of the curriculum to graduates was the large increase in annual salaries of respondents. Prior to graduation 87.7% of the respondents indicated annual salary levels at less than

$34,000, after graduation 66.7% reported salary levels equal to or in excess of this range.

From a demographic perspective, the B. S. in Aviation Management serves a white male population with a relatively high average age at enrollment (25). Employment data indicates that prior to matriculation the military was the major source of employment. At the time of the survey the data reflects an interesting shift in employment sectors. Following graduation the major source of employment was reported to be the airlines with the military sector closely behind. However, graduates indicated that the third largest source of employment was "Other Areas Outside the Aviation Industry" with a separation of 0.7% between the second and third most popular sources of employment. It is pertinent to conclude that the degree not only provides a bridge from military service to civilian aviation employment but also that the degree affords graduates opportunities outside of the aviation industry

The respondent's evaluation of the B. S. in Aviation Management curriculum "core courses" indicated that the courses "Professional Development" and "Labor-Management Problems" were considered most valuable and the courses "Legal Aspects of Aviation" and "Data Interpretation" were considered least valuable. As it relates to "major courses" in the curriculum "Airline Management" and "Aviation Maintenance Management" were considered most valuable, and the courses "Airport Planning" and "General Aviation Operations" were considered least valuable.

The survey results suggested areas for further analysis. One area in particular is the concept of beginning a longitudinal study of AVM graduates using the same methodology in each study. A second suggestion is that a comparison be made of on- and off-campus AVM responses, especially in the areas of respondent demographics and curriculum.

Using respondent's "least valuable" comments and faculty and administrator recommendations on results of the survey, the following changes are under consideration or have been made to the AVM program:

Core Courses

1. AVM 375-Legal Aspects of Aviation was moved from the core to the aviation major course listing.
2. ATS 383-Data Interpretation has been removed from the core course list.
3. ATS 364-Work Center Management has been revised to be more aviation oriented and has also been dropped altogether from the off-campus program. The new course number and title used on-campus is "AVM 302-Current Aviation Management Practices and Processes."
4. Independent Study Courses-These courses have been revised overall in terms of their direction and purpose, especially as they relate to the off-campus program where they are used most extensively.
5. ATS 416-Applications of Technical Information was revised and made more aviation oriented. It's new course number and title is "AVM 301-Aviation Management Writing and Communication."

Major Courses

The five major courses rated as "least valuable"; Airport Planning, General Aviation Operations, Aviation Maintenance Management, The Air Traffic Control System, and Aviation Industry Regulation, are currently being examined as to their content, validity, and “fit” in the on- and off-campus curriculum. As yet, no decisions have been made to their disposition.

REFERENCES

American Council on Education: Center for Adult Learning and Educational Credentials. (1998). Military Installation Voluntary Education Review (MIVER): Final Report: MIVER revisit to Marine Corps Air Station (MCAS) Yuma, Arizona, 8–10 March 1998. (Washington, DC: Author).

Lippincott, C. E. (1981). Follow-up study of Southwest Missouri State University's elementary educatiion graduates. Unpublished doctoral dissertation, University of Arkansas.

Skyles, G.C. (1993). Aviation Management program graduate follow-up study on- off-campus from 1983 to 1990. Unpublished doctoral dissertation, Southern Illinois University, Carbondale.

Southern Illinois University at Carbondale. (1994). (Survey of graduates during calendar year 1991). Unpublished raw data.

Southern Illinois University at Carbondale. (1998). (Survey of graduates during calendar year 1991). Unpublished raw data.

State of Illinois Board of Higher Education. (1993, July 13). Item #6: Undergraduate education policies: Implementation update. Springfield, IL: Author.

Turner, J.L. (1991). A follow-up survey of graduates of the J. W. Fulbright College of Arts and Sciences. Unpublished doctoral dissertation, University of Arkansas.

Table 1

Race/Ethnic Identification

Category	Frequency (n = 797)	%
American Indian/Alaskan	8	1.0
Black Non-Hispanic	38	4.8
White Non-Hispanic	698	87.6
Asian/Pacific Islander Indian Subcontinent	25	3.1
Hispanic	28	3.5

Note. Total number of survey participants is 806. However, n values reported on Tables vary as all participants did not respond to all questions.

Table 2

Completion of AVM Major Coursework and Baccalaureate Degree Requirements

	Completion of Major (n = 785)		Completion of Degree (n = 802)	
Year	Frequency	%	Frequency	%
1996	23	2.9	43	5.4
1995	62	7.9	72	9.0
1994	67	8.5	75	9.4
1993	59	7.5	62	7.7
1992	79	10.0	83	10.3
1991	78	9.9	91	11.3
1990	97	12.4	85	10.6
1989	80	10.2	81	10.1
1988	65	8.3	62	7.7
1987	60	7.6	54	6.7
1986	60	7.6	53	6.6
1985	55	7.0	41	5.1

Note. Total number of survey participants is 806. However, n values reported on Tables vary as all participants did not respond to all questions.

Table 3

Present Degree Held and Future Academic Plans

Degree	Degree Currently Held (n = 802)		Future Academic Plans (n = 465)	
	Frequency	%	Frequency	%
Bachelor's	705	87.9	N/A	N/A
Master's	92	11.5	368	79.1
Doctoral	5	0.6	52	11.2
Other	N/A	N/A	45	9.7

Note. Total number of survey participants is 806. However, n values reported on Tables vary as all participants did not respond to all questions.

Table 4

Employment Status

Industry Sector	Prior to Enrollment Frequency	%	During Enrollment Frequency	%	Now Frequency	%
Military	357	45.0	336	42.3	137	17.3
Federal Government Agency	23	2.9	40	5.0	68	8.6
Non-Profit State or Local Agency	6	0.8	27	3.4	22	2.8
Airlines	16	2.0	21	2.6	201	25.3
Fixed Base Operator	50	6.3	65	8.2	37	4.7
Manufacturing	13	1.6	15	1.9	56	7.1
Airports	10	1.3	25	3.1	47	5.9
Self-Employed	16	2.0	18	2.3	32	4.0
Other Area Within the Aviation Industry	31	3.9	54	6.8	119	15.0
Other Area Outside the Aviation Industry	73	9.2	66	8.3	132	16.6

Note. Total number of survey participants is 806. However, n values reported on Tables vary as all participants did not respond to all questions. For Table 4 n = 794.

Table 5

Gross Yearly Salary Levels Prior To and After Graduation

	Prior to Graduation (n = 709)		After Graduation (n = 778)	
Level	Frequency	%	Frequency	%
Below $20,000	388	54.7	80	10.3
$20,000 - $34,000	234	33.0	179	23.0
$35,000 - $49,000	70	9.9	254	32.6
$50,000 - $64,000	14	2.0	152	19.5
Over $65,000	3	0.4	113	14.5

Note. Total number of survey participants is 806. However, n values reported on Tables vary as all participants did not respond to all questions.

Table 6

Achievement of the Primary Purpose for Enrolling in the AVM Program

Primary Purpose for Enrollment	Frequency
Aviation Industry Employment	
Federal government	81
State or municipal government	34
Private Industry	351
Other segment	78
Other reasons	
Military advancement	137
Civilian employment after military service	118
Career advancement within the aviation industry	214
Salary increase	49
Self-development	97
Other reason	19

Note. Although respondents were asked to choose only one primary purpose, a number selected two or more. Total number of survey participants is 806. However, n values reported on Tables vary as all participants did not respond to all questions. For Table 6 n = 801.

Table 7

Evaluations of the Core Courses

Course	Selected as Most Valuable (n = 736)		Selected as Least Valuable (n = 700)	
	Frequency	%	Frequency	%
Applications of Technical Information	98	13.3	83	11.9
Work Center Management	118	16.0	93	13.3
Labor-Management Problems	172	23.4	62	8.9
Data Interpretation	19	2.6	96	13.7
Professional Development	192	26.1	54	7.8
Fiscal Aspects	59	8.0	85	12.1
Legal Aspects	33	4.5	134	19.1
Independent Study	45	6.1	93	13.3

Note. Total number of survey participants is 806. However, n values reported on Tables vary as all participants did not respond to all questions.

Table 8

Evaluations of the Major Courses

Course	Selected as Most Valuable (n = 706) Frequency	%	Selected as Least Valuable (n = 680) Frequency	%
Airport Planning	41	5.8	178	26.1
Aviation Industry Regulation	81	11.5	67	9.9
Airport Management	107	15.2	49	7.2
Airline Management	156	22.1	35	5.1
General Aviation Operations	33	4.7	85	12.5
Aviation Maintenance Management	138	19.5	71	10.4
The Air Traffic Control System[a]	43	6.1	69	10.1
Aviation Safety Management[a]	55	7.8	42	6.2
Current Issues in Aviation Management	34	5.6	25	3.7
National Airspace System[a]	18	2.6	59	8.7

Note. Total number of survey participants is 806. However, n values reported on Tables vary as all participants did not respond to all questions. [a] Unavailable off-campus.

COLLISION AVOIDANCE AT NONTOWERED AIRPORTS

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ABSTRACT

From January 1 of 1988 to December 31 of 1998 there were an average of 16.9 midair collisions and 17.7 fatalities per year involving general aviation aircraft in the United States (Carter, 1999). In February of 2000 alone there were five midair collisions (NTSB, 2000). Most midair collisions occur in the traffic patterns of non-towered airports and on final approach. What can a general aviation pilot do to reduce the risk of a midair collision at a non-towered airport? What are the FAA's and Transport Canada's recommended procedures for traffic patterns? What alternative procedures are currently in use by pilots and are they safe? A review of the regulations, advisories, and various articles on the subject, a survey of flight instructors on the methods taught to enter such patterns, and a discussion of legal precedents and certificate actions will aid the pilot in choosing a method for pattern entry at non-towered airports.

INTRODUCTION

According to figures from the National Transportation Safety Board (NTSB), during the period from January 1, 1988 to December 31, 1998 there were approximately 16.9 midair collision accidents per year involving general aviation aircraft in the United States (L. Carter, NTSB, personal comm-unication, August 13, 1999). According to Carter, the number of fatalities averaged slightly above one per accident. February of 2000 proved to be a disastrous month with five midair collisions, three of which occurred during a two day period, involving five fatalities (NTSB, 2000). A study by the Aircraft Owners and Pilots Association (AOPA) Air Safety Foundation showed that nearly half of these midair collisions occurred while in, approaching, or departing a traffic pattern (AOPA, 1998). Furthermore, many of these accidents occurred during good weather, at non-towered airports, and on or near final approach (AOPA, 1998; Duncan, 1997; Landsberg, 1997).

According to the Trans-portation Safety Board of Canada (TSB), during the period from 1989 to 1998 there were 31 collisions between airplanes in Canada. Of these 31 collisions, 20 occurred in the air and 11 involved aircraft on the ground. Of the 31 total collisions, 28 involved general aviation aircraft. Of the 31 collisions, 7 occurred during take-off, approach, or landing (TSB, 1997).

The number of collisions and fatalities at non-towered airports indicates that there is room for improvement in the area of safety regarding the procedures for operating at such airports. A review of the regulations, advisories, and various articles on the subject, a survey of flight instructors on the methods taught to enter such patterns, and a discussion of legal precedents and certificate actions will aid the pilot in choosing a method for pattern entry at non-towered airports.

LITERATURE REVIEW

Regulations

According to the Code of Federal Regulations (CFR, commonly known to pilots as FARs) 14 CFR 91.126 (b)(i) (1991) states that when approaching to land at a non-towered airport all turns shall be made to the left (except at those airports displaying right hand patterns). The regulation does not specify at which point of the traffic pattern pilots must enter, nor does it specify the procedure for exiting the pattern. 14 CFR 91.103 (2000) pertains to preflight action and states that before any flight, other than one remaining in the local area, pilots shall familiarize themselves with all available information. This includes checking the Airport/Facility Directory (A/FD) or other commercial publication for information regarding traffic pattern direction and traffic pattern altitude (TPA).

The Canadian regulations are similar. Canadian Air Regulation (CAR) 602.96 (3) states, "The pilot-in-command of an aircraft operating at or in the vicinity of an aerodrome shall [emphasis added] (a) observe aerodrome traffic for the purpose of avoiding a collision; (b) conform to or avoid the pattern of traffic formed by other aircraft in operation; (c) make all turns to the left when operating within the aerodrome traffic circuit, except where right turns are specified by the Minister in the Canada Flight Supplement;…(e) where practicable, land and take off into the wind unless otherwise authorized by the appropriate air traffic control unit; (f) maintain a continuous listening watch on the appropriate frequency…" (Transport Canada, 1996). Note that the Canadian regulations are slightly more specific than the US regulations. The pilot is also directed to observe the flow of traffic, land into the wind, and utilize the radio.

Variants for Traffic Patterns

One reason the regulations and advisories are not more restrictive is the number of variants to traffic patterns. For instance, the TPA may not be the same for all aircraft operating in the traffic pattern. Some nontowered airports that cater to both small, general aviation aircraft and larger twin engine or turbine aircraft may have one TPA for slower aircraft and a higher TPA for faster aircraft (Federal Aviation Administration [FAA], 1993). Furthermore, the available altitude above TPA in which a pilot may overfly the airport may be restricted by overlying airspace (such as Class B airspace).

If helicopters are present at the airport, they may fly a pattern similar to the fixed wing pattern but at a lower altitude (500 feet above ground level [AGL]) and closer to the runway. The only stipulation in 14 C.F.R. 91.126 (b) for helicopters is that they avoid the flow of fixed wing aircraft when approaching to land (FAA, 1991). This means that in addition to being lower and closer, the helicopter pilot may choose to fly the pattern on the opposite side of the runway from the fixed wing traffic (FAA, 1993).

If gliders are present, their traffic pattern is inside the powered aircraft pattern. Some airports have an established Glider Operating Area on one side of the runway. Extreme caution must be exercised at these airports. According to Advisory Circular (AC) AC90-66A the glider pattern will normally be on the same side of the runway as the Glider Operating Area (FAA, 1993). For instance, if Runway 9 and 27 both have standard left hand traffic for powered aircraft and a Glider Operating Area exists on the north side of the runway, the powered aircraft will be operating south of the runway when Runway 27 is in use, and the gliders will be operating north of the runway with right hand traffic. Add a helicopter to the scenario and chaos can erupt.

A glaring example of an airport rife for multiple patterns is Ephrata, Washington. According to Jeppesen's Airway Manual Services Northwest United States Airport Directory, Washington 10 (Jeppesen, 1999), Ephrata Municipal airport has two runways: runway 02/20 and runway 11/29. The TPA for fixed wing aircraft is 800 feet AGL and for ultralights is 250 feet AGL. Runway 2 has right traffic. The remarks contain the following:

> Birds in the vicinity
>
> Airplane use of runway 11 is discouraged due to glider operations
>
> Agricultural aircraft in area
>
> Heavy glider activity from April through October
>
> Ultralight activity in area
>
> Aerobatic activity over center of airport
>
> Navy aircraft carrier deck is painted on the runway

There was a midair collision at this airport on August 1, 1993 between a student pilot on a solo flight in a Cessna 150 and a Grumman 164B cropduster (NTSB, 2000). The collision occurred while the Cessna 150 was on final approach for runway 2. The cropduster had entered the airport environment from the north (the same side as the appropriate right hand pattern for runway 2) and was spraying chemicals on the edge of the runways. There were conflicting reports regarding whether or not the Grumman pilot radioed position reports on the common traffic advisory frequency (CTAF).

Determining the Traffic Pattern

The best way for a pilot to determine the direction of a traffic pattern for a particular runway is to look up the information in the A/FD. The A/FD provides information about public airports including direction of turns and traffic pattern altitudes. If a runway has non-standard right hand traffic, the reason (such as obstacles or a noise sensitive area) will often be given. Several other commercial and state publications are also available which provide the same information as the A/FD.

14 CFR 91.103 states, "Each pilot in command shall, before beginning a flight, become familiar with all [emphasis added] available information concerning that flight" (FAA, 2000). The term "all available information" implies checking on the traffic pattern, including direction of turns and traffic pattern altitude, for the intended airport. It should be noted that not all publications include the traffic pattern altitude. If no altitude is shown, the Aeronautical Information Manual (AIM) Part 4, Section 3, Paragraph 4 recommends 1,000 feet AGL (FAA, 1999).

The AIM describes various aids that can help the pilot determine the most appropriate runway and the direction of the traffic pattern. Nowhere in the FARs or the AIM is there a suggested procedure for how to overfly an airport to check on these aids. The AIM (FAA, 1999) in chapter 4, Section 3, Paragraph 4 does state that "… pilots of enroute aircraft should be constantly on the alert for other aircraft in traffic patterns and avoid these areas whenever possible." This paragraph also states that most traffic pattern altitudes extend from 600 feet AGL to 1500 feet AGL, and occasionally when military turbojet aircraft are present the pattern may be as high as 2500 feet AGL. Furthermore, AIM chapter 4, Section 1, Paragraph 9

(FAA, 1999) details the recommended procedures for communication on the CTAF for non-towered airports, including reporting when inbound from 10 nautical miles out.

Entering the Pattern

14 CFR 91.126 (FAA, 1991) states that when approaching to land all turns shall be made to the left (or right if the runway displays approved signals or markings). This regulation does not specify how many legs in the pattern must be flown nor at what point the pilot should enter the pattern. According to Duncan (1997) of the FAA, the procedures are only recommended and are not more specific in order to give pilots some flexibility because of "changing wind conditions, intrusion of other traffic, and other possible emergencies…". For example, an airport layout may be such that a pilot suspects mechanical turbulence on the pattern side of a runway. In that case a straight in approach or base entry may bypass the turbulence.

The AIM, Chapter 4, Section 3, Paragraph 4 (FAA, 1999) diagrams the recommended procedure for entering a traffic pattern (see figure 1). The recommended entry is on a 45 degree angle (the 45) to the downwind. Note that for most airports the 45 has the approach end of the runway at the apex of the angle. This allows the pilot to enter the downwind leg at approximately midfield. If the runway is very long (over 4000 feet) the aim point will be upwind of the approach end in order for the aircraft to arrive on the downwind leg at the midpoint of the runway. Many new and even experienced pilots aim at a 45 degree angle to the midpoint of the runway, which is hazardous as it puts the pilot in potential conflict with aircraft on the crosswind leg or exiting on the 45. Although the AIM stipulates that the pilot should be at TPA when entering the downwind leg (FAA, 1999), this can lead to some confusion: should the pilot be at TPA at the point where the turn is made from the 45 to downwind or prior to that point when on the 45 degree entry itself? Advisory Circular AC 90-66A is a little more specific. It states that once "… the proper traffic pattern direction has been determined, the pilot should then proceed to a point well clear of the pattern before descending to the pattern altitude" (FAA, 1993). The prudence of descending to TPA away from the traffic pattern can be seen by imagining the scenario of a high winged aircraft already established on the 45 at TPA and a low winged aircraft above it descending to TPA. Such a scenario is a perfect setup for a midair collision.

The Canadians approach traffic pattern entries somewhat differently. Although Canadian Air Regulation (CAR) 602.96 (3)(c) also specifies making "all turns to the left when operating within the aerodrome traffic circuit, except where right turns are specified," the similarities stop there (Transport Canada, 1996). The Canadian Aeronautical Information Publication (AIP) contains provisions for entering the circuit from the upwind side (Transport Canada, 1999). Furthermore, the AIP distinguishes between circuit entries for airports in a mandatory frequency (MF) area (an area of sufficient traffic to warrant requirements for communication) and those not in an MF area. According to AIP Rules of the Air (RAC) 4.5.2.(a)(v) and (vi) (Transport Canada, 1999), when operating within an MF area where the airport advisory information is available over the radio, the "aircraft may join the circuit pattern straight in or at 45 degrees to the downwind leg, or straight in to the base or final legs." If the aircraft is in an MF area where airport advisory information is not available or at an aerodrome not within an MF area, the "aircraft should approach the traffic circuit from the upwind leg, or, once having ascertained without any doubt that there will be no conflict with other traffic entering the circuit or traffic established within the circuit, the aircraft may join the circuit on the downwind leg" (Transport Canada, 1999). Referring to figure 2, note that the downwind entry is made straight in to downwind and not at a 45 degree angle (Transport Canada, 1999, figure 4.6). AIP RAC 4.5.2 (a)(ii) states that "unless otherwise specified or required by the applicable distance from cloud criteria, aircraft should join the downind leg, or enter the crosswind at an altitude of 1,000 feet AAE (above aerodrome elevation.) When joining from the upwind side, plan the descent to cross the runway in level flight at 1,000 feet AAE or the published circuit altitude. Maintain that altitude until further descent is required for landing" (Transport Canada, 1999).

Upwind Entries

For years there has been an ongoing argument regarding the necessity of entering the traffic pattern at a non-towered airport on the recommended 45 degree to downwind entry. Some pilots have long argued that the regulations state only the direction of turns and do not prohibit zero degree to downwind entries, base entries, straight in approaches, or crosswind entries from the upwind side of the runway. In "The Great Debate" (Landsberg, 1997), published by the AOPA's Air Safety Foundation, Landsberg described an alternative method for entering the traffic pattern from the upwind side. In this method, the pilot enters the upwind leg at pattern altitude, crosses over the runway near the midfield point, and turns to the downwind leg. At the time the article was published, Landsberg stated that "there was consensus within the FAA to allow the upwind entry as an alternate way to get onto the downwind leg. The negotiated settlement was that upwinders should yield to aircraft on the downwind or about to enter downwind from the normal 45-degree entry point" (Landsberg, 1997).

Michael Henry, the FAA's Washington, D. C. manager of the General Aviation and Commercial Division for Flight Standards, reported that the upwind entry method is currently under review by the FAA and a new advisory circular regarding pattern entries at nontowered airports is being drafted. He stated that the FAA personnel working on the advisory circular have not yet reached consensus regarding the upwind entry method. According to Henry, acceptance or rejection of the upwind entry method "goes back to the Law of Primacy." Pilots who were initially taught by their instructors that an upwind entry method was inherently dangerous were against it. Those pilots whose instructors taught the upwind entry method thought that it was safe" (M. Henry, personal communication, April 5, 2000).

Proponents of the upwind entry method argue that this method had been successfully used in Canada. In Canada, the upwind entry is an established procedure and is taught to student pilots from the beginning of their training. This substantiates Henry's statement regarding the Law of Primacy. Furthermore, the fact that there are significantly fewer licensed pilots and aircraft operations in Canada must also be considered.

There is one aspect of the Canadian upwind entry recommendation that calls for concern. AIP RAC 4-3-2 (a)(ii) states that the pilot should be at circuit altitude prior to entering the crosswind leg (Transport Canada, 1999). In this respect, the Canadian AIP is similar to the US AIM in that neither publication addresses how or where the pilot should descend to circuit altitude/TPA. Since the AIP shows no procedure for the descent to circuit altitude prior to being established on the upwind approach to the crosswind, several aircraft could be converging on the same point with the possibility of higher aircraft descending into lower aircraft.

DISCUSSION

How Flight Instructors Teach Pattern Entries

The method used by a pilot to enter the traffic pattern at a non-towered airport is included in the pilot's initial flight training. A survey of flight instructors showed the diversity of methods currently being taught, especially the methods used for an upwind entry and the potential for conflicts in traffic patterns.

Method

Participants. 78 flight instructors responded to the survey. The instructors were attending Flight Instructor Refresher Courses (FIRCs) sponsored by the Washington State Department of Transportation, Aeronautics Division. The first FIRC was held in November of 1999 and the second was held in January of 2000. Both FIRCs were held in western Washington state. The population was a convenience sampling; volunteers who wished to participate returned completed surveys after FIRC sessions.

Materials. 100 surveys (50 at each FIRC) were distributed randomly to participants during registration periods. The surveys requested instructors to diagram how they taught their students to enter the traffic pattern at a non-towered airport. The survey included a sketch of a runway with a segmented circle displaying standard left hand traffic and a wind direction indicator. The instructors were asked to describe how they teach (1) entering the pattern when arriving on the same side of the airport as the pattern and (2) entering the pattern when arriving from the side opposite the pattern.

Results. The surveys showed that the majority of the respondents teach according to the recommendations of the AIM and AC 90-66A. The survey results are tabulated in Table 1.

There were three primary methods described by the instructors. The first method entailed overflying the airport from the upwind side to maneuver to the 45 (see figure 3). The second method involved turning to the downwind after crossing over the airport at TPA (see figure 4). The third method was to avoid the traffic pattern completely and maneuver to enter on the standard 45.

Of the seventy-eight respondents, forty-three chose method one, although there were some differences in how the respondents described the method. Twenty-four respondents stated they would overfly the airport at TPA + 500 feet, thirteen respondents stated they would overfly the airport at TPA + 1000 feet, and another six respondents chose an altitude other than TPA + 500 or + 1000 feet. Twenty-one of the seventy-eight respondents chose the upwind entry method. Nine of those respondents chose to cross over the runway near the approach end of the runway and twelve of them chose to cross at midfield. Twelve of the respondents chose either a variation of the overflight or upwind methods and two depicted entering on the 45 with no indication of how they would maneuver to that position. Additionally, four respondents misunderstood the instructions and did not answer appropriately. Note that there were eighty-two responses from the seventy-eight respondents. This discrepancy was due to four respondents who listed both an overflight method and an upwind entry method.

The survey showed some frightening trends. Eight of the twelve responses classified as variations depicted flying outbound on a 45 degree angle from the approach end of the runway while descending to TPA. Such an approach would be in serious danger of a collision with an aircraft climbing out and following the procedure recommended by AC 90-66A (FAA, 1993). Two of the variation responses depicted the overflight method but showed a descent while inbound on the 45 degree entry. Due to the blind spot ahead of and below an aircraft, such an approach could result in a descent into traffic already established on the 45 at TPA. Finally, two of the variation responses depicted upwind entries while descending to TPA. This method could also result in a blind descent into traffic already established at TPA.

Legal Ramifications

Pilots must consider the legal ramifications of entering the pattern in a nonstandard fashion. Any pilot who enters the traffic pattern in opposition to the direction of turns established in the A/FD (and now shown for most airports on the sectional chart) may be faced with a violation of 14 CFR 91.126 (b)(1) (FAA, 1991).

Precedence has already been established in this matter when two airline pilots sustained certificate action regarding the manner in which they approached a nontowered airport. (Yodice, 1995). In both incidents the pilots were conducting approaches to the nontowered airport at Kotzebue, Alaska. The first incident involved a captain of an air carrier making a right turn onto final from approximately three miles out. Another aircraft was approaching the runway from a VOR/DME approach and both aircraft had to alter course. The FAA cited the captain with a violation of 14 CFR 91.89 (now known as 91.126) and suspended his Airline Transport Pilot (ATP) license for 20 days (Yodice, 1995).

The second incident involved a captain also executing a right turn to final. The captain stated that he made the turn to final approximately four miles out, which then constituted a straight in approach. This captain was also cited with a violation of 14 CFR 91.89 (now 91.126) and his ATP certificate was suspended for 25 days. The captain appealed the suspension to the NTSB. An NTSB law judge found that the turn was made much closer to the airport, between one to two miles out, and therefore constituted a right hand turn approaching to land. The captain then appealed to the full Board but the suspension was upheld (Yodice, 1995).

These two incidents set important precedents of which pilots should be aware. First, a turn to final from one to two miles away from the airport does not constitute a straight in approach. Second, regardless of how far out a straight in approach is initiated, “it must not interfere with aircraft in the traffic pattern or on an instrument approach” (Yodice, 1995). Furthermore, should a collision occur as the result of an aircraft NOT following the procedures recommended by AC 90-66A (FAA, 1993), the pilot (should he or she survive) may be faced with a hefty lawsuit.

There have been several court cases that resulted in findings regarding the use of the AIM and ACs. The first case, Associated Aviation Underwriters and Fidelity and Casualty Company of New York v. United States of America (1979), resulted in a judgment that stated, “A pilot must have studied and must know provisions of [sic] Airmen’s Information Manual and

Federal Aviation Authority advisory circulars pertaining to his flying activities and, furthermore, is charged with that knowledge of those facts which were then material to the safe operation of his flight."

The second case, Brenda Mallen, as widow of Steven Mallen v. United States of America (1979), resulted in a judgment stating, "In negligence action, airman's information manual and FAA advisory circulars are admissible as competent evidence of practices customarily followed by pilots, as it relates to standard of care."

The third case, referred to as In re N-500L CASES Civ. No. 78-2126 (1981), resulted in a judgment stating, "Information contained in FAA advisory circulars … is chargeable to all certified pilots and is evidence of standard of care…"

The most incriminating judgment regarding traffic pattern entries resulted from a fatal midair collision (MAC) at a non-towered airport at Greenwood, Indiana. In this case, referred to as In re Greenwood Air Crash (1995), the judgment included a statement that the " pilot initiated [sic] nonstandard right-hand turn and decided to obtain his Instrument Flight Rules (IFR) clearance at [sic] critical time in take off, while still climbing away from [sic] airport, [sic] increased his duty to be vigilant to see and avoid other aircraft." If the thought of a midair collision does not frighten all pilots into compliance with required and recommended procedures, perhaps the thought of certificate action, lawsuits, and financial ruin will.

Risk Reduction

There are numerous ways a pilot can reduce the risk of a midair collision at a non-towered airport. First, the pilot should follow 14 CFR 91.103 and become familiar with all available information regarding the intended airports to be used (FAA, 2000). The pilot should check the A/FD, review any Notices to Airmen (NOTAMs) for the area, and, if any questions or doubts exist, call the phone number listed in the A/FD for the airport manager or fixed base operator (FBO).

Second, the pilot should use the radio as recommended in the AIM (FAA, 1999) and in AC 90-42F (FAA, 1990) and listen for other aircraft in the area. When arriving at a non-towered airport, the CTAF (shown on aeronautical charts and in the A/FD) should be monitored within 10 miles of the airport (or as soon as possible when on an instrument flight plan). If flying an aircraft without an installed radio, one should consider investing in a hand-held radio. They provide an inexpensive form of insurance and are well worth their cost in terms of risk reduction.

Third, the pilot should maneuver the aircraft so as to enter the pattern on the 45 to downwind. Until such time as the FAA publishes an advisory circular describing an upwind entry method, aircraft approaching the airport from the opposite side of the pattern should plan to overfly the airport at an altitude appropriate for the activities and the TPAs of the airport and maneuver onto the 45. The survey of Washington State flight instructors showed that their preferred method of maneuvering to the 45 was to:

a. fly directly over the center of the runway on a perpendicular course and at an altitude above TPA,

b. fly outbound until well clear of the traffic pattern, begin the descent, turn 90 degrees toward the upwind direction, and

c. maneuver so as to enter on the 45 to downwind after reaching TPA.

If the pilot is unable to determine the active runway by using the radio prior to reaching the airport, the same method may be used to overfly the segmented circle and wind direction indicator to ascertain the active runway and pattern direction before entering the pattern.

Fourth, the pilot should be aware of any variant traffic patterns that may be in concurrent use, such as ultralights or gliders. Once again, a check of the A/FD, a call to the airport manager or FBO, or careful monitoring of the CTAF can warn the pilot of such activities. This knowledge can help the pilot to understand where possible conflicting traffic might appear. If glider activities are encountered, the pilot should also refer to 14 CFR 91.113 regarding right-of-way rules (FAA, 2000).

Fifth, when taking off and remaining in closed traffic, the pilot should adhere to the following recommendations for maneuvering from AC 90-66A (FAA, 1993):

a. The pilot must ascertain that there is no conflicting traffic prior to taxiing onto the runway. If the taxiway or runup area allows, a 360 degree turn can be made to check the final approach course and traffic on base from either direction. Long delays on the runway or taxiing into position and holding should be avoided as the potential for collision is greatly increased.

b. On departure, the pilot should climb straight ahead until reaching an altitude of at least TPA minus 300 feet so that pattern altitude will be reached prior to turning to downwind. This enables the pilot to have the nose lowered to the level flight attitude on downwind, which greatly improves the pilot's ability to see other aircraft at the same altitude on downwind.

c. If a go-around has been executed, the pilot should continue upwind until reaching the end of the runway, even if pattern altitude or TPA minus 300 feet has been reached prior to that point. This will prevent a premature turn to crosswind that might not be expected by other aircraft in the pattern.

d. On downwind, TPA should be maintained until at least abeam the approach end of the landing runway. The base leg should be turned at a point that is approximately 45 degrees between the tail of the aircraft and the runway; however, this point is varied depending on wind and the traffic ahead in the pattern.

Sixth, when taking off and departing the airport traffic pattern, pilots should follow the recommendation of AC 90-66A (FAA, 1993) and continue straight ahead or exit with a 45 degree turn toward the traffic pattern after passing through TPA. Although the CFRs, the AIM, and AC 90-66A do not specify when a turn back towards the airport may be made, common sense dictates that it would be less than prudent to turn back towards the airport prior to reaching an altitude above other aircraft in the pattern.

Seventh, it is important to remember that the AIM (FAA, 1999, Chapter 4, Section 3, Paragraph 4) states, "Traffic pattern altitudes should be maintained unless otherwise required by the applicable distance from cloud criteria (FAR 91.155)." This means that during marginal visual flight rules (VFR) conditions, the pilot must be familiar with the National Airspace System and the type of airspace located at the airport of intended use (FAA, 1999). In marginal VFR conditions this could require flying the pattern at an altitude below normal TPA. If this does not sound appealing, perhaps waiting for a day with better weather conditions would be a better choice.

Eighth, when instrument traffic is in operation, the instrument pilot and other aircraft in the pattern must be aware of each other. Since the A/FD does not show instrument approaches, familiarity with instrument approach vocabulary and careful monitoring of the CTAF can warn the VFR pilot of IFR activity. The VFR pilot should understand that in minimum VFR conditions, the instrument pilot might be trying to transition from an instrument scan to an outside visual scan upon breaking through the clouds. Instrument pilots should understand that during operations at non-towered airports their final approach segment may not be congruent with the VFR pattern. This means that an instrument pilot on an approach to a runway other than the one in use may wish to break off the approach at a higher altitude, circle to land, and sequence in with the VFR traffic rather than do an approach to minimums to a different runway. To emphasize the potential for disaster, a recent midair fatality collision in Florida involved an aircraft on a VOR approach to runway 23 while other traffic was using runway 5 (AVweb.NewsWire, 1999).

If on a straight in approach to the active runway, instrument pilots should understand that they are operating contrary to the AIM and AC 90-66A and that failure to give way to other traffic established in the pattern could potentially result in civil action in the event of a collision (517 F. Supp. 825, 1981; 462 F. Supp. 674, 1979; 506 F. Supp. 728, 1979, 924 F. Supp. 1518, 1995). As shown in the cases involving instrument pilots making turns contrary to the active pattern (Yodice, 1995), pilots may be cited for failure to follow 14 CFR 91.126 (FAA, 1991), even if such turns are of a relatively small angle to final.

CONCLUSION

There are no substitutes for thorough preflight planning, good radio procedures, vigilance, and adherence to regulations. Why, then, would a pilot fail to follow the recommended procedures? Perhaps the pilot is trying to save time and money. Whatever the reason, failure to follow the AIM and advisory circulars as well as the regulations can cause confusion and lead to potential conflicts. In addition, the cases cited show that civil courts have established precedent regarding the need for adherence to the AIM and ACs. Until such time as the FAA publishes its new AC regarding traffic pattern entries at non-towered airports, pilots should comply with the AIM and existing ACs. The long way around to enter on the 45 may, in the long run, save the pilot considerable time and money from litigation.

REFERENCES

Associate Aviation Underwriters and Fidelity and Casualty Company of New York v. United States of America, 462 F. Supp.674 (N.D. Texas 1979)

14 C.F.R. § 91.103, 91.113, 91.155. (2000, January 1). Washington, DC: U.S. Government Printing Office.

14 C.F.R. § 91.126. (1991, December 17). Washington, DC: U.S. Government Printing Office.

AOPA Air Safety Foundation. (1996). How to avoid a midair collision: a safety project of the AOPA Air Safety Foundation [pamphlet CO11-10/96]. Frederick, MD: Author.

AOPA Air Safety Foundation. (1998). 1998 Nall Report: Accident trends and factors. Frederick, MD: Author.

Duncan, P. -A. (n.d.). Staying the course. FAA aviation news [reprint of April, 1997 issue], 5-7.

Federal Aviation Administration. (1990, May 21). Traffic advisory practices at airports without operating towers (FAA Publication No. AC 90-42 F). Washington, DC: U.S. Government Printing Office.

Federal Aviation Administration. (1993, August 26). Recommended standard traffic patterns and practices for aeronautical operations at airports without operating control towers (FAA Publication No. AC 90-66A). Washington, DC: U.S. Government Printing Office.

Federal Aviation Administration. (1999, July 15). Aeronautical Information Manual. (4-3). Washington, DC: U.S. Superintendent of Documents;

In Re Greenwood Air Crash, No. IP93-9446-C-T/F, 924 F. Supp. 1518 (S.D. Indiana, 1995).

In Re N-500L Cases, Civ. No. 78-2126, 517 F. Supp. 825 (D. Puerto Rico, 1981), aff'd, 691 F.2d 15.

Jeppesen. (1999, August 13). Jeppesen Airway Manual Services, Northwest United States Airport Directory. (Washington, 10). Englewood, CO: Author.

Landsberg, B. (1997, April). Safety pilot: the great debate. [15 paragraphs]. AOPA Pilot. [On-line serial]. Available Internet: Hostname: aopa.org. Directory: asf/asfarticles/sp9704.html.

Mallen v. United States of America, 506 F. Supp. 728 (N.D. Georgia 1979), aff'd, 832 F.2d 1062.

National Transportation Safety Board. (2000). Available Internet: Hostname: ntsb.gov. Directory: aviation/SEA/93A168B.

National Transportation Safety Board. (2000). Available Internet: Hostname: ntsb.gov. Directory: aviation/CHI/00A066A.

Transport Canada. (1999, October 7). Aeronautical Information Publication. Canada (RAC 4.5). Ottawa, ON: Canadian Government Publishing.

Transport Canada. (1996, October 10). Canadian Air Regulations. (Subpart 2 – Operating and Flight Rules). Available Internet: Hostname: tc.gc.ca. Directory: aviation/regserv/carac/CARS/cars/602e.

Transportation Safety Board of Canada. (1997). Available Internet: Hostname: bst-tsb.gc.ca. Directory: eng/stats/air.

Yodice, J.S. (1995). Pilot Counsel: straight-in approaches. [15 paragraphs]. AOPA Pilot. [On-line serial]. Available Internet: Hostname: aopa.org. Directory: members/files/pilot/1995.

Table 1

Survey of 78 Flight Instructors

Method of Entering Traffic Pattern from Opposite Side of Pattern	# of Respondents
Overfly from upwind side at TPA + 500 feet	24
Overfly from upwind side at TPA + 1000 feet	13
Overfly from upwind side at TPA + other	6
Maneuver to enter on the 45 only	2
Upwind entry crossing near approach end	9
Upwind entry crossing near midfield	12
Other methods	12
Improperly filled out surveys	4

Note. Four respondents depicted both an overflight method and an upwind entry method

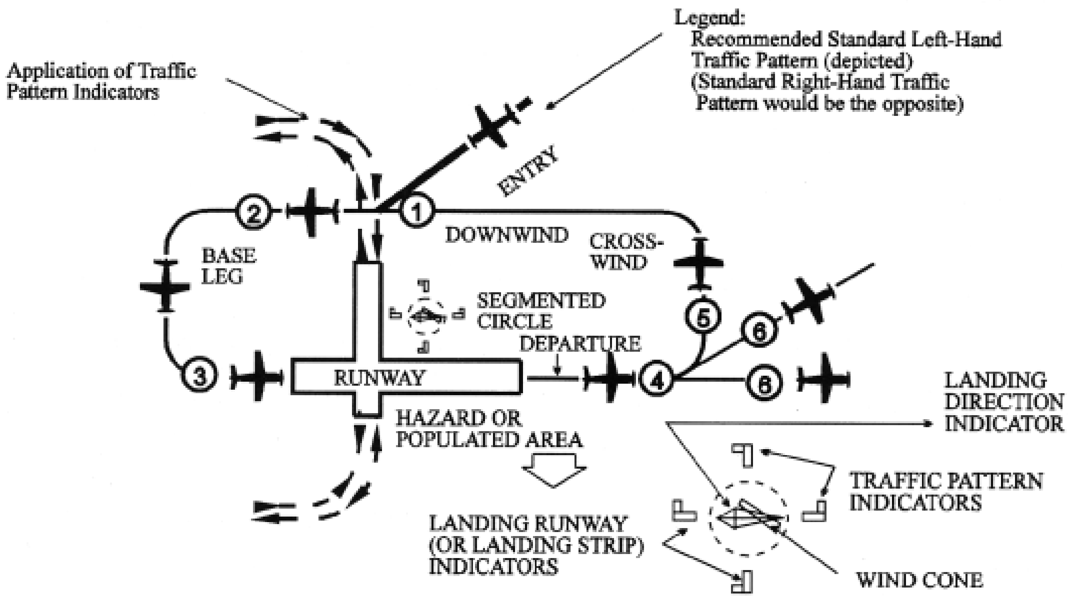


Figure 1. Traffic pattern operations single runway. From *aeronautical information manual* (section 4-3-4, figure 4-3-2), by Federal Aviation Administration, 1999, July 15, Washington, DC: Superintendent of Documents.

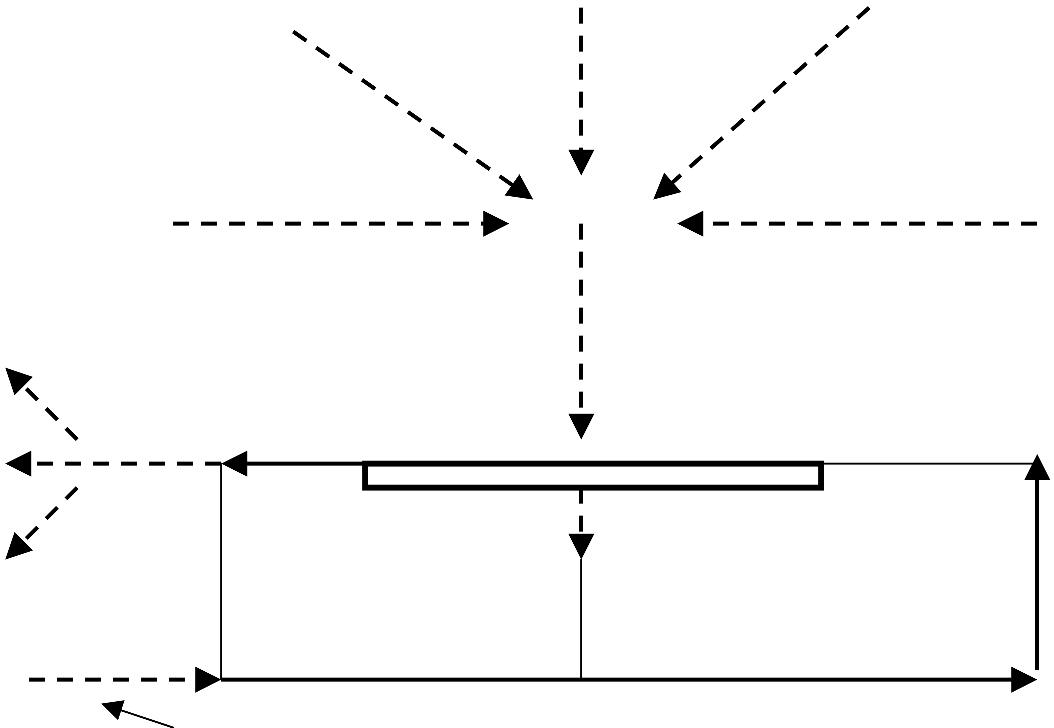
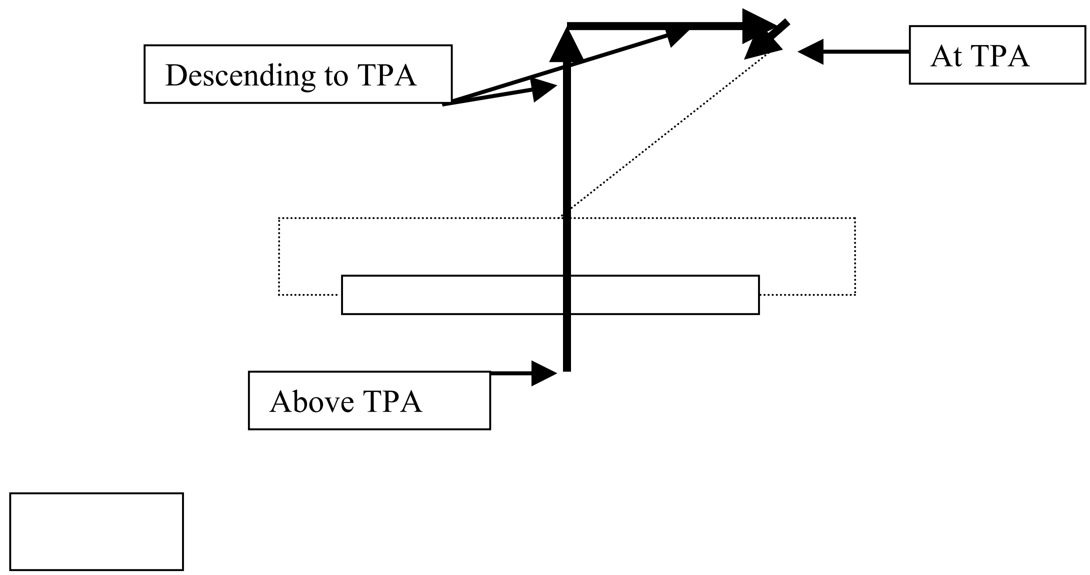


Figure 2. Standard left-hand circuit pattern. From a*eronautical information publication* (rules of the air, section 4.5.2, figure 4.6), by Transport Canada, 1999, October 7, Ottawa, ON, Canada: Civil Aviation Communications Centre.

Figure 3. Overflight method to descend to TPA and enter on the 45 to downwind. Sloan, 2000.



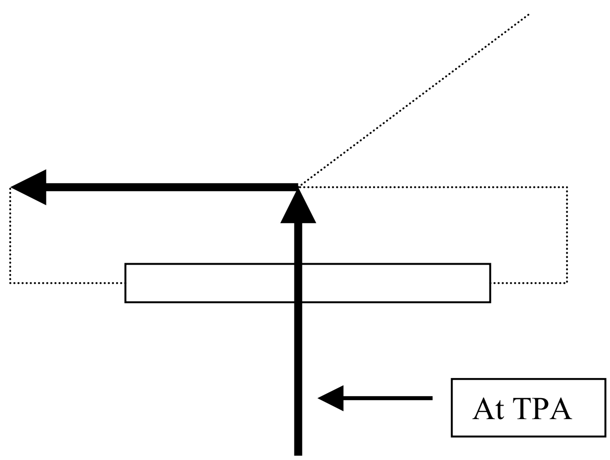


Figure 4. Upwind entry at TPA with turn to downwind leg. Sloan, 2000.

ATTRACTING WOMEN TO AVIATION CAREERS: WHAT RECENT STUDIES REVEAL

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ABSTRACT

The percentage of women attracted to careers in aviation remains surprisingly low despite efforts by the industry to increase its talent pool by encouraging women to participate. This paper presents a review of literature relevant to the question of why the numbers of women choosing careers in aviation have not increased in the past two decades, and why even those who demonstrate an initial interest in the field eventually look for career satisfaction in other fields.

INTRODUCTION

Women continue to enter the workforce in increasingly larger numbers (Naisbitt & Aburdene, 1990). Yet the talent pool of women available to the aviation industry is not increasing -- particularly in the technical side of the industry. Women still hold less than 6% of all FAA Airline Transport Pilot Certificates (U.S. Civil Airmen Statistics, 1998). The small number of women entering careers in aviation is evidenced in collegiate aviation where enrollment and retention of women remains low. Recent studies indicate that women are underrepresented in both aerospace engineering and aviation in general (Bowen & Mathis, 1991).

Researchers have begun to ask why. Why do women remain under-represented in the aviation field despite governmental and industry policies which encourage women to join the aviation workforce? Studies that focus on women in science and engineering, and studies conducted specifically within the aviation environment, reflecting the experiences and perceptions of women, shed some light on why women are seriously underrepresented in aviation, and the factors that influence women in choosing and remaining in the field of aviation. The purpose of this paper is to report what recent studies reveal about attracting women to pursue careers in the field of aviation.

DIFFERENCES IN LEARNING AND LEADERSHIP STYLES

Differences in learning, leadership, and communication styles between men and women have been identified in several studies. Turney (1994) found that women learn in a cooperative, collaborative manner, often through conversation and sharing of ideas. Men prefer competition and debate, and frequently learn in a more autonomous style. Desjardens (1993) contrasted the leadership styles of women and men. She indicated that men wish to make important contributions, seek challenges, and exhibit a pattern of casual interaction with people in the workplace. Women, however, tend to be less concerned with their rank, are careful about risk-taking, and are attuned to the personal feelings and reactions of others.

DIFFERENCES IN COMMUNICATION

Research also indicates that communication styles of men and women differ considerably. Male language is direct and female language tends to be indirect and more subtle. Weiss (1993) reported that women used modifiers and query tags, often avoiding definitive statements. Sitler (1998) suggested that these characteristics might be related to confidence issues. She stated that women's language tends to contain metaphor, imagery and various superlatives, such as "Nothing is working," and men mistakenly take these expressions literally. Machado (1994) agreed with Tannen (1990) in stating that women were more inclined to "negotiate" in their communication styles. He said that men speak to exchange information and establish status, while women talk to exchange information and establish consensus.

Style "miscommunications" have a negative effect on women who consider aviation careers. Clear, concise, unambiguous, and rapid communication is a necessity in the cockpit. However, the assumption that women should automatically adapt the male style without training, or "wash out" of the program does not address the communication style issue.

SOCIAL AND EMOTIONAL BARRIERS

That aviation remains traditionally a male's career is evident in Eiff and Stitt's (1993) reports of social and emotional barriers facing women in aircraft maintenance environments. These include biased language, jokes, pictures, and non-acceptance by management. Women have not been prepared to confront these issues clearly and directly. In a male-oriented industrial setting, women are often not perceived as professional colleagues. Luedtke (1993) states that women in aviation careers "must cope with their own and others' resistance to their assumption of attitudes and behaviors necessary for effective leadership" (p. 38).

ENROLLMENT IN TECHNICAL FIELDS

Seymour and Hewitt (1997) report that enrollment and retention of students in technical fields has been a continuing area of concern among educators. They identified three dominant issues, namely (1) science and mathematics education was failing to foster science literacy in the population, (2) too few undergraduates and graduates were recruited and retained to meet the nation's future needs, and (3) the sciences recruited too exclusively among white males- thereby depriving the nation of the talents of women of all races and ethnicity, and of men of color (p. 1).

Seymour and Hewitt (1997) undertook a three-year study, aiming “to discover, and to establish the relative importance of, the factors with greatest bearing upon the decisions of undergraduates at four-year colleges and universities to switch from science, mathematics and engineering majors into disciplines which are not science based" (p.13). The issue of retention is of concern for both male and female students. They found that there are at least 26 factors which appear to influence retention and "what distinguished survivors from those who left was the development of particular attitudes or coping strategies" (p. 30). These coping strategies have yet to be defined.

WOMEN IN TECHNICAL FIELDS

Persistence rates for men in technical fields varied between 61 percent at highly selective institutions and 39 percent for national samples. Comparative persistence rates for women, however, showed a high of only 46 and a low of 30 percent. While the absolute number of men leaving these programs is higher, the proportionate loss of women is greater and their under-representation actually increases as they progress in their undergraduate education (Seymour & Hewitt, 1997, p. 5-7).

Seymour and Hewitt asked: "What would cause a large number of well-prepared, well-qualified young women, particularly those at highly selective institutions, to perform more poorly than their male counterparts in freshman and sophomore science and mathematics classes?" (p. 235). They identified the unique experiences of women in these programs, including coping with a misogynist tone set by faculty and negative attitudes and behavior of male peers (p. 248).

IMPACT OF THE “WEED OUT” SYSTEM ON WOMEN

Traditional male education is based on the idea that young men should be challenged to test their mettle before being allowed to join adult males. This is the basis of the “weed-out” system. Women don't relate to this and see the system as very "male" and not applicable to them. They feel unwelcome and they perceive that men prefer to exclude women from these “trial” rituals (Seymour & Hewitt, 1997, p. 259-261).

NEGATIVE EXPERIENCES WITH FACULTY

Among173 women interviewed by Seymour and Hewitt, only eight reported a direct experience with faculty that was unacceptable. More common were "war stories" which were seen to convey the message that women were not welcome because their experiences were different. Some faculty also tended to make material seem more difficult than it is in order to build the mystique of a discipline (p. 260). Professors refer to students as "you guys" making some wonder if professors even see women since they socialize more with male students (Seymour & Hewitt, 1997).

Women reported that they are sometimes assumed to be incompetent in "hands on" work, and complained of being ordered around, with faculty allowing their male peers to take charge, and give women help they did not ask for.

Another significant factor report-ed by Seymour and Hewitt was the need for setting the right tone from the top. Improving retention of students is not possible without the support from the institution’s leadership.

WOMEN'S CONFIDENCE

Astin and Sax (1996) also explored the experiences of under-graduate women in the sciences. They addressed women's lack of self- confidence in their mathematical and scientific abilities, the lack of role models, parental and societal influence, and traditional teaching practices, as influencing their persistence rates in these programs. One interesting finding contradicted conventional wisdom. Astin and Sax (1994) found that interacting with faculty actually had a negative effect on women's mathematics confidence, the opposite effect of that observed in men.

Graydon (1987) identified a lack of confidence in women in achievement situations that are perceived as sex-role inappropriate. Graydon stated: "Given that many sports are perceived as being masculine in nature, and are by definition competitive situations, it is not surprising that many women feel a lack of self-confidence and therefore avoid the situation altogether by opting out. Some women of course do not opt out of competitive sports, they manage to overcome or avoid the self-confidence trap, possibly due in some measure to positive socialization experiences, the complexity of which we are only just beginning to unravel" (p.57-58).

RETENTION OF WOMEN IN COLLEGIATE AVIATION

While the examination of women in science, mathematics, and engineering offers insights into the problem of the retention of women in aviation programs, research among aviation students indicates that this group faces unique problems.

Early gender-related research offers some basic insights. Lever's (1974) early studies suggest that women are initially not as prepared for aviation careers as men are. She determined that the games children play contribute to the preservation of typical sex role divisions in society by preparing boys with social skills required for careers and girls with skills required for raising families (p. 29-30).

Lather (1986) claimed that "woman's voice is one of empowerment" (p.65). Her study suggests that training approaches should be based on the empowerment of those being trained. She suggests that encouragement and empowerment should be built into the training design

Cockpit interactions and requirements present special challenges to those desirous of encouraging the participation of women in aviation. A recent study by Sitler (1998) identified a series of things instructor pilots should know about women so that they can support retention of women pilots and so that women don't drop out of flight training. These include:

1. Women are slower to gain confidence in the airplane.

2. Women require more flight hours before initial solo flights.

3. Women are more fearful of stalls, spins, and unusual attitudes.

4. Women are slower to grasp aerodynamics.

5. Women are quicker to grasp instrument flight.

6. Once women learn a procedure, they rarely vary it.

7. Women handle aircraft controls more smoothly.

8. Women have far fewer accidents in airplanes than men do (45-46).

According to Stuart (1999), "Women's need for more explanations [during flight training] may be an issue of confidence. She suggests that a woman is so afraid of doing something wrong that she wants to know all that she can about a flight maneuver before attempting it. Knowing all about it builds her confidence (p. 49). Regarding women's needs for a broader knowledge base, Tobin (1994) reported that women require a few more training hours to complete pilot training, but not significantly more according to studies she reviewed (p. 42). Tobin reported that females scored higher on academic qualification tests for

U.S. Navy pilot selection, while men scored higher on mechanical and spatial apperception tests. She found that although the average flying score was identical, the number of aircraft hours flown by women students was slightly higher (not statistically significant) than those for the males. This finding correlates with Sitler's finding that women are slower to solo. Interestingly, Tobin's study found that the attrition rate for women in the Navy pilot training was less than 5% and almost 12% for men.

Stuart's in-depth study of 27 women pilots found that "aircraft were designed by men for men. If the airplane is adjustable to fit 90% of the men, it is not likely to fit 50% of the women. Of the 27 respondents [in her study], 18 reported problems with the fit of the aircraft they fly. Most problems for women are found with Cessna 152's and 172's, the type aircraft used typically in flight training" (p. 49).

CHALLENGES AHEAD

Further studies are needed to focus specifically on the aviation environment and the experiences and perceptions of women students involved in aviation. Although gender balance is unlikely in the foreseeable future, the more women participate as aviation students, the more they teach faculty and peers how to behave toward women. But it is difficult in a predominantly male culture for women to change the atmosphere. If we are going to tap all the potential talent available to the aviation industry rather than just half the talent, it would appear useful to establish a comfortable climate for women. Further investigation is needed on how women learn, lead, and experience satisfaction in career development.

REFERENCES

Astin, H. & Sax, L. (1996). Developing scientific talent in undergraduate women. In C. Davis, A.B. Ginorio, C.S. Hollenshead, B.B. Lazurus, P.M. Rayman (Eds.), The equity equation (pp. 96-121). San Francisco: Jossey-Bass Publications

Bowen, B. & Mathis, J.(1991, September). Women in aerospace engineering faculty of higher education. Frontiers in Education. American Society of Engineering Education. Purdue University.

Changing America: The new face of science and engineering final report. (1989, December). The Task Force on women, Minorities, and the Handicapped in Science and Technology.

Desjarens, C. (1993). Leadership competencies. National Institute for Leadership Development, Phoenix, AZ.

Eiff, G. & Stitt, B. (1993). Some serious questions about women in aviation careers. St. Louis, MO: Fourth Annual Women in Aviation Conference.

Graydon, J.K. (1987). Psychological research and the sportswoman. In E. Adrian (Ed.), Sportswomen. New York: Karger.

Lather, P. (1986). Feminist perspectives on empowering research method. Proceedings of the 8th Annual Curriculum Theorizing Conference. 22-24 October. Reprinted Minnesota: Mankato State University.

Lever, J. (1994). Games children play: Sex differences and the development of role skills. Doctoral dissertation, Yale University, New Haven, CT.

Luedtke, J. (1993). Maximizing participation of women in collegiate aviation education. Doctoral dissertation. Wichita State University. (ERIC document reproduction service no. ED 359885)

Machado, R. (1994, January). A Happy Cockpit: Reducing Cockpit Stress Between the Sexes. Flight Training. 5. 50-52.

Naisbitt, J. & Aburdene, P. (1990). Megatrends 2000. NY: William Morrow Co.

Potts, D. (1990, September 3). Bias lurks in all phases of qualitative research. Marketing News, 24, 12-13.

Seymour, E. & Hewitt, N.M. (1997). Talking about leaving. Boulder, CO: Westview Press.

Sitler, R. L. (1998). The cockpit classroom: Women's perceptions of learning to fly and implications for flight curriculum and instruction. Doctoral Dissertation, Kent State University, Kent, Ohio.

Stuart, R. (1999). Gender differences in the cockpit. New Zealand Wings Magazine.

Tannen, D. (1990). You just don't understand: women and men in conversation. NY: Ballentine Books.

Tobin, L.L. (1994). Women military pilots: have perceptions and attitudes toward them changed in the last 15 years? Proceedings of the 5th Annual International Women in Aviation Conference 45-47. Lake Buena Vista, FL.

Turney, M. A. (1994, October). Women's learning and leadership: Impact on CRM. Paper presented at the Fall Conference of the University Aviation Association. New Orleans, LA. (ERIC Document No. ED 377 7347).

United States Department of Transportation Federal Advisory Committee. (1993, August). Pilots and aviation maintenance technicians for the twenty-first century: Assessment of availability and quality. Washington DC: U.S. Government Printing Office.

Weiss, M. J. (1993, Fall) Integrating Communication and Gender In The Medical Setting. Proteus, A Journal of Ideas. 10. 55-59.