Chapter 5: Conclusion

The role of the pilot is also changing: from one of simply a control manipulator to that of a system manager and information processor. We constantly look to the training process to keep skills honed as new technologies blend with and take the place of old ones. It is through training that we accommodate change.

Schwartz (1989)

Introduction

General Aviation (GA) includes all aviation activities that are not directly related to either the military or the airlines. Both the military and commercial airlines have stressed formal decision-making training in their initial and recurrent pilot training programs. Such has not, however, been the case in GA. Although the Federal Aviation Administration (FAA) has mandated that aeronautical decision-making (ADM) be included in GA training programs (FAA, 2000), there are few current guidelines regarding the scope of such training. In addition, there is little specific information related to the conditions under which such training could best be delivered.

Judgement errors among GA pilots are well documented (e.g., Jensen and Chappell, 1983; National Transportation Safety Board, 2000). These errors have contributed to numerous accidents, injuries and fatalities. This study reviewed the decision-making processes of expert and novice aviators. It identified differences and suggested activities that could be incorporated into a Private Pilot Ground School (PPGS) course to assist novices in becoming better decision-makers.

The type of decision-making most pertinent to aviation-related activities has been referred to by numerous writers (e.g., Kaempf and Klein, 1994; Stokes, Kemper and Kite, 1997) as *naturalistic decision-making* (NDM). This particular type of decision-making, according to Orasanu and Connolly (1993), is characterized by decisions made under stress and involve ill-structured problems in which the decision-maker must react quickly in a dynamic and uncertain environment.

There has been little written about decision-making and GA student pilots. Most of the more recent ADM studies (e.g., Driskill, Weissmuller, Quebe, Hand and Hunter, 1998; Kochan, Jensen & Chubb, 1997; Stokes, Kemper and Kite, 1997) involved subjects with considerably more experience than that of the typical student pilot (under 100 hours of flying time). This study identified the ADM weaknesses of student pilot subjects and the ADM proficiencies of expert pilot subjects.

Although most of the ADM literature originates from the discipline of psychology, this study was viewed through the lens of an educator and certified flight instructor. Nevertheless, this study examined some of the cognitive processes as they related to ADM. The primary emphasis of the study was to understand better the thought processes of student and expert subjects and to use the data to help student pilots develop a practical foundation in ADM.

The research question explored the differences in pre-flight and in-flight decision-making processes between novice and expert subjects. The study determined that differences did exist. Specific themes and characteristics of expert and novice subjects are summarized in Figure 22.

Figure 22: Expert and Novice ADM Themes and Characteristics

Characteristics (*) are listed under each of the themes

Experts	Novices
Established the Context *identified general framework within which each scenario occurred	Hazardous Attitudes: *Invulnerable *Impulsive * Macho *Tendency to permit "irrelevant factors" to affect ADM processes
Defined the Situation *acquired specific details regarding each of the scenarios	Interpretation of Risks: *formed priorities without much analysis *realization of inexperience but inconsistent application in practice *recognition of few alternatives *hesitant uncertain — often changed their minds
Prioritized Plans and Alternate Plans *consistently prioritized actions and attempted to formulate back-up plans	Emphasis on Rules and Procedures: *FAA *Pilot's Operating Handbook *flight and ground instructors *ATC *procedures acquired through self-directed learning
Recognized and Use of Familiar Experiences *intuitive decisions based on accumulated knowledge and experiences	Recognition of Familiar Conditions: *recognized familiar situations that subjects believed to be analogous to ADM scenarios *made use of relevant ADM experiences to help resolve scenarios.
Assessed Risks *assessed all risks pertinent to the scenarios	Information Acquired to Assess Risks: *purposely limited volume of information acquired to resolve scenarios *quality of information was often superficial or irrelevant

Methods

Four student pilot (SP) subjects were selected from students enrolled in a PPGS course that was taught by the researcher at Montgomery County Airpark, Gaithersburg, MD. Two preliminary studies were conducted during the Spring and Fall of 2000. During the preliminary studies the researcher determined that SPs needed to have acquired a minimum of flying time and experiences to be useful participants in the study. The minimum requirements for SPs, therefore, consisted of: a. accumulation of twenty hours of flight time; b. soloed (subjects had flown an aircraft by themselves); c. currently involved in cross-country flight training; d. had acquired knowledge applicable to ADM scenarios (in PPGS and during flight training)

Four expert pilot (EP) subjects were also selected for inclusion in the study. Criteria for their selection was based on several requirements that included: a. acquisition of a minimum of five thousand hours of flight time; b. currently working as a professional pilot; c. had worked as a professional pilot in a minimum of two mediums (e.g., flight instructor, charter pilot, airline pilot, etc.). The researcher was fortunate to locate four EPs whose experience and flying time far exceeded these minimums.

The data for the study was acquired through interviews of the subjects. The interviews were based on three ADM written scenarios and one video scenario. The written scenarios were selected from fifty-one ADM scenarios contained in an FAA study (Driskill, Weissmuller, Quebe, Hand and Hunter, 1998). The written scenarios were revised during the pilot studies to include more variables that would, it was assumed, be useful in eliciting additional information from the subjects. Two of the written scenarios involved in-flight decision-making. One of the written scenarios involved pre-flight decision-making. The video scenario (FAA, 1991b) included both pre-flight and in-flight decision-making segments.

Two assumptions were made by the researcher. First, it was assumed that the "expert" pilots were representative of experienced professionals. Second, it was assumed that the ADM written and video scenarios that were used to obtain data served as practical surrogates for pre-flight and in-flight experiences of the subjects.

Each of the subjects was presented with the three ADM written scenarios. The first part of each interview consisted of the subject's general reaction to the scenario. A variety of topic areas were compiled by the researcher into an Interview Guide that was used to help focus the conversation on pertinent issues. The second part of the interview consisted of presenting the subjects with four written alternatives. The subjects were asked to rank order the alternatives and to explain their reasons for ranking the alternatives as they did. An example of one of the scenarios used in the study is presented in Figure 23.

Figure 23: Scenario 3: Presented to Student and Expert Subjects

You are at a small airport with minimal facilities and at the end of your walk around pre-flight, the flaps refuse to retract from 30 degrees. It was a planned two hour flight back to your home airport. The weather, which was good, seems to be deteriorating with higher winds and lower ceilings than were forecast. A friend, who is a student pilot at your home airport, has scheduled your aircraft for his Private Pilot flight test with the FAA in four hours. An airport attendant (who is not a mechanic) says he has seen this problem before and states that the “limit switch is stuck.” There is no Airframe and Powerplant (A&P) mechanic at this airport, but there is an A&P mechanic at an airport 35 miles away. The attendant says he knows where a switch for this exact model aircraft can be quickly picked-up and he could install it. He says he also could reach up through the inspection port and free the switch enough to raise the flaps but cannot guarantee they will work when airborne. You call the flight school and get their answering machine. You are on your own. You decide to:

Rank Order	**Alternative**
1 2 3 4	a. leave the flaps down and fly to the nearby (35 miles) airport and have a certified (A&P) mechanic fix the problem
1 2 3 4	b. have the attendant reset the switch, get the flaps up and fly home.
1 2 3 4	c. have the attendant change the switch, check it out, then fly home and have the flight school’s mechanic inspect the work
1 2 3 4	d. wait until the flight school can fly an A&P mechanic in and change the switch

The response format for the video scenario was also changed from what had been done during the initial pilot study. The first portion of the video scenario involved pre-flight actions. This was followed by an in-flight section. During the pilot studies, it was determined that stopping the video after each segment (pre-flight and in-flight) and interviewing the subjects about each portion of the video independently, resulted in an increase in the quantity and quality of data.

The data acquired during the interviews was transcribed and coded by the researcher. Open coding, a process that involves fracturing the data, was followed by axial and selective coding as described by several writers (e.g., Strauss and Corbin, 1990, 1998; Yin, 1994). The identification of characteristics and general themes began to emerge during that process. The characteristics and themes were subjected to peer review during several *coding seminar* classes offered at Virginia Tech.

The research design sought to establish the pre-flight and in-flight decision-making characteristics and themes of student pilot and expert pilot subjects. The design also sought to make direct comparisons. As stated in Chapter Four, these comparisons included: a. SP pre-flight with SP in-flight; b. EP pre-flight with EP in-flight; c. SP pre-flight with EP pre-flight; d. SP in-flight with EP in-flight; e. SP in-flight with EP pre-flight and f. SP pre-flight with EP in-flight.

Relating Findings to the Literature

Numerous researchers (e.g., Cannon-Bowers, Salas & Pruitt, 1996; Orasanu and Connolly, 1993; Simon, 1981, etc.), have written about NDM. This type of decision-making is characterized by “real world” conditions in which dynamic environments, time constraints, stress and uncertainty affect one’s thought processes. The subjects in this study were presented with scenarios that included such conditions. The extent to which the subjects were able to cope with the issues inherent in the scenarios was dependent on their respective experience levels, training and knowledge of the subjects. Overall, and not surprisingly, the EP subjects were better able to cope with issues included in the scenarios than were the SP subjects. One of the possible explanations for the superior judgement abilities of EPs in naturalistic settings was what some writers (e.g., Craig, 1998; Klein, 1997b; Stokes, Kemper & Kite, 1997) have referred to as “recognition-primed decision-making” (RPD).

RPD was described by Klein (1997b) as a process in which decision makers used a combination of knowledge, experiences and wisdom to make intuitive judgements. He emphasized that accumulated experiences were important and significant factors in helping make quick and effective decisions. Klein explained that these experiences helped decision makers recognize important “cues” that were used as guides for developing responses to specific problems. It was apparent that the EP subjects made use of their experiences in addressing the issues inherent in the scenarios presented to them during their interviews.

Another useful explanation for the superior judgement abilities of EPs in naturalistic environments involves the concept of “cognitive maps.” Tolman (1948) in his experiments with rats, stated that:

> The stimuli, which are allowed in, are not connected by just simple one-to-one [stimulus-response like] switches to the outgoing responses. Rather, the incoming impulses are usually worked over and elaborated in the central control room into a tentative, cognitive-like map of the environment p. 192.

Cognitive maps have been used by numerous researchers (e.g., Csanyi, 1993; Laszlo, Artigiani, Combs and Csanyi, 1996) to examine behaviors and to explain the resolution of problems in a variety of settings. Laszlo, et al. defined cognitive maps as:

> ...mental representations of the worlds in which we live. They are built of our individual experiences, recorded as memories and tested against the unceasing demands of reality. These maps, however, do not simply represent the worlds of our experiences in a passive and unchanging way. They are, in fact, dynamic models of the environments in which we carry out our daily lives, and as such determine much of what we expect, and even what we see. Thus, they represent and at the same time participate in the creation of our experience of reality itself.
>
> p. 3.

Student subjects in this study appeared to make use of mental maps in their thought processes. The cognitive maps of SP subjects, however, were primitive in comparison to those of the experts. Although the SP subjects attempted to rely on pertinent experiences, their maps were rudimentary and consisted of numerous gaps. Many of these cognitive gaps could have contributed to the presence of several observed characteristics that included: uncertainty, inability to recognize alternatives, an emphasis on rules and procedures and the presence of hazardous attitudes.

In contrast, the cognitive maps of EPs in this study appeared to be significantly more developed. The experts were able to make connections quickly between problems presented in the scenarios and their experiences. These experiences provided them with a more detailed map and enabled them to find alternate routes to a desired end. The result was that they were able to formulate viable alternatives quickly and effectively.

When experts were unable, because of time constraints, to rely on their cognitive maps, they were quick to rely on another process that some writers (e.g., Jensen, 1995) have referred to as “satisficing.” The concept of “satisficing” involves making decisions within the time constraints of a naturalistic environment. It involves choosing a course of action that, while not the absolute best alternative, would not necessarily result in negative consequences and would represent a viable option. During interviews with expert subjects, it was evident that several related incidents involved a “satisficing” based response (see EP2's account on pages 81-82).

Due to their lack of experiences, student subjects were unable to depend heavily on either cognitive maps or the concept of “satisficing” to resolve problems. Student subjects, therefore, tended to rely on established procedures. In addition, they frequently exhibited *hazardous attitudes* that had the effect of making a bad situation worse.

Diehl, Hwoschinsky, Lawton & Livak (1987) identified five *hazardous attitudes.* They included: a. anti-authority (not willing to comply with rules and regulations); b. impulsiveness (acting quickly without thinking); c. invulnerability (refusing to believe that negative events could occur); d. macho (overestimating one's competencies) and e. resignation (giving up — taking no action to improve a situation). During student subject interviews, three of these attitudes (impulsiveness, invulnerability and macho) were evident on numerous occasions. In addition, SPs demonstrated another dimension that I included as a *hazardous attitude.* That dimension was their tendency to allow irrelevant factors (e.g., accepting advice from unqualified individuals) to influence their decision-making processes. None of the EP subjects revealed any of the hazardous attitudes during their respective interviews.

Two of the five hazardous attitudes were not observed during interviews with student subjects. None of the SPs displayed *resignation* during their interviews. In addition, the *anti-authority* hazardous attitude was not only absent but, to the contrary, student subjects were concerned about assuring they followed guidelines and procedures and did not break any rules. This appears to confirm the findings of Dreyfus & Dreyfus (1986) who wrote about one's journey from novice to expert. Dreyfus & Dreyfus stated that this journey consisted of specific stages.

The authors termed the first part of this journey as the *novice* stage. The writers stated that this initial level was characterized by learners receiving basic instruction in a particular subject. They also indicated that learners in this stage typically relied on facts and guidelines presented by their instructors without much regard to the context within which the situation (or scenario) occurred. The SP subjects were representative of the *novice* stage of the Dreyfus model. They consistently relied on established guidelines and procedures. In addition, the student subjects often relied on specific lessons that were either taught by their instructors or acquired through independent study.

Findings

As stated previously in Chapter Four, there were differences in the decision-making characteristics of expert and student subjects. These differences are depicted in Figure 21 on page 105. A more concise representation of these differences is depicted in Figure 24.

Figure 24: Differences in Expert and Novice Pre-flight and In-flight Decision-making

Comparison	Differences in Decision-making Characteristics
SP Pre-flight and In-flight	-Limited number of items to consider while In-flight, but not in Pre-flight -Made attempts to calm down and take time to assess risks while In-flight, but not in Pre-flight
EP Pre-flight and In-flight	-Sought information only from qualified individuals in Pre-flight ADM -Considered effects of stress and fatigue during Pre-flight ADM
SP and EP Pre-flight	-SPs: inadequate information - adhered to rules and procedures - exhibited Hazardous Attitudes -EPs: Sought information only from qualified individuals - planned diligently (detailed analysis of all pertinent issues)
SP and EP In-flight	SPs: recalled experiences they believed to be helpful - recognized few alternatives - purposely limited number of items to consider EPs: used prior experiences to help resolve problems - prioritized plans and back-up plans
SP In-flight and EP Pre-flight	SPs: hesitant and uncertain - stressed importance of calming down and take time to assess risks EPs: considered effects of stress and fatigue - ignored options that they believed involved excessive risks
SP Pre-flight and EP In-flight	SPs: adhered to rules and procedures - realized their inexperience but nevertheless chose demanding and sometimes dangerous alternatives (hazardous attitudes) EPs: established the general context within which the scenario existed - defined the specific conditions of the scenario - reluctant to depend on others (self-reliant)

The EP subjects in this study exhibited similar ADM thought processes as did experts in previous studies (e.g., Dreyfus and Dreyfus, 1986; Stokes, Kemper and Kite, 1997). They were quick to recognize cues from their experiences to help resolve scenarios. It was apparent that their respective *cognitive maps* served as useful and effective guides. For example, prior to making their "go-no/go" decision, EP subjects exhibited detailed pre-flight planning that included everything from reviewing the legal aspects of a planned flight to the effects of fatigue. The SP subjects ignored these important pre-flight considerations.

The expert subjects also attempted to place each of the scenarios in its larger context. They frequently asked questions to assure they completely understood the overall framework within which the scenarios occurred. In addition, the experts asked numerous questions about each of the scenarios in an attempt to acquire as many specific details as possible.

Student subjects, responding to in-flight decision-making scenarios, frequently attempted to limit the amount of information available for processing. Two SPs remarked that they did not want to be "overloaded" with information. This sometimes resulted in SPs stressing information that was not particularly pertinent, or even irrelevant, while ignoring factors that were relevant. Several of the student subjects also talked about trying to "calm down" while attempting to resolve in-flight decision-making scenarios and discussed methods (e.g., departing the traffic pattern at an airport) to allow themselves time to determine an appropriate course of action.

Student subjects stressed rules and procedures in their responses to issues related to the scenarios. These rules and procedures emanated from a variety of sources including: a. pilot's operating handbook; b. Air Traffic Control; c. FAA rules and regulations; d. guidelines established by flight and ground instructors and e. procedures and guidelines obtained during self-directed learning. In addition, the student subjects often hesitated in attempting to chose an alternative and frequently changed their minds.

All of the SP subjects, in their responses to decision-making scenarios, demonstrated hazardous attitudes. Even though they seemed to recognize the fact that they were inexperienced, and attempted to abide by rules and guidelines, SP subjects often chose alternatives that involved difficult and sometimes even dangerous options. The student subjects also frequently elected to choose alternatives without acquiring all pertinent information. This could be a result of their incomplete cognitive maps.

Need for Further Research

This study established differences between the ADM characteristics of expert and novice subjects. The findings of the study, however, may not necessarily be generalized to a larger population of pilots. Additional research will be required to accomplish that goal. A variety of additional studies could prove beneficial.

A quantitative study, including relatively large numbers of student pilot subjects, could build on the findings of this study. For example, such a study could measure (via. pre-tests and post-tests) the presence of *hazardous attitudes* (or other attributes) among student pilots. Acceptable subjects would be divided into a control group and a treatment group that received

ADM training within, for example, the context of a Private Pilot Ground School (PPGS). In addition, it would be interesting to note how those involved in such a study progressed in their respective careers as pilots. Although challenging to conduct, such a longitudinal study could reveal important data related to the value of ADM training received early in one's flying career.

As noted previously, all of the SP subjects had manifested hazardous attitudes in their ADM thought processes. None of the EP subjects displayed such attitudes. Was this due exclusively to the differences in the relative experience levels of the subjects? Additional research will be needed to confirm that assumption and to identify specific training methods that could prove productive in reducing hazardous attitudes. In addition to the hazardous attitudes noted by numerous writers (e.g., Berlin, Gruber, Jensen, Holmes, Lau, Mills & O'Kane, 1982; Diehl, Hwoschinsky, Lawton & Livak, 1987), I included a tendency to rely on *irrelevant factors* (factors that have no relevant bearing on a particular problem) as a hazardous attitude. The extent to which these *irrelevant factors* affect decision-making of novice pilots, and what can be done to eliminate them, remains to be discovered.

The use of simulators, rather than written and video scenarios, could also be useful in obtaining data from subjects. Although ADM studies involving simulators had been done in the past, (e.g., Connolly, 1990; Jensen, 1988; Stokes, Kemper & Kite, 1997) none of the subjects involved student pilots (students who had not earned their private pilot licenses). Providing subjects with ADM scenarios in simulators as student pilots could prove to be useful both to the researcher (in acquiring data) and also to the subjects (whose ADM experiences could result in a more profound and lasting impression).

As stated previously, the student subjects in this study had all soloed and had begun their cross-country flight training. In addition, all of the student subjects had acquired a minimum of twenty hours of flying time and had received flight and ground instruction in subject matter pertinent to the written scenarios. One wonders, however, if the results would have been different had the student pilot subjects been more experienced. For example, would the findings have differed had the novice subjects attained more knowledge and expertise (what Dreyfus; 1986, referred to as the *advanced beginner* or *competence* stages)?

The concept of *cognitive maps*, as they relate to expert and novice ADM, is another area in need of additional research. The evolution of such maps and methods to assist novices in their development could produce useful data. In addition, it would be interesting to examine individuals who are pre-disposed to developing cognitive maps. Determining the characteristics of such individuals and the basis of their pre-dispositions could yield important insights into helping students acquire the ADM skills of experts.

Two of the student subjects discussed how they had read a variety of publications (e.g., books, magazine articles, etc.) that they assumed had helped them become better decision-makers. These readings were in addition to the required readings related to the PPGS course in which they were enrolled. One of these self-directed learners (SP3) appeared to be more proficient than the other subjects in coping with the scenarios presented in the study. A study involving the role of self-directed learning in the acquisition of ADM skills could prove enlightening. It would also be interesting to note whether there was a relationship between those who were prone to self-directed learning and those who were predisposed to forming and using cognitive maps. One could also study the relationship and possible correlations of those attributes to the acquisition of ADM competencies.

It would also be interesting to determine whether this research has wider applications. Research involving expert and novice decision-making in naturalistic environments could have many possible applications. For example, one might consider conducting research among fire-fighters or police officers. In addition, one might acquire useful information from expert and novice managers or administrators, in a variety of settings, who find themselves in environments characterized by time constraints, stress and problems that are difficult to define.

Recommendations

The data obtained in this study made it clear that there were notable differences in the pre-flight and in-flight ADM thought processes of expert and novice subjects. Furthermore, the study demonstrated that expert subjects, in naturalistic settings, relied on their cognitive maps to assist them in coping with issues in each of the scenarios. It seemed clear that the student subjects would benefit from training designed to assist them in developing more detailed and comprehensive cognitive maps. The specific components of such training could be based on the research of numerous writers.

For example, several researchers (O’Byrne, Clark and Malakuti, 1997; Stepich, 1991) suggested methods to assist novices in acquiring the skills of experts. Generally, the researchers emphasized that such programs should stress both basic principles and theories as well as opportunities to apply these principles and strategies to realistic and relevant scenarios. Other researchers (Dreyfus and Dreyfus, 1979), in their study related to pilots coping with emergency situations, emphasized that effective training must be based on specific contexts. The writers suggested that pilots should be exposed to a large number of relevant scenarios to enhance their abilities to recall appropriate courses of action. Wiggins (1997) stressed that teaching cognitive skills to novice aviators was vital to their development. He stated that such cognitive training could include such activities as protocol analysis (thinking aloud while performing a task) and the analysis of errors (reviewing accident reports). These suggestions could potentially serve as effective cognitive map builders and assist novices in both pre-flight and in-flight ADM.

A PPGS could serve, in part, as a vehicle through which the cognitive maps of students are enhanced. This could be accomplished by including ADM segments into PPGS classes (see Appendix B). Based on the findings of this study and the recommendations of the researchers previously cited, specific components of ADM training within the context of a PPGS should include: a. basic ADM principles and strategies; b. practical ADM scenarios that involve both pre-flight and in-flight situations and c. feedback from the instructor and fellow students.

Although the primary emphasis of a PPGS is to prepare students for the Private Pilot written examination, short ADM segments could be included in each class. A model PPGS syllabus that includes teaching basic ADM strategies to novices and assisting them in the development of their aeronautical cognitive maps is included on the following page in Figure 25. The model is similar to the syllabus I used during the pilot studies (see Appendix B) but has been altered to reflect an emphasis on cognitive map-building.

The focus of the ADM portion of each class would be to help refine the cognitive maps of students. Accordingly, an emphasis should be placed on learning basic ADM principles and then applying these principles to actual scenarios. The scenarios chosen for each class should relate to corresponding PPGS topics. A pool of scenarios could be accumulated from which instructors could select those most appropriate for specific classes. It is recommended that four PPGS classes contain pre-flight ADM scenarios and eight PPGS classes include in-flight ADM scenarios. The reason for stressing in-flight scenarios is based on the fact that most available scenarios involve in-flight problems. In addition, in-flight scenarios present more of an immediate threat than do most pre-flight scenarios. It is assumed that a variety of other topics (e.g., situational awareness, risk management, poor judgement chains, stress management, etc.) would be discussed as they relate to specific ADM scenarios. Due to time constraints and the emphasis placed on cognitive map-building (by reviewing as many ADM scenarios as possible), only three specific ADM models are included in my recommended PPGS/ADM syllabus. In addition, PPGS instructors should recommend that students maintain a "reflective journal." These journals, as noted by Anderson and Henley (1997), could promote important feedback opportunities. They could also help students to develop more detailed cognitive maps.

Figure 25: Model PPGS/ADM Syllabus

Class	PPGS Topic	ADM Activity
1	Airports, Aircraft and Traffic Patterns	Hazardous Attitudes
2	Aerodynamics	"PAVE" Model & Personal Minimums Checklist
3	Communications, ATC & Airspace	"S-D-R-V" Model
4	Aircraft Instruments	ADM Pre-fight Scenarios *
5	Aircraft Systems	ADM Pre-flight Scenarios *
6	Weight and Balance	ADM Pre-flight Scenarios *
7	Aircraft Performance	ADM Pre-flight Scenarios *
8	Basic Meteorology	ADM In-flight Scenarios *
9	Weather Reports and Forecasts	ADM In-flight Scenarios *
10	Basic Navigation	ADM In-flight Scenarios *
11	Radio Navigation	ADM In-flight Scenarios *
12	Flight Planning	ADM In-flight Scenarios *
13	FAA Rules and Regulations	ADM In-flight Scenarios *
14	Medical Factors	ADM In-flight Scenarios *
15	Practice Examination	ADM In-flight Scenarios *

* ADM Scenarios could include any or all of the following (as time permits):

1. written scenarios (see Appendix E)
2. National Transportation Safety Board accident reports
3. written scenarios from popular aviation-related magazines
4. personal experiences of students
5. video scenarios from FAA or other sources

As previously mentioned, *hazardous attitudes* are well documented in the literature and were apparent in all of the SP subjects involved in this study. Accordingly, a discussion of these attitudes that includes their causes and possible remedies should be included early in the PPGS and could serve as an excellent introduction to the ADM portion of the PPGS. If possible, instructors should also attempt to include scenarios that demonstrate these hazardous attitudes.

The "PAVE" model (FAA, 1998; Jensen, Guilkey and Hunter, 1998) focuses on the pre-flight "go-no/go" decision. It was presented to students in its videotaped version during the PPGS course. The model consists of four components that aviators should check prior to flight. The components include: a. **P**ilot (physical and mental condition prior to flight); b. **A**ircraft (fuel, oil, properly equipped, etc.); c. en**V**ironment (weather) and d. **E**xternal Factors (time demands, stress, etc.). The "PAVE" model also includes an easy-to-use "Personal Minimums Checklist" (see Appendix C) that pilots can view as a guide in deciding whether or not to initiate a flight.

The "S-D-R-V" model focuses primarily on in-flight decision-making. The components of the model consist of: a. **S**ituational awareness; b. **D**iagnosis (of problems); c. **R**esolution (of problems) and d. **V**igilance (to assure that other problems and/or the original problem is addressed completely). The "S-D-R-V" model was presented to PPGS students in the form of an FAA CD-ROM (FAA, 1999b) and should be included as part of novices' ADM training.

The focus of ADM training within the context of a PPGS should be the development of students' cognitive maps. Cognitive maps, based on experiences, can help pilots to appreciate the relevant properties of problems. They help pilots to see more clearly. It is, therefore, recommended that ADM training components include numerous ADM scenarios. The relevance and quality of the chosen scenarios will determine their ultimate value.

In addition, the medium through which the scenarios are presented to students will also affect their value. For example, presenting scenarios to students in simulators would result in a more profound effect since they more closely replicate actual experiences. It is often not possible, however, to arrange for students to use full-motion simulators or, for that matter, any simulators. In such cases, scenario simulations could perhaps be provided to students through commercial software on personal computers. If neither of these alternatives is possible, instructors could examine scenarios with students during PPGS classes. The scenarios should correspond to topics covered in the PPGS classes and the instructor should be certain to take the time to discuss thoroughly the pros and cons of options provided by students.

Conclusion

I recently met a former PPGS student who had been in one of my preliminary studies. He told me that the scenarios we had discussed during class had been helpful and related how he had applied one such lesson to his subsequent flying. During the PPGS we had discussed various scenarios related to the decision-making process when faced with entering a busy, non-controlled traffic pattern (many airplanes trying to land at an airport without a control tower). He explained how after obtaining his license he had experienced this situation and how his subsequent course of action (he chose to depart the traffic pattern and return a few minutes later) was influenced by the scenarios we had discussed during the PPGS course.

I believe that most student pilots can benefit significantly from discussing ADM scenarios. The process of analyzing a variety of relevant scenarios appeared both to enhance their thought processes during the course of the PPGS and contribute to the development of their respective cognitive maps. The PPGS/ADM syllabus depicted in Figure 25 (p.128) represents a starting point in helping students to develop such maps.

This study may also have applications for other activities that involve naturalistic decision-making. For example, it is conceivable that appropriate scenarios could be found for novice fire fighters, police officers, emergency room personnel, mountain climbers etc. The key objective would be to present novices with approriate scenarios in an attempt to help them develop relevant cognitive maps.

My journey into the thought processes of expert and novice pilots has been enlightening. It has helped me become a better ground and flight instructor. The experience also helped me to comprehend better the complexities involved in conducting research related to experts and novices.

In some respects, I wish I were beginning the study at this time. The pilot studies, re-wording of scenarios, interviewing, transcribing, coding and analyzing of data have resulted in a better appreciation for the importance of carefully reviewing each of the many details involved in qualitative research. The experience has also helped me to realize that one must always consider making changes that could elicit more useful data.

For example, following the interviews of subjects I began thinking about the effects of changing the wording of the scenario involving the flaps that were stuck in the fully extended position. How might the responses of subjects changed had that scenario been re-worded to indicate that the flaps had been stuck at ten degrees (frequently used for short-field takeoffs) rather than at thirty degrees? How might the responses differed if the scenario had been re-worded to indicate that the attendant who offered to help fix the flaps had also been a flight instructor (but not a mechanic)?

Recently, I unexpectedly experienced this scenario. A student and I were practicing "touch-and-go" takeoffs and landings. The maneuver consists of landing, allowing the aircraft to slow down, applying power, retracting the flaps, taking off, flying around the traffic pattern and, once again, landing. On this occasion, everything appeared normal until the aircraft began climbing. It soon became apparent that the airplane was climbing at a significantly slower speed than normal. The rate of climb was also reduced. Following a quick check of the throttle and magneto settings (to assure the engine was developing sufficient power), I glanced outside. The flaps had not retracted and had remained fully extended — we had taken off with full flaps. Since there was not enough runway to abort the takeoff and the aircraft was climbing (although at a slow speed and rate), we nursed the aircraft around the traffic pattern and landed without incident. A certified mechanic later diagnosed and corrected the electrical problem. Needless to say, two cognitive maps were enhanced during that flight. Experiences such as this, however, do not often occur during flight training.

Furnishing students with the knowledge necessary to pass an FAA examination has always been the primary focus of PPGSs. A PPGS could also provide students with a unique opportunity to enhance their ADM competencies. By substituting knowledge in the form of ADM scenarios for actual experiences, instructors could help students form more extensive and relevant cognitive maps. The enhancement of such maps could prove to be just as important and, perhaps, even more important than any specific topic covered in a PPGS. It is essential, therefore, that instructors consider including ADM training along with relevant scenarios within the context of PPGSs and other ground based, aviation-related courses. It is a pursuit worthy of our time, patience and best efforts.