

## **Chapter 4: Findings**

Experts use forward thinking and start solving problems from an intuitive perception of the situation. These perceptions are based upon the context and cues available from the situation as well as experience and training.

Adams (1993)

## Introduction

My findings are presented in four sections. The first section reviews information acquired during interviews with expert pilots (EPs). The second section addresses findings relevant to the student pilot (SP) subjects. The third section compares the pre-flight and in-flight decision making processes of EP and SP subjects. These comparisons are based on the research design previously discussed in Chapter Three (see Figure 14, p. 58). Finally, I will discuss and summarize the study's major findings and pose questions that are examined in the concluding chapter.

## Expert Pilots

Underlying EP aeronautical decision-making (ADM) thought processes was an intuitive perception and assessment of risks inherent in the naturalistic environment of aviation. All of the EPs stressed that safety was a primary consideration in their ADM and framed their responses in a manner that reflected what they considered to be safe and prudent alternatives. The common characteristics shared by experts, resulted in the emergence of specific ADM themes.

In their responses to the scenarios presented in this study, EPs exhibited five key themes related to their ADM thought processes. These themes included: a. *establishing the context* (general framework) within which the scenarios occurred; b. *defining the situation* (specific aspects) and the precise nature of the scenarios; c. *prioritizing plans and alternate plans* to manage the scenarios effectively; d. *recognizing and using familiar experiences* as cognitive guides in their decision-making thought processes and e. *assessing risks* by analyzing information related to potential alternatives and attempting to increase the quantity and quality of available data. Each of these themes will be discussed in turn.

### Establishing the Context

EPs were concerned about the context within which each of the scenarios occurred. By *context*, I refer to the general framework within which the scenario is presented. Each of the EPs demonstrated a desire to comprehend fully the context of each scenario.

For example, in response to the second scenario (SC2 — see Appendix E) which involved a drop in RPM during a cross-country flight, the first expert pilot (EP1) expressed a concern

about the season and how that could affect his thought process:

You don't say what the temperature is, you know, is it summer, winter, what? If, lets say it's winter time, that there's a good possibility that condensation in the fuel tank could have frozen and I now have ice and not necessarily just water, you know, I don't have water, I have ice. So that is a possibility and it's clogging up the hole that the fuel drains through.

(Appendix G: page 164, 37-48)

EP1 also stressed that pilots in such a predicament (SC2) needed to be cognizant of their precise location:

Am I near a town? Am I over the town? Where am I? That you said here [in the written scenario] that I'm fifteen miles from the nearest airport. OK maybe the nearest airport is ahhh, far away from the town, outside of town.

(Appendix G: page 167, 383-389)

The second expert pilot (EP2) also stressed the importance of the context within which the scenarios were framed. EP2 emphasized that the recency of flying experience in a particular aircraft was significant. He also pointed out that the specific type of flying experiences (e.g., instructional flight, IFR/VFR, etc.) were important considerations:

But if it's like the Pilatus [a complex and sophisticated, general aviation, aircraft] that I fly weekly, two or three times a week, and I know all the automated systems work if it [the clouds] really gets low and I need some help, then it [lowest altitude that he will descend in the clouds] may be a little lower. You know, and it depends on how recent I've been IMC [instrument meteorological conditions -- flying in the clouds] in the airplane also.

(Appendix G: page 174, 464-472)

In response to SC2, EP2 like EP1 discussed the importance of his precise location at the time the scenario took place and how that would affect his decision-making process:

Well, if what's below me is making the situation look worse where there's houses or I'm over a city or, you know, skyscrapers all around then. I mean, I've got a bad set of tools to work with and I'm gonna have to try to get it out of that situation the best I can and that's gonna alter any decision-making process right there.

(Appendix G: page 183, 697-706)

The third expert pilot (EP3) also expressed a desire to define the context within which the scenario took place. In responding to SC2, EP3 emphasized that he would only consider a particular alternative (shutting down the engine) in a particular context (an extreme emergency that would place himself and his aircraft in imminent peril and during which there were no viable alternatives):

The only time I'd do that [shut down the engine] is if I knew I had to put it into a field. I might shut down, shut off the motor, shut off the fuel before landing in a field just to prevent...preventing any kind of fire. Cutting down the chance of fire or an explosion.

(Appendix G: page 197, 635-643)

Although EP3 had experience as a flight instructor, he had not flown in small training aircraft for several years. Like EP2, he stressed the importance of recent flying experiences in a particular type of aircraft:

Considering I haven't flown a small airplane like this in a long time. I, it's been years. I would keep it on [carburetor heat] for a few minutes and see what happens.

(Appendix G: page 196, 543-547)

The fourth expert pilot (EP4) was also concerned with the context within which scenarios occurred. In the first scenario (SC1), EP4 took time to explain the term "demonstrated cross-wind component." He emphasized that the demonstrated cross-wind component of a particular aircraft was not a legal mandate and that it did not prevent a pilot from attempting a landing. In addition, EP4 discussed the importance of the pilot's proficiency in a particular aircraft:

There's some things that you need to consider here. The winds are essentially ninety degrees to the runway at ten knots gusting to seventeen. There is a demonstrated cross-wind component -- demonstrated of fifteen knots. So does that, that doesn't mean that the gusts to seventeen really exceeds the cross-wind component. You have to understand that the cross-wind, demonstrated cross-wind component has no legality. There's nothing legal about it. If you are proficient in the airplane, you should be able to handle a ten knot ninety degree wind fairly easily.

(Appendix G: page 204, 26-43)

EP4 was also concerned about the frequency of specific flight experiences. In his responses to the fourth scenario (SC4), he expressed concern about the pilot who was experiencing in-flight problems:

If this is a flight that she has done routinely, you know, she's done this seventy-seven times, then she sort of knows what to expect along the way.

(Appendix G: pages 215-216, 228-232)

This concern, regarding the specific type and frequency of flying experiences, was expressed once again in EP4's comments about the pilot in the same scenario; EP4 stated:

I mean you go out to Kansas and you fly in Kansas, you know they have skies overcast at two thousand feet — thirty miles visibility. And this happens all the time. Would you consider going from Wichita over to Venton, Kansas at two thousand feet? Yeah, cause you've done it a thousand times. If this is the first time she's been in Port Columbus, first time she's made this flight, she's got too many things working against her.

(Appendix G: page 217, 292-305)

### Defining the Situation

Expert subjects were concerned about understanding and appreciating fully the subtleties of each of the scenarios. They asked numerous questions to assure that they comprehended fully the nuances and details of the situations presented to them. The insights gained from these questions were undoubtedly helpful to them in evaluating their options and the selection of what they considered to be prudent alternatives.

For example, EP1 emphasized that the time of day was an important consideration in his decision-making. He indicated that flying at night involved additional planning and that not taking the time to plan adequately could hamper his ability to make sound judgements; EP1 explained:

Now if it's dark, you know, are there trees there? Is it dark because its trees or is it dark it's just a plowed field. You need, would need to know, flying along prior to this incident happening, where are you? Position awareness, am I near a town? Am I over the town? Where am I?

(Appendix G: page 167, 376-384)

EP1 also expressed concerns about the wind and how variations in wind speed and direction could affect in-flight problems. In response to SC4, he discussed these potential problems:

It may have taken you two hours to get here because you had favorable tail winds, but now you're going to be fighting the head winds and it may take you three hours and you don't have three hours worth of time [fuel] in the airplane.

(Appendix G: page 170, 106-112)

EP2 was also concerned about defining fully the specific aspects of each of the scenarios. For example, during his interview relating to SC1, EP2 stated that the purpose of the flight would have been an important element in his thought process:

I would like to know why I was going to that Regional Airport in the first place? I mean was it just for a cup of coffee or do I really need to stop there? Or am I low on gas or, you know, is there weather moving in that I've got to get it [the airplane] down there or something? Just to land and get a cup of coffee and turn around and come back and just put some time on the airplane. I don't need to go there.

(Appendix G: page 175, 498-510)

EP2 exhibited an interest in more thoroughly clarifying the conditions related to SC2. In his response to the mechanical difficulties mentioned in that scenario, EP2 stated:

I'd like to know how much RPM have I lost? I mean if I'm at 2,500 RPM and it goes down to 24 [hundred RPM] well, that's not a real problem. It just says [the scenario states] that I'm gradually, 'slowly loses RPM, no indication of oil or fuel [problems].' So I'd like to know how much [RPM] that I'm losing.

(Appendix G: page 179, 263-271)

In addition, EP2 expressed concern about how physical and mental pressures could effect a pilot's performance. Specifically, he wanted to acquire additional information about the pilot of the aircraft in SC4. He was apparently attempting to evaluate whether or not she was physically and mentally prepared for the flight:

She should have also pre-flighted herself. It was pretty obvious that she had been in a meeting. We don't know how long, but she was at a meeting. And it could have been a long day. Is she really fit to do this flight, too? She may not have been fit to do this flight. So, you know,

sometimes the weather's fine and everything is going in your favor, but it's been a long day and you're just too exhausted.  
(Appendix G: page 187, 188-199)

Defining the situation more thoroughly was also a priority of EP3. In response to SC2, he expressed a concern about the specific conditions that he would need to consider if he were forced to execute an emergency landing:

Well, if I had to choose a suitable area, I mean let's assume it's a field. Is it long enough? Had it been plowed? Maybe there are ruts in the ground. If there are, landing with the ruts instead of against them. Are there, is there other crops there — corn, things of that sort? Wires that I might have to avoid, trees I might have to clear?  
(Appendix G: page 194, 208-217)

In a response to the same scenario, EP3 also emphasized the importance of defining the situation with regard to the specific terrain at a nearby airport:

Well, if the airport was in a valley or between mountains, you know, I'd want to consider that because I'd want to keep as much altitude as I can for as long as possible. And I'd rather keep that altitude 'till I get over the airport instead of trying a descent prior to the airport. Cause that would give me more air to ground clearance. If it were in the flatlands, that obviously, that wouldn't be a consideration of terrain.  
(Appendix G: page 195, 385-397)

All of the expert pilots were concerned about weather conditions and attempted to determine the specific weather relevant to each of the scenarios. For example, EP4 explained that the weather would be a vital factor in his decision-making process:

So if I had partial flaps, I would definitely takeoff. But then the weather that was good seems to be deteriorating with higher winds and lower ceilings. I'm not sure how to interpret that. You know, I'm assuming I had VFR [Visual Flight Rules — generally favorable flying conditions] even though the ceiling is coming down I still have VFR conditions. I mean if the ceiling is coming down; down, down, down. Obviously then that is a no-brainer, too. You're not gonna go. VFR with partial flaps, I'd do it. IFR [Instrument Flight Rules — generally unfavorable flying conditions which may include flying in the clouds] or marginal VFR, no.  
(Appendix G: pages 210-211, 48-69)

In his response to SC3, EP4 expressed considerable concern about an attendant's offer to attempt to fix a problem with the aircraft's flaps. He suggested that if the situation met certain conditions, he might personally attempt to fix the problem and fly back to his home airport.

I mean, you know, I'm a retired engineer and I've turned a wrench many a day on engines. But there are things that I might do because I know I can get that flap up. But I'm not sure I would trust someone else to do it. I mean I would be, if I could see that the flap was stuck and I could get the flap up myself, and then pull the [circuit] breaker or something so that it wouldn't come down. I might be inclined to get airborne and then boogey on back home and then just plan not to use flaps.

(Appendix G: page 212, 609-623)

### Prioritizing Plans and Alternate Plans

The EPs expressed concerns about developing workable plans to cope with each of the scenarios. They also tended to prioritize their actions. In addition, the EPs were concerned with developing alternate plans or "escape routes."

For example, in response to the scenario involving a loss of engine power, EP1 stressed that if he experienced a similar engine problem and thought that he would not be able to fly to the nearest airport, he would more than likely land at the first suitable field (rather than pressing on):

If I know that I'm going to be landing five miles away from the airport, why not just make it five miles [instead of trying to fly a bit closer]? Why do I want to stretch it to four? I have a good site underneath of me, I'm going to put it down right there.

(Appendix G: pages 165-166, 178-184)

EP1 also stated that if he realized he would be unable to fly to the nearest airport, he would communicate his predicament to the nearest control tower and inform them of his intentions. Those intentions, to attempt an off-airport landing, reflected his alternate plan:

If I realize that I'm not going to make the airport, I'm going to call the [control] tower and say, 'Sir, I'm not going to make the airport.' I'm going to look for a field, a road, you know, something to put the airplane down in and do it as carefully as I can.

(Appendix G: page 165, 165-172)

EP2 discussed his priorities in developing a plan for coping with the engine problem depicted in SC2. He also discussed and emphasized the importance of having an alternate plan; EP2 stated:

So I think I would check the fuel valve and mag settings first and then if that still wasn't any good, then I would, once I know I am making the [emergency landing] field, secure the engine, secure the aircraft — meaning shut off the mixture, stop the engine and I could read this [the alternatives to the scenario] as saying when it says, 'Check the fuel valve' to shut it off. Or it could be checking it to make sure it was on. Mag switch settings, I'd turn them off, too. Once I checked everything and nothing's working, I'm going to secure the electrical system, the fuel system to eliminate possibility of a fire and fuel spills on landing. (Appendix G: page 182, 493-509)

Additionally, EP2 developed a plan for coping with the flap problem depicted in SC3. His plan encompassed a series of priorities starting with and emphasizing safety and concluding with notification of a friend who planned to use the same aircraft for a scheduled flight test with the FAA:

The first thought was safety. The second thing to do is leave it on the ground, see if we can get somebody to come in and look at it. Somewhere, up front, to be courteous to the other pilot who is getting ready for a flight test in it [the airplane] is to try to get hold of them or the [FAA] examiner. Because that is a big day for somebody, getting their license, and you don't want them to be pacing the carpet back and forth, waiting for the airplane and you're not gonna be there. After the safety issues are considered, I would call them. If I could get a mechanic to come in and fix it, you know, that would be after my safety thoughts and then, once I knew what my final decision is, then I'd notify the flight school and the applicant. (Appendix G: page 184, 211-232)

EP3 also stressed the formation of plans and the need to formulate options. In response to the aircraft with engine and electrical problems described in SC2, EP3 discussed his plan and alternatives.

So option 'A,' look for somewhere where you are. [option] 'B' would be continue on, turning off non-essential power, non-essential electrical items.....if I saw another runway close by, meaning underneath me, I would opt to land there because a rough running engine at that point, fifteen miles down the road could mean an engine not running at all.

And I'd rather have some power and be able to control it to a runway right below me than taking the chance of continuing on.  
(Appendix G: page 193, 80-101)

EP3 emphasized that a major priority involved in his thought process would be the amount of fuel remaining in the aircraft. When confronted with SC1 and the possibility of flying to an alternate airport, EP3 made this concern clear:

Well, all these scenarios — one thing I would keep in the back of my mind; do I have enough fuel to make all these decisions? If I don't have enough fuel, then it turns into a total different scenario. [when asked to explain how fuel would effect his thought process, EP3 stated:] Well, if fuel were a consideration, I would tell the tower 'I'm declaring min-fuel [minimum fuel] and I'm landing on [runway] 28.'  
(Appendix G: page 190, 134-147)

EP4 made it clear that he always preferred to have a back-up plan. He used the term “escape route.” His response to a question involving his thought process about the “go/no-go” decision captured his emphasis on this priority:

...you always want to know where there's VFR [generally favorable weather] conditions. You always have to have an escape route. I can't emphasize that enough. You don't have an escape route, you're reducing your options automatically.  
(Appendix G: page 213, 901-907)

As was previously stated, all of the EPs stressed safety and how they could minimize damage and injuries. EP4 expanded on this priority as well as what he considered to be a pilot's “worst enemy” in response to an inquiry about emergency, off-airport landings:

Well, I think the most important thing is as a pilot — if you have to put a plane down somewhere, you need to put it down someplace where you're not gonna hurt anybody. That's probably the most important thing in my thinking. I mean this is your responsibility. There are places where you couldn't possibly put it [the airplane] down without doing major damage to people and vehicles on the ground, but I think in your as you play the 'where can I land' game, you're always looking to keep it, damage, to an absolute minimum. Not to yourself, I mean you put yourself in this position so you have to think about other people. The second [priority] or the first, or the second, depending on how you look at it would be

the worst enemy you have in the cockpit is panic. You know, you can go through a period of denial and you can do whatever, but you really have to fight the tendency to panic and I think a lot of that comes from how you are instructed. You know, if you're instructed to always fly the airplane, that's number one, always fly the airplane. (Appendix G: page 206, 494-524)

### Recognizing and Using Familiar Experiences

The experts often linked their selection of alternatives and decision-making processes to their experiences. The scenarios presented to the experts often sparked recognition of an event or incident which served as a cue and catalyst for what appeared to be their intuitive decision-making responses. Several of these recognition-based decision-making alternatives were based on dangerous incidents experienced by the experts. Those incidents appeared to result in profound lessons that affected their subsequent practice.

For example, during a discussion regarding the pilot in SC4 who ran out of gas, EP1 related an incident that has since affected his decision-making process:

The situation was we were leaving from here [Montgomery County Airpark, located in Gaithersburg, MD] going down to Sanford FL in a Navajo [twin engine, general aviation aircraft]. We hold 189 gallons of fuel in that airplane. I did the paper work calculation that we should have been able to make our destination and still have an hour worth of fuel left. I monitored the fuel gauges [during the flight] and realized that we were having head winds and that it was slowing us down about forty-five minutes longer than anticipated. When we crossed over Savannah, going into Sanford, FL, ATC [air traffic control] or Approach Control [local air traffic controllers at Sanford] sent us out over the ocean which is a straight line down to Daytona, to the Daytona area and then to Sanford. And so I accepted that [clearance from ATC] and now I am like forty miles out in the ocean and I'm seeing that I'm sucking up fuel quicker than I should have and I'm passing all those airports to my right that are on dry land and I'm forty miles out in the ocean. Well, I'm here to say that we made it, but I put 179 gallons of fuel in the airplane when we landed at Sanford. And as I said, it holds 189 [gallons of fuel]. So I had ten gallons, that's five gallons a side for those two engines which would probably be at the most, ten minutes of air time. From that time on, after paying for that fuel, I decided on our next trip to Savannah and into Sanford that I had to go to the bathroom in Savannah. I don't care if I had to or not — I had to [go to the bathroom]. And that's the way I flew for that company from that point on.

(Appendix G: page 172, 430-471)

Perhaps one of the study's most significant examples of an expert basing decisions on lessons gained from experience occurred in a response from EP2. The subject related an event that appeared to have affected his reaction to SC2 (scenario which involves a drop in RPM at 4,500'). All of the EPs except EP2 stated that they would first attempt to keep the engine running and nurse the aircraft to the nearest airport. EP2, however, stated that his first priority was to find and land in a suitable field:

Well, my first thought is to look outside for a field and see what I'm over. And my initial thought is to set up and land at a field while I still have power. The engine losing RPM, practically, I don't know how low it has gotten in this scenario, but my first intention is to pick a field below me and set up for a normal landing while I still have power and do a precautionary landing in a field.

(Appendix G: page 176, 15-26)

That response from EP2 was unanticipated. I asked EP2 about how his prior flying experiences may have factored into his thought processes with regard to SC2. EP2 revealed that he had experienced a similar situation. Following further prompting, EP2 related his story:

I probably had maybe 2,000 hours [of flying time]--between two and three thousand hours, most of it as a flight instructor at that time. And it was a training flight. And we had been flying for over an hour. Left our home base and we're up in Pennsylvania and we just did a low approach and we're on a missed [approach for landing] from an instrument approach [EP2 and his student were practicing instrument landing approaches and missed approaches]. And the airplane had a problem with some fuel leaks and oil leaks and they thought that they had fixed them. And some oil started leaking and caught fire on the engine. And as soon as it happened, it was — I just looked right below the window and said 'my airplane' [to the student pilot] and grabbed it [controls of the aircraft] and set up for the field. I think I may have shut the engine off earlier than final [approach for landing]. It was a 152 [Cessna 152 — two seat training aircraft] and we opened it [doors of the aircraft]. I, with one, with both hands I just reached over and popped both doors open and got the windows open and smoke evacuated. Well, we were IFR [limited visibility] in the cockpit. And, so, I probably shut the engine off a little earlier than final, but we landed and by the time we landed, the prop had stopped and everything so it was a complete 'dead stick' landing [landing with no power]. But it was in a field and it was no sense trying to go anywhere else because we were losing power and we had just left, I think it was Harrisburg, so I just, I was probably within ten miles of an airport with a tower. Didn't even have time to talk to them

because I was still , I don't know maybe fifteen hundred feet above ground level at that time. But I didn't even notify them. I had to call on a telephone and it was funny, I, we had landed in a field and we were behind a shopping center. And it was early in the morning so the only thing that was open was a restaurant. Well, we walked around the front and you know, I walked in and I said, 'excuse me, could you tell me what town we're in, you know, where we're at?' And they looked at me like 'you're crazy.' I said, 'well, we just landed a plane in your back yard there and we need to make some phone calls here and let people know where we are.' So that part of it was kind of comical.  
(Appendix G: pages 177-178, 90-155)

Later in the interview, EP2 was presented with the alternatives associated with SC2. When EP2 was asked to rank order the alternatives for SC2 he, like all of the other experts, first chose what seemed to be the most practical and logical choice; "C" (keep the carburetor heat on and see what happens). EP2, however, continued to emphasize what appeared to be the lesson he had learned in his previously cited experience. He stated:

But I would rank 'C,' keep the carb heat on and see what happens as probably a first thing because it's like insurance. You know it's not going to hurt to have it, but it's there when I need it. So, I'm gonna keep the carburetor heat on and then once I'm sure of the field that I picked — [choice] 'A.' [Pull out the mixture, stop the engine and check the fuel selector valve, mag switch settings and declare an emergency]. I'd have to modify [choice] 'A' somewhat. Once I'm sure of making the field, I can pull out the mixture and secure everything, stop the engine and all that good stuff and declare the emergency if I have time. So it would be [choice] 'C' and then [choice] 'A.'  
(Appendix G: pages 180-181, 412-428)

Despite the fact that SC2 involved a drop in RPM and a possible electrical problem, EP2's personal experience involved an engine fire at a significantly lower altitude, a lasting impression seemed to have been formed. EP2's experience appeared to prompt his decision to choose choice 'A' after what had appeared to be the most logical choice (C) which he and the other experts had selected first. It is interesting to note that all of the other experts selected choice 'A' as their last alternative for SC2.

EP3 also had an experience that was similar to the incident described in SC2. His experience and subsequent actions are related on the following page:

I was flying from Washington National [airport] to Montgomery County Airpark [Gaithersburg, MD] and took off out of National in a Cessna 172 and the engine started running rough — producing less power, however, it was enough to make it to my destination. But the same scenario, you know, ‘Where can we land just in case?’ Can we land at College Park, at Andrews Air Force Base, Fort Meade, somewhere in between? We kept pressing on because I knew Gaithersburg was close by. The engine was running rough, but it still had enough power to make it to Gaithersburg.

(I then asked EP3 about his thought process during this experience)

Again, I did normal things, checking the fuel selector, carb heat, mag switch settings, make sure both mags are on. And everything was in its proper place. Those were the first obvious things to check...that’s an easy fix. Again, they were in their normal place so that wasn’t a factor. I thought about calling ATC [air traffic control] declaring an emergency; however, it wasn’t that bad so we didn’t do that. And just continuing to think of places to land at just in case the engine did quit. And since I knew the area pretty well, I knew exactly where to go. There were quite a few airports between those two that we could have landed at safely.

(Appendix G: pages 198-199, 767-810)

It was obvious that the experience of EP3 was far different from the experience of EP2 and was more closely related to the conditions presented in the scenario. Nevertheless, the experience of EP3 and his ability to recognize important cues from that experience, appeared to be an important factor in his decision-making process as he noted during the interview:

Just because in every day, my every day job things like this occur. And maybe not this specific thing but other things that are similar to it and it’s something that you have to contend with. And I guess, you know, I’ve been flying for twenty years. I’ve dealt with this before, things similar, and it’s always turned out OK.

(Appendix G: page 191, 244-253)

EP4 discussed the value of a personal experience in relation to the electrical problem discussed in SC2. He explained that during a training flight to a major airport he had noticed a flickering light on a control panel. EP4 stated that he paid little attention to the light and upon arrival began practicing instrument approaches. On one such approach, however, he was faced with a major problem. When asked to elaborate he recounted the following incident:

We were cleared to do the ILS [Instrument Landing System — type of precision approach for landing] into Runway 33 Right — low approach [no landing - just a practice approach]. There was a [Boeing] 727 [type of commercial jet aircraft] waiting to take the runway. This is at night and we lost, you know, we were inside the outer marker [within two miles of the runway threshold] and we lost total electrical power. No, we were just right at the, just about right at the outer marker — maybe just a little bit outside because, you know, when you lose electrical power, a lot of people don't realize this, I mean when you say it, it sounds silly, but people don't realize it. You're headset doesn't work, the intercom doesn't work, radios don't work. You're shouting at each other. That little flashlight that you should have tucked away in your shirt isn't there and as you're shouting at each other; 'should I pump the [landing] gear down? Yes, great idea, pump the gear down.' [laughs]. Because this was an electric motor and a hydraulic system [referring to the landing gear]. So you had to 'chchch' pump it down. We lost, we didn't get any signal light at all from the tower. Fortunately, the 727 opted not, you know, they saw all of our lights just blink out and they opted not to take the runway until they figured out what we were gonna do. So we figured at that point we're just gonna land the airplane, apologize later. But the [control] tower didn't even have any knowledge — you know, we called the tower after we got off the, you know, out of the airplane and they said, 'Oh, yeah, we were wondering where you went.' But they, all the lights just blinked right out.  
(Appendix G: page 208, 835-880)

Later in the interview, reflecting on that experience, EP4 stated that the incident had taught him to be more observant and diligent:

But you know, you know from your experiences you learn to look for certain things and do certain things. You know, I know if I have a flickering light on a display, I'm gonna look real close at those alternators. Make sure they're charging; make sure the battery is charging.  
(Appendix G: page 209, 915-923.)

### Assessing Risks

The experts were all concerned about thoroughly assessing risks pertinent to the scenarios. Risk assessment involved the analysis of all information germane to the scenarios including legal aspects, outside factors, stress and weather. EP1, for example, emphasized how his decision-making process would be affected by legal concerns, specifically FAA rules and regulations:

The Federal Aviation regulations say that this airplane is grounded for this flap problem and it's against the rules and regulations and I am not

going to put myself in the danger of flying this airplane in that condition. Although it could be flown, but the regulations say, 'no' and 'I am not going to violate the regulations just for the sake of getting the plane home so that somebody can go take the checkride in a plane that they can't fly in the first place.'

(Appendix G: page 168, 103-116)

EP3 also expressed concern regarding legal issues and how these factors would affect his response to SC3. He was particularly troubled about the possibility of unauthorized personnel performing maintenance on his aircraft. He was adamant that his decision-making would, to a significant degree, be governed by what was legally permissible:

Well, I mean, I'm not gonna let him [the attendant] try to fix the problem because he's not a mechanic. And this goes into a legal thing here. Let's say I did let him fix it and he did get the flaps up and I flew it. OK, the airplane had a problem, it wasn't signed off by a proper maintenance and that's what has to be done in this situation when there's a repair. It's got to be signed off by a mechanic. He doesn't, he might say he knows what he's doing, but that doesn't mean anything. He might not know what he's doing. So, you know, there's a legality thing here. If there was an accident because of it, there could be law suits, all kinds of things. It could open just a huge can of worms in this scenario. So, bottom line is the plane stays where it's at.

(Appendix G: pages 200-201, 55-76)

Several of the experts discussed how "outside factors" should not be included in a pilot's thought process. They stated that these factors could result in unnecessary risks and complicate what would otherwise be an obvious decision. EP2, for example, emphasized how pilots should not permit others to pressure them into making questionable decisions:

...try not to let or don't let other people outside of you, don't let anybody else influence your decision to takeoff because you know, a newly rated pilot or somebody with relatively low experience may be pressured. If they call the flight in and got this private pilot and he said, 'Look man, I gotta have that airplane back. I got a check ride this afternoon and this examiner is tough and she'll chew me out if I cancel at the last minute. Get that airplane back here.' Somebody may be influenced by that or their arm twisted to say, 'OK, I'll get it back for you, I'll get it back. I'll takeoff and I'll be back in a couple of hours.' So don't let anybody outside of yourself make decisions for you because you're the one that has to deal with it. You're the one who has to live or die with it once you take it off [the airplane].

(Appendix G: pages 185-186, 587-610)

The effects of stress were noted by all of the experts. Several of them discussed how stress and related pressures could cause pilots to overlook procedures and choose alternatives that they would not otherwise consider. For example, EP2 discussed how stress may cause pilots to take unnecessary risks:

Well, if I tried once [to land] and had to go around, then I'd be really stressed out thinking 'Man, I got to get it down this time or die.' And I'm gonna do things that I probably wouldn't do if I was thinking clearer.  
(Appendix G: page 173, 316-321)

EP3 also discussed the insidious effects of stress. He remarked how stress could cause some pilots to overlook important procedures. In his response to SC4, EP3 made that clear:

Well, the stress is obviously building and because of the non-ability to get the fuel when she wanted it. So, because of that stress it might, the stress itself might take away from her ability to check, do checks or checklists that normally would be routine.  
(Appendix G: page 203, 73-80)

EP1 noted that flying is inherently stressful. Referring to the pilot in SC4, he emphasized that pilots should attempt to manage stress by keeping it within acceptable parameters.

Was she's creating some more stress for herself that she doesn't really need? As I said earlier, flying is stressful. You need to be able to handle that stress. You don't need additional stress, that personal stress that she's gotten herself into.  
(Appendix G: page 171, 123-130)

Factors related to the weather were emphasized repeatedly by all of the experts. No other specific risk factor was mentioned more frequently. EP2 related an incident that included the assessment of several pre-flight risk factors including the weather. His experience illustrated an appropriate course of action when risk factors reached a point at which a pilot does not feel comfortable:

I had the boss's wife wanted me to fly her to Key West [from Gaithersburg, MD] and drop her off and come back in the same day. And it's six hours non-stop in the Pilatus and I said, 'Well, I can't do that by myself,' I said, 'if I could find a co-pilot and the weather is good, I'll do it.' She said, 'But

the airplane will make it non-stop, we do it all the time.' I said, 'Yeah, but that her husband is also a pilot and he'll sit up front with me and if I have to use the bathroom or eat or something, you can get up and there's somebody else up there.' I said, 'That's a six hour flight.' I said, 'I'm gonna have to limit myself on my drinking my fluids, because I can't get up and use the restroom and then I'm gonna get down there and it's at least an hour and a half on the ground; unload your stuff and to get fuel and file a flight plan and get a [weather] briefing and get back in the air. It's gonna be a fourteen hour day before I know it. I'm gonna be getting back late at night,' I said, 'I can't do that flight.' And it so happened that the weather was too bad. There was a big line of thunderstorms across Florida. And I said, 'I'm not gonna.' I said, 'I'll be fit to go down there, but I'm not gonna be fit to come back even if the weather wasn't a factor.' I said, 'That's just too long of a day for me.' I said, 'We can't do that.' She said, 'Well, let's just go down there and see how you feel and you may feel like flying back.' I said, 'No, I'm not going to accept this flight with the intent on flying back tonight.' We leave here at eight in the morning. Eight, nine, ten, eleven, twelve, one, two; it would be two o'clock when we get down there. Give me two hours on the ground, it will be four o'clock. It will be ten, eleven o'clock by the time we get back up here.' I said, 'And I have to get up at five-thirty in order to get there and get the airplane ready for you.' I said, 'That's too long of a day.' (Appendix G: pages 187-188, 202-256)

The expert pilots included in this study displayed similar characteristics in their ADM thought processes. As a group they were concerned about the general context within which each of the scenarios occurred. They were also interested in examining and defining the specific conditions that existed in each of the scenarios. Likewise, the experts were mindful to prioritize their actions and assure that they had contingency plans in the event that problems arose following their initial alternative choices.

Experts in this study also based many of their decisions and alternative selections on their prior flight experiences. They frequently cited personal experiences that they recognized to be similar to the written scenarios. Those personal experiences appeared to assist the experts by cuing them into courses of actions that they believed would be helpful.

Finally, the experts sought to assess risks by analyzing factors relevant to the scenarios (when time permitted). Overall, the expert pilots demonstrated careful and diligent decision-making characteristics based on their experiences. Student subjects in this study, however, had not accumulated the quantity and quality of aviation experiences of the expert subjects. The thought processes of these novice aviators will now be examined.

## Student Pilots

The student subjects had all soloed (flown an aircraft by themselves) and, at the time of the interviews, were training for their cross-country flights (more than fifty miles one way). Student pilots one and two (SP1 and SP2) had completed one solo cross-country flight. Student pilots three and four (SP3 and SP4) had been on a dual cross-country flight (with their flight instructors) and were preparing for their first solo cross-country flights. All of the student pilots in the study had completed pertinent ground school classes necessary to comprehend fully the scenarios. During pre-interview conversations, all subjects were informed that they should feel free to ask questions at any time and were encouraged to do so. Subjects were also provided with opportunities (i.e., through pauses and a purposely slow interview pace) to ask questions throughout the process.

The student subjects revealed a number of distinguishing decision-making characteristics. These characteristics were consolidated and served to identify five major themes: a. the quantity and quality of *information acquired to assess risk* was often deficient; b. the *interpretation of the risks* associated with each scenario reflected a lack of attention to pertinent issues related to the scenarios; c. decision-making was frequently based on *recognition of familiar conditions* with which subjects could relate; d. decision-making often reflected an *emphasis on rules and procedures* that SPs had been taught or acquired through independent study and e. SPs exhibited “*hazardous attitudes*” in their decision-making process. Each of these themes will be addressed in turn. The ADM themes and corresponding characteristics are depicted on the following page in Figure 20.

### Information Acquired to Assess Risk

The SPs often attempted to define the conditions in the scenario but typically did so in a manner that resulted in the accumulation of relatively little pertinent information. More often than not, the SPs asked few questions regarding the scenarios. When they did attempt to obtain additional information, the details sought were frequently only tangentially relevant to key issues and risks. Undoubtedly, these tendencies could be attributed to the general inexperience of SPs which prompted their focus on non-critical factors. The factors chosen by the SPs often appeared to be related to topics or issues with which they had some prior knowledge or experience.

**Figure 20: Student Pilot Decision-making Themes and Characteristics**  
 (Characteristics are listed below each Theme — top row)

Information Acquired to Assess Risk	Interpretation of Risks	Recognition of Familiar Conditions	Emphasis on Rules and Procedures	Hazardous Attitudes
1. purposely limited volume of information acquired to resolve scenarios (did not want to “overload” themselves with information)  2. quality of information was often superficial or irrelevant (from perspective of author)	1. formation of priorities without much analysis  2. realization of inexperience (but inconsistent application to practice)  3. recognition of few alternatives  4. hesitant and uncertain, often changed their minds	1. familiar situations that were believed to be analogous to ADM scenarios  2. relevant ADM experiences	1. FAA  2. Pilot’s Operating Handbook  3. flight and ground instructors  4. ATC  5. procedures acquired through self-directed learning	1. invulnerable  2. impulsive  3. macho  4. irrelevant factors (factors not pertinent to the scenario)

Occasionally, the SPs expressed a desire to limit purposely the number of items they would consider. Even when they had the time to do so, SPs often elected to restrict their thought processes. For example, when SP3 was questioned about how his familiarity with an airport might affect his thought process, he responded:

Well, the fact that I’m more familiar with this airport takes somewhat of a, of an extra burden off me. It’s like every extra factor that comes into the situation means like I’ve got much more stuff to think about, you know, and it’s already a situation where, you know, I need to really be on top of, be on my toes and on top of the situation to ahhh, so I don’t want any more factors in the equation than I, than I have to put in there.

(Appendix I: page 256, 202-214)

SP1 provided another example of student decisions based on limited data. SP1 was asked about additional information he would like to have prior to making a decision with regard to landing in a cross-wind (SC1). SP1 chose to confine his request for obtaining additional information to one source. The source was a pilot who would be landing prior to his landing;

SP1 stated:

I would see what the Piper Cherokee would do. If he would try, try to land...if he would try to land on [runway] 35 and he kind of looks a little unstable, I would, I wouldn't think about landing there. I would if he looks kind of stable. Then I would go ahead and give it a try.

(Appendix I: page 225, 25-33)

An obvious problem with SP1's response was that he had no knowledge regarding the pilot of the Piper Cherokee. For all SP1 knew, the pilot in the Cherokee could have been a ten-thousand hour airline pilot. In addition, it is highly unlikely that SP1 could determine the stability of the Piper Cherokee by observing its approach and landing. Attempting to do so could have resulted in SP1 becoming distracted and neglecting other important responsibilities (e.g., preparing for landing), producing a worsening situation.

The inexperience of SPs resulted in inadequate cognitive maps to assist them in responding to the scenarios. These underdeveloped cognitive maps appeared to make them prone to acquire information that was either superficial or irrelevant. There was often a focus on issues unrelated to major problems. The students typically centered their attention on one detail or issue that often did not involve the most critical factors and did little to enhance effective decision-making.

For example, when SP1 was asked about the decisions he would need to make with regard to landing in a cross-wind (SC1), he continued to base his response on the pilot in the Cherokee that was landing prior to his arrival. SP1 expressed concern about having more information available but, once again, seemed willing to base his decision-making on what would have been, at best, superficial information. SP1 remarked:

Well, I could, you could radio into the, the Piper [other aircraft] and ask him, you know, how bad was it? Was there a strong cross-wind and how bad was it gusting — did you find when you came into land? How bad was it? Another one to do would probably be going ahead and just trying it, you know, I would like to have a little bit more information before I would do it.

(Appendix I: pages 226-227, 289-300)

Student subjects were also prone to obtaining information that was irrelevant to what should have been major concerns. It was not uncommon for the students to contemplate information that should not have been seriously considered. SP4, for example, in his response to a problem with his flaps (SC3) discussed the possibility of permitting the attendant to attempt to fix the problem (it is important to note that the attendant is not a licensed aircraft mechanic). In his decision-making process, SP4 discussed issues that were not worthy of consideration:

So you want to make sure, make sure it's done properly before you take it up and that's ummm, you know, how old is the attendant? How many times has he, has he seen that stuff? That's the other question you have to think [about], too. And ahhh, I mean, thirty-five miles is not that far.  
(Appendix I: page 269, 84-93)

### Interpretation of Risks

The student subjects often had problems interpreting the risks associated with the scenarios. One of their major short-comings was that they tended to form priorities without an in-depth analysis of pertinent factors. In addition, the students appeared to realize their lack of experience but were often unable to relate their inexperience to the decision-making process (i.e., did not make conservative decisions, reflecting their lack of experience). Finally, the student pilot subjects typically recognized few alternatives, often hesitated about choosing any alternative and changed their minds frequently.

In response to the scenario involving an engine problem at 4,500' (SC2), SP1 stressed how a major priority would be to shut down the engine. Despite the fact that the scenario indicated that the problem might be resolved (by turning on carburetor heat), SP1 seemed intent on turning everything off and executing an emergency landing (similar to the response of EP2, but SP1 had no relevant prior experience). SP1 did not appear to be concerned about the possibility of resolving the problem and made virtually no effort to analyze risks associated with his plan. When questioned about what he would do, SP1 responded:

I would shut off the fuel. I would call in before anything and tell them, you know, what my situation is. Shut my fuel off, shut my electrical off, shut, you know, my mag and masters. Basically, everything I would shut off.  
(Appendix I: page 233, 813-820)

SP4, in responding to the same scenario, seemed primarily concerned with the fact that he might be losing electrical power. Although the engine problem was an obvious priority, SP4 all but ignored it, and the necessity to find a suitable landing site. SP4 seemed to fixate on the possible electrical problem and repeatedly discussed concerns associated with a possible electrical failure. When asked about his thinking priorities, SP4 continued to emphasize the potential electrical failure and the effect this might have on his ability to communicate:

All of a sudden moderate to heavy, I mean air traffic. You know what, I guess that would be a concern too because, I mean, that would be a concern because you'd be going in there [referring to airspace in which two-way radio communication is required] with no radios and, you know, how would you know where you're at? And, you know, how do you know where they're at? [referring to other aircraft]. And that's or what runway is being landed [“on” - the runway in use].  
(Appendix I: page 267, 208-219)

The student pilots realized that they were inexperienced and frequently mentioned that this would influence their decision-making. This realization, however, did not always translate into their stated flying practices. For example, SP1 explained that he would takeoff and fly the aircraft with the flaps stuck in the extended position (a hazardous undertaking for a student pilot). However, SP1 concluded the interview (SC3) by acknowledging his inexperience.

As a student pilot, I think if, if I find anything that's anything that out of the unordinary [sic] you know, maybe a screw's loose. Or maybe a rivet is, is joggled or you know, a stabilizer, a stabilizer isn't stable [chuckles]. I would definitely go ask somebody with experience and I wouldn't, you know, I'm a student pilot, I don't have much experience with something going wrong. Maybe I've only had one or two things happen and I always ask my instructor or a mechanic. So I would definitely always ask somebody. I wouldn't leave it down to myself.  
(Appendix I: page 240, 1047-1062)

There appeared, therefore, to be a condition in which they recognized their inexperience but did not consistently consider that important factor in their decision-making process. For example, in the same scenario as previously cited (SC3), SP2 acknowledged his inexperience but failed to base his decision-making on that underlying reality. Specifically, SP2 did not appear to appreciate the danger involved in taking off with flaps fully extended and overestimated the

potential problems associated with landing without flaps. In response to a question about the attendant working on the flaps, SP2 remarked:

Again, I don't have any experience in landing an airplane with no flaps so worse case scenario, they don't go back down. I would have certainly, I couldn't ahhh, you know, takeoff would be fine, obviously, straight and level, but when it comes to land, when I hit the flaps and nothing's happening, so I have no drag [slows airplane down] or anything like that, ahmm, or very little drag, ahhh, I would have a problem with that as well. Just because I have no experience in it.

(Appendix I: page 245, 328-341)

As a group, the student pilots were not able to discern consistently more than a few viable alternatives for each scenario. In some cases, students were only able to articulate one alternative. Such was the case with SP1 with regard to SC1. When asked what he would do if the control tower stated that runway 35 was the active runway (which would require SP1 to land in a cross-wind that would be difficult for students), he remarked:

Well, I would , I would probably go ahead and ahhh, go ahead and try to put it down. Other than that I don't see what else I could do.

(Appendix I: page 228, 567-570)

SP4 also found it difficult to choose viable alternatives. Unlike SP2 who was concerned about the possibility of landing with no flaps, SP4 was undisturbed by that potential problem. He did not seem to appreciate fully that there were other alternatives open to him that would not include making a flight which involved flaps that were not operating properly. SP4 stated:

I mean, I guess if it came down to it and I had the flaps up and you can always make a no-flap landing. So I mean that, I mean, that is possible. So I mean that, ahmm, they're up [the flaps] and, you know, I guess you can, make that, make that flight. You know, I've made non-flap landings before so I mean it is possible. So it's ahmm, yeah, if it's up — I'll make the flight and get home and get it fixed.

(Appendix I: page 271, 530-543)

The SPs were often hesitant and uncertain about choosing alternatives and assessing risks. They frequently changed their minds and would often contradict what they had previously stated. At times it was difficult to determine what they would actually do. Such was the case with the

decision-making of SP2 and his actions with regard to the aircraft with flaps that would not retract (SC3). In the following three excerpts, SP2 first indicated that he would not consider flying the aircraft. This is followed by an excerpt in which SP2 seemed to be wavering about whether or not to permit the attendant to fix the problem. In the last excerpt, SP2 stated that under extenuating circumstances, he would fly the aircraft despite the possible problems associated with the flaps.

SP1: I would have a problem with some stranger who's not a mechanic; messing with wires and switches and all that stuff on the airplane.

ELD: Is there, is there a reason why you wouldn't, a specific reason why you wouldn't allow it? If he were able to get them up, get the flaps back up?

SP2: Yeah, there is because I know, I've seen the inside of a wing — [laughs] it's a lot of wires and all that stuff going on and for somebody to, that I don't even know, to come along and say they'd fix it. You know, I'm putting basically my life in their hands. They could, that thing could, you know, he could cross wire something....aircraft are complicated machines so that's the primary reason, there's too much that can go wrong.  
(Appendix I: pages 246-247, 432-462)

ELD: How about if the attendant said that that it's , the limit switch is just stuck...and he said 'I could fix it in just a second.'

SP2: Well, this is a difference between him saying 'I can fix it' and, well he's got to , you know, it's just stuck, somebody put some gum on there or something. There is a difference between 'I can fix it' and 'this is what you have to do.'  
(Appendix I: page 248, 539-551)

ELD: If there was a serious situation like that [SP2 had previously described an emotional situation that 'demanded' his presence]. Let's say there was a serious problem at home...

SP2: Uhuh

ELD: Would that affect your decision-making process?

SP2: Yes, I hate to say 'yes' but yes.

ELD: Tell me about that.

SP2: Well, I'm not sure for everybody, but for me — I tend to put other people before me. And I do not concern, well, I won't say 'I don't concern myself' but to me if, you know, my dad or mother or brother was on their death bed, ahmm, me making an educated risk, taking an educated risk is more important than, you know, saying final words. I hate to be that drastic but a situation that demands my presence. Demands my presence, not, you know, wants my presence or I want to have its presence but demands my presence.

ELD: So if an extreme situation like that were to occur in this particular scenario, what might that cause you to do?

SP2: I would take the least risky action. Probably have him put the flaps up. Just reset the switch and go.  
(Appendix I: pages 249-250, 931-970)

A similar exchange occurred with SP4 with regard to the same scenario (SC3). Prior to reviewing the listed alternatives, SP4 indicated that he would not permit the attendant to work on the aircraft. While discussing the rank ordering of alternatives, SP4 stated that his third alternative choice would be to “have the mechanic change the switch and check it out and fly home” (Appendix I: page 280, 570-571). When asked if this third alternative choice was a viable option, SP4 replied:

SP4: If I had to.

ELD: What factors would go into making that a ‘must’ choice — a viable choice?

SP4: That it doesn't — if that switch wouldn't become unstuck. I'd be setting it and you had, and you put a new switch in it and then the, and the flaps retract. Then you're in the same scenario as, as the 'resetting the switch and getting the flaps up' [another of the alternatives for this scenario]. Then the plane's flyable. You might not have flaps coming down. So you might have to make a non-flap landing.

ELD: Just to make sure I understand what you were saying previously. Before you saw the alternatives, you seemed to indicate that you would not allow the attendant to do much of anything. But it seems like now you're saying well, in certain situations, I might let him reset the switch or change the switch. Is there a reason for the change in thinking there?

SP4: Because these are my alternatives, those are given I mean so...

ELD: But are you saying then that you wouldn't actually do those alternatives?

SP4: I don't think, I wouldn't feel comfortable with the attendant doing it — me personally. I mean, I'd wait, you know, it's not, I mean, they can always reschedule a flight test. And I'd probably rather have a mechanic do it and make sure it's done right.

(Appendix I: page 272, 595-643)

### Recognition of Familiar Conditions

The student subjects frequently discussed conditions with which they were familiar. These familiar conditions were of two types. The first involved an activity with which all of the student pilots could relate — driving an automobile. The second involved actual ADM occurrences that the SPs had experienced during their training.

All of the SPs were licensed to drive automobiles. During the SP interviews, subjects discussed decision-making analogies involving their driving experiences. For example, when asked about the effects of stress on the decision-making process of the pilot in SC4, SP2 responded that *time* seemed to be a more important factor and stated:

I gotta get there and, you know, we all experience that when we're driving. I have a Jeep Cherokee and it tells you how many miles you have left and sometimes it says two miles left in gas, but I gotta get somewhere and I go. It's not a stress thing, it's just — I gotta go there, I gotta get there. Now it's different in flying in an airplane because I can just pull over [in his car].

(Appendix I: pages 254-255, 406-417)

Other student pilot subjects also discussed their driving experiences and how these experiences related to flying. SP3, for example, provided an interesting analogy when asked about his thought process with regard to the scenario that involved a problem with the aircraft's flaps (SC3); SP3 remarked:

This may be off, off tangent a little bit but just recently my car, my wife's car, the horn stopped working. Well, you can drive the car just fine without the horn. But, you know, one day you're in the parking lot and a big truck starts backing up towards you. It would be real nice to have the horn right about then. And it's

[laughs] it's the same thing with the airplane.  
(Appendix I: page 262, 317-327)

The student subjects were also able to recognize familiar ADM experiences based upon their training and experiences and related those occurrences to the scenarios. SP2, for example, explained how attitude and stress can affect one's decision-making abilities while discussing the pilot in SC4. SP2 related the following experience:

Last weekend I went out flying and I wasn't in a bad mood, but I was kind of just a little tired maybe. Not extremely tired, probably like I am right now. Ahmm, man I was, I was struggling landing the airplane. I felt like I never landed and airplane before. So I, it makes a huge difference. It makes a huge difference and I would guess that research has shown that. I've heard people talk about it before, too.  
(Appendix I: pages 252-253, 109-121)

When questioned about his thought process with regard to the scenario involving a flap problem (SC3), SP3 also related an interesting experience that had a direct bearing on his decision-making. SP3 remarked:

And actually, I don't know if you remember hearing around here but actually, I did cancel a flight here [at Montgomery County Airpark — where all of the SP subjects were receiving their flight training] with an airplane because of a flap problem. My instructor, I noticed on walk around [pre-flight inspection of the aircraft] that one of the flaps would move three or four inches in and out, and the other one wouldn't and we had one of the mechanics come out and look at it and then they grounded the airplane. So, I essentially have done this problem before [referring to SC3]. And the airplane doesn't fly, so, because you don't know what's gonna happen and you don't know if the flaps are gonna work right once you get up there...  
(Appendix I: page 261, 247-266)

### Emphasis on Rules and Procedures

During their interviews, SPs often referred to rules, procedures and guidelines that they had learned or had become familiar with during their training. These rules and procedures could be classified into five categories that included guidelines obtained from the: a. FAA; b. Pilot's Operating Handbook (for the aircraft they are flying); c. flight and ground school instructors; d.

Air Traffic Control and e. rules and guidelines acquired through self-directed learning. Each of these categories will be discussed in turn.

The FAA was frequently mentioned during the SP interviews. SPs were concerned about not breaking rules or taking actions that would result in punitive measures. In responding to a question related to landing in a cross-wind (SC1) SP1, stated:

I would definitely want permission before [he lands] because then I wouldn't have to worry about people yelling at me. You know, maybe the FAA coming out and I'm going to have to answer questions. You know, I don't want to have to go through all that hassle.

(Appendix I: page 230, 927-934)

The other student pilots also expressed concerns about assuring they did not violate any FAA rules or regulations. For example, in his response to inquires regarding whether or not he would fly the aircraft with a flap problem (SC3), SP3 commented:

I'm sure it says somewhere in the FARs [Federal Aviation Regulations] that you're not suppose to be flying airplanes with you know, having this type of problem. So, it's probably illegal to fly an airplane that's got a problem with the flight control surfaces.

(Appendix I: page 263, 545-554)

Each of the SPs had purchased a Pilot's Operating Handbook (POH) for the aircraft that he flew. The POH provides pilots with general information, guidelines and operating limits for specific aircraft. During the interviews, students often discussed the importance of adhering to guidelines specified in their POH. A response by SP1 reflected the significance that the students attached to their POH:

Well, the first thing I would think about is if the plane, excuse me, if the plane is able to fly with the flaps retracted [meant to say 'extended'] thirty degrees. I'll open the POH and see what the requirement is — if it can fly or if it's unsafe to fly. That's what I would probably be thinking about — first thing.

(Appendix I: page 234, 25-38)

SP2, in discussing the same scenario (SC3), also placed an emphasis on checking his POH prior to making a decision. When asked about his thoughts about taking off with the flaps extended, SP2 stated:

...first of all I would check my Pilot Operating Handbook and make sure, first of all, I can even takeoff from this particular airplane with full flaps. Some airplanes, I would imagine, you cannot do that so, that's one consideration. And I'm not even sure I'd be concerned. I'm sure I could get the plane up in the air. My concern would be just flying for that extended period of time at that slow speed. With that situation, with the flaps, with damaged flaps. So I would check the POH...  
(Appendix I: page 244, 192-207)

Students also emphasized the importance of instructors' guidelines and rules established during flight and ground school instruction. For example, in his response to the scenario in which the aircraft experiences a loss of power (SC2), SP2 emphasized an important practice that was emphasized by his instructors and other pilots whose advice he valued; allowing the carburetor heat time to melt any possible ice:

...and I've heard many times from different people, different pilots instructors, professional pilots that things get worse before they get bad [meant to say 'better'] with carb icing.  
(Appendix I: page 242, 28-34)

SP4 also stressed the importance of guidelines imparted to him by his instructors. An old flight instructor's adage regarding one's priorities in flight states that a pilot should; *aviate, navigate and communicate*. SP4 remembered this guideline in his response to the cross-wind landing scenario (SC1), and commented:

I think that's where, in my experience, I'm still unfamiliar with, you know, as a new pilot that would be, I think, cause you're always — I guess you're worried about first being told to fly, navigate, communicate. So I'm at, you know, so that's, you know, in doing that the first thing is to fly the plane...  
(Appendix I: page 265, 849-861)

The student pilots also expressed concerns about complying with procedures and rules established by ATC. In his comments related to a possible cross-wind landing (SC1), SP1

expressed fear that he might get into “trouble” with the FAA for insisting on using another runway. When asked what type of trouble he was concerned about, he stated:

FAA may have some questions about that. You know, other people may, you know, be kind of ticked at me, you know, because, you know, a little bit of distraction in the [traffic] pattern.

(Appendix I: page 229, 895-900)

Other students expressed a variety of concerns about possible violations of FAA regulations. In comments made about the scenario involving a drop in RPM (SC2), SP4 was apprehensive about violating rules that mandated the establishment of two-way radio communications with ATC. SP4 seemed so concerned about not violating these rules that he considered turning around and returning to his home airport. SP4 commented:

My next thing is, OK, you know, this is no radios. Am I able, am I allowed to enter this airspace and you know, seeing that, that where I took off was uncontrolled [did not require contact with ATC] and I was able, you know, you could enter without radios, then you might be best just to go back.

(Appendix I: pages 266-267, 168-176)

One of the more interesting findings of this study was that students seemed to acquire important guidelines through self-directed learning. Student subjects commented about items they had read or “picked up” from a variety of sources. Typically, this information was obtained by reading a variety of aviation-related publications. When asked about the attendant’s offer to help fix the flaps in SC3, SP3 provided an example of self-directed learning:

...I don’t know if I’m misquoting but I thought I read somewhere that it really takes like three factors to make an accident. So, factor one, number one is unreliable flaps. Factor number two is the weather is getting worse and you know, if just one more thing goes wrong on route, I mean, it’s you’ve now got this situation that’s not good at all.

(Appendix I: page 260, 106-116)

SP4 also referred to information acquired through self-directed learning. In response to an inquiry regarding his thought process about a problem with his aircraft's flaps (SC3), SP4 responded in a manner that reflected his appreciation for his newly acquired information:

I know I just read something where it says that you're able to fix, make corrections on your airplane, but you also have to have it approved [by a certified mechanic]. So, you know, you make that correction, you know, you also have to have an approval before you can fly it...  
(Appendix I: pages 268-269, 57-65)

### Hazardous Attitudes

The student pilots displayed evidence of hazardous attitudes in their decision-making processes. Of the five hazardous attitudes previously discussed in Chapter Two, (see Berlin, et al., 1982), the SPs exhibited three (invulnerability, impulsiveness and macho). In addition, the SP subjects exhibited a tendency to permit *irrelevant factors* (factors that were not directly related to problems depicted in the scenarios) to influence their decision-making.

During several interviews, student subjects appeared to believe that they were invulnerable. They often discussed their willingness to accept what can only be considered dangerous options. The students were not only willing to accept alternatives that would place themselves in danger but would also place their aircraft and others in jeopardy. For example, despite stating that he planned to be cautious, SP1 discussed his willingness to attempt a landing in a substantial cross-wind. The cross-wind in the scenario (SC1) was gusting to seventeen knots. The strongest cross-wind that SP1 had ever landed in (with an instructor) was fifteen knots:

You know, if that was my destination, I had something to do, I would try. You know, there's a first time for everything. So I would try but I would be very cautious, very cautious because I know I only landed in a fifteen knot gusting cross-wind and seventeen knots is gonna be even worse. So, you know, ahhh, I would definitely be very cautious. I would know that this is my limit and this is over my limit.  
(Appendix I: page 231, 1000-1011)

SP2 also demonstrated a tendency to accept an alternative that had the potential to place himself and others in jeopardy. In his response to a question related to the same scenario (SC1),

the subject stated that if his request to land on another runway were denied, he would attempt a landing on the active runway (runway 35 with a cross-wind gusting to 17 knots). SP2 had previously remarked that he had experienced landing in cross-winds and that this would not necessarily present a problem; SP2 stated:

OK, I would, in this situation, accept clearance to the runway 35 due to the simple fact that the winds, you know, it would almost be a situation, I hate to say it, but everybody else is doing it [laughs].  
(Appendix I: page 241, 736-741)

The student pilot subjects also exhibited a tendency to act impulsively. Their thought processes reflected this in a variety of ways. For example, at the end of his interview related to the aircraft with the flap problem (SC3), SP2 was asked what he would do if he had more experience landing without flaps (SP2 indicated that this would be a primary concern). SP2 had wavered about both the extent to which he would permit an attendant to assist him and whether or not he would consider flying the aircraft. SP2 concluded that portion of his interview by commenting:

Maybe one of the circuit breakers is out [indicates a potential electrical problem]. If that was the case and I'd experienced landing with no flaps, then sure, I'd do it.  
(Appendix I: page 251, 1027-1032)

SP1 also demonstrated impulsive thought processes in his response to the same scenario (SC3). The subject stated that if he had the money, he would probably stay the night and attempt to obtain assistance to fix the problem the next day. When asked what he would do if he did not have the funds to stay the night, the subject responded:

If I didn't have money to stay the night and, you know, it was a little airport, way out in the country and, you know, I wasn't comfortable with the place or wasn't familiar with it, then I would probably try to reset the flaps to the upright position. Make sure they're down and locked, I mean up and locked.  
(Appendix I: pages 238-239, 833-842)

Student subjects also demonstrated a macho attitude. This attitude was manifested in the form of statements and responses that reflected unrealistic expectations of their competencies and experience levels. When SP3 was asked about his first priority with regard to the scenario dealing with a power loss (SC2), he seemed to be completely unconcerned about the potential hazards:

I mean, let's say the engine does fail. I mean you ahhh, keep a cool head. People make off airport landings all the time. I mean you know, people fly gliders, they don't have a problem with this kind of thing [laughs].

(Appendix I: page 258, 108-114)

When SP1 was asked about the attendant helping him address the problem with the flaps (SC3), he implied that he could personally resolve the problem. Although he was not a certified mechanic, SP1 spoke as though he were and that he would not be dependent on the attendant for help; SP1 remarked:

Yeah, I would let him help me try to raise the flaps. Then again, I wouldn't let him do all the work. I know I wouldn't have him looking over my shoulder and, you know, telling me what to do.

(Appendix I: pages 236-237, 716-721)

Student pilots also permitted irrelevant factors to influence their ADM thought processes. It was not unusual for students to permit factors that were not related to the scenario to take precedence over more pressing factors. For example, when responding to a question about his thinking priorities related to the scenario involving the engine problem (SC2), SP4 seemed completely oblivious to what should have been his major concern — the engine problem. SP4 appeared to be only concerned about the possible electrical problems and how that might affect the aircraft (note — the engine in the aircraft SP4 was flying did not depend on electrical power); SP4 stated:

I guess, you know, am I gonna lose my radios? That would be the first thing, you know, with those, with the strain. You know, what it's gonna affect, how is this gonna affect the operation of the other, you know, the operation of the airplane in general? You know, what's gonna be affected by it?

(Appendix I: page 266, 155-163)

In his responses to questions posed in SC3, SP1 made it clear that he would consider his friend (who was waiting to take a flight test). SP1 indicated that this outside factor would affect his ADM process; he remarked:

You know, of course you know, I want my friend, you know, [to] get his checkride, do well, you know, have this plane up flying and that would make me want to, want to go more.  
(Appendix I: page 235, 574-580)

As a group, the student pilot subjects exhibited similar characteristics. The information they used to assess risk were often inadequate and, at times, was purposely limited. Their interpretation of risks associated with each of the scenarios was often accomplished without much analysis, despite awareness of their inexperience. They recognized a limited number of alternatives and were often hesitant about possible courses of action. In addition, student subjects used familiar experiences (e.g., automobile driving and experiences from their flight training) to assist them in resolving problems. Students also emphasized the importance of adherence to rules and guidelines from a variety of sources that they believed to be authoritative. Finally, the thought processes of student subjects included hazardous attitudes which prompted courses of action that would, if followed in actual flight situations, place them and others in jeopardy.

#### Comparisons of Pre-flight and In-flight Decision-Making Processes of Expert and Novice Pilots

This section compares the decision-making processes of expert and novice subjects. The discussion will center on the research design (see Figure 14, page 58) previously discussed in Chapter Three. To facilitate this comparison, I revised Figure 14. The revision is depicted on the following page as Figure 21. The information in Figure 21 was expanded (from what was provided in Figure 14) to reflect the major traits of expert and novice subjects with regard to their pre-flight and in-flight decision-making processes.

It should be noted that there are cases (noted by astrixes) in which decision-making characteristics were noted to be present (at least several times) both in pre-flight and in-flight settings. The quadrant selection for those characteristics were based on the context of the subjects' interview comments (pre-flight or in-flight) in which the characteristic was most often noted. The selection of specific characteristics (used for the six comparisons in Figure 21) were

based on those characteristics that appeared to be representative of the most pertinent distinctions for each comparison and are identified by letters (in italics and parentheses following each characteristic) in Figure 21. The italicized letters in Figure 21 correspond to the following letters used to designate the six comparisons: 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. Each of these comparisons will be discussed in turn.

Figure 21: Expert and Novice Pre-flight and In-flight Decision-making Comparisons

	Novice Pilots	Expert Pilots
Pre-flight	<ul style="list-style-type: none"> <li>-Acquired inadequate additional information*(c)</li> <li>-Adhered to rules/procedures*(c &amp; f)</li> <li>-Priorities with little analysis*(d)</li> <li>-Exhibited Hazardous Attitudes*(c)</li> <li>-Realized inexperience but (f) chose difficult alternatives*</li> </ul>	<ul style="list-style-type: none"> <li>-Sought information only from qualified individuals (b &amp; c)</li> <li>-Considered effects of stress and fatigue (b and e)</li> <li>-Planned diligently and careful (c) analysis (e.g., legal, safety, etc.)**</li> <li>-Ignored excessive risks**(e)</li> </ul>
In-flight	<ul style="list-style-type: none"> <li>-Recalled experiences*(d)</li> <li>-Recognized few alternatives*(d)</li> <li>-Hesitant and uncertain*(e)</li> <li>-Purposely limited number of items to consider (a &amp; d)</li> <li>-Stressed importance of attempting to calm down and to take time to assess risks(a &amp; e)</li> </ul>	<ul style="list-style-type: none"> <li>-Established context ** (f)</li> <li>-Defined situation** (f)</li> <li>-Used prior experiences to resolve problems**(d)</li> <li>-Self-reliant**(f)</li> <li>-Prioritized plans and backup plans**(d)</li> </ul>

\* applies to both pre-flight and in-flight ADM for Novice Pilots

\*\* applies to both pre-flight and in-flight ADM for Expert Pilots

### Student Pilot Pre-flight and In-flight Decision-making

The characteristics associated with SP pre-flight and in-flight decision-making were found to be nearly identical. There were two exceptions that were present only in SP in-flight decision-making. The two exceptions included the tendency of SPs to limit the number of items purposely to consider when attempting to reach a decision and their tendency to make an effort consciously to calm down and take time to evaluate a situation prior to choosing an alternative.

Throughout the SP interviews, there were numerous examples of SPs exhibiting a purposeful effort to confine their in-flight thought processes. They seemed to believe that too much information would hinder, rather than help them make a decision. SPs also pointed out that prior planning could assist them in this goal (limiting the number of things to consider while in flight). For example, when asked about why being familiar with an airport could be helpful, SP3 explained:

Well, as I said, there would be one less thing to think about. I would know generally how things look there [the airport at which SP3 intends to land]. You'd have a good idea of — you wouldn't know what the pattern [traffic pattern for arriving and departing aircraft] looks like at this airport. You wouldn't have to be thinking about things like, you know, trying to figure out, is it supposed to be a left pattern [turns to the left] or right pattern and, you know, what were the procedures at this airport. That's if I already knew all that stuff, then it would just add a little more comfort factor into the whole situation.  
(Appendix I: pages 256-257, 219-238)

Student subjects were also sensitive to the effects of remaining calm when experiencing in-flight problems. They spoke of the importance of taking time to evaluate situations and to escape from an environment that could, as they perceived the scenarios, result in pressure to make hasty decisions. SP1, for example, mentioned that he would need time to think through the alternatives facing him in SC1. In response to a question about this process he responded:

I'd probably depart the pattern [referring to the traffic pattern of the airport at which he intended to land], not far. Not more than five miles out. Depart the pattern for a little bit, try to calm myself down, think about, you know, what I should do. You know, now if I didn't have no fuel, I definitely wouldn't want to go too far. And the first thing would be to probably trying to calm myself down. But trying to, you know, I would definitely have to leave the [traffic] pattern to calm myself down. If you're in the pattern,

you always got to look for airplanes. You've got to make sure you're at the right altitude, stuff like that. So I would depart the pattern so I could calm myself down.  
(Appendix I: page 232, 1042-1058)

### Expert Pre-flight and In-flight Decision-making

EP pre-flight and in-flight decision-making characteristics were also similar in many respects. As was the case with the student subjects, there were two exceptions. Both of these exceptions involved pre-flight characteristics of the experts. The first of these pre-flight characteristics was that the EPs would only accept assistance from those who they deemed to be competent. Individuals they perceived to be incompetent were either quickly dismissed or viewed with considerable skepticism. A second characteristic demonstrated by the EPs during pre-flight ADM involved their recognition of the effects of stress and fatigue and their reluctance to fly if these factors were deemed excessive.

One of the major considerations in the third scenario was whether or not to permit an unqualified individual (the attendant) to attempt to fix the aircraft. EP3 demonstrated a typical expert pilot response. When asked about the most important thing he needed to consider in this scenario, EP3 replied:

The safety of the person who could be operating this airplane and if someone not authorized to fix it were to do it and then someone flew it, meaning me, and there were an accident, you know, it could be terrible, so if I were to fly it, I wouldn't fly it and I wouldn't want anyone else flying it until it were properly repaired. So, the airport attendant would be told by me, 'You're not to touch the airplane.' I don't care if he knows exactly what it is [the problem]. 'You're not doing it and I don't care who you are, you're not a mechanic.' And that's the way it would be, so I'll lock the airplane and leave, get a rental car.  
(Appendix G: page 201, 95-113)

The experts also expressed concerns during pre-flight about factors that could affect them if they chose to fly. They were particularly concerned about flying when they did not have adequate rest or when they knew they would be in situations that could produce excessive stress. In responding to a question relating to the pilot in the fourth scenario, EP2 commented about the factors he believed to be important considerations in pre-flight decision-making:

I'd like to know her recency of experience. You know, she may be current for the regs, but is she proficient? Is she comfortable flying IFR [Instrument Flight Rules — flying in the clouds]? You know, some pilots will do it with an instructor, but they don't like to do it on their own [flying in the clouds]. When's the last time she's been in IMC [Instrument Meteorological Conditions — flying in the clouds] by herself? You know, had done all the work by herself? What time did she get up that morning? How long had she been up prior to takeoff? They're all factors to consider in this decision to go or not to go.  
(Appendix G: pages 188-189, 286-300)

### Student and Expert Pre-flight Decision-making

The most distinguishing differences between the pre-flight decision-making of experts and novices was that the novices were willing to take chances, frequently relied on advice from questionable sources and sometimes exhibited hazardous attitudes in their decision-making processes. In addition, they did not always acquire adequate additional information upon which their priorities and decisions were based. In contrast, expert pilots actively sought information from qualified sources and took time to evaluate carefully all of the factors related to an upcoming flight.

SP1 provided an example of SP pre-flight decision-making processes. In his response to questions about the factors he would consider in making a pre-flight decision, SP1 mentioned that he would probably wait “if it was a nice summer night.” When asked what he would do if it were a “cold winter night,” SP1 responded:

Oh man, that wouldn't be nice. Well, then I would probably...again I, I would ask some pilots, see what they would do and if it's cold, I had no money, I had no food, I wasn't familiar, you know, it was a little airport and I couldn't get hold of any mechanic, couldn't. Now, worse case problem, and I couldn't set the flaps up. I would probably have to go, go to this thirty [chuckles] thirty-five mile trip over to this other airport. But I would definitely be pretty cautious about flying.  
(Appendix I: page 239, 864-879)

Expert pilots exhibited diligence in their pre-flight decision-making processes. They were careful about the information they used to assess risks and were cautious not to neglect to consider all pertinent factors. For example, when responding to the scenario that involved the

flap problem (SC3), EP1 emphasized that it was his responsibility to assure that the problem had been corrected by a certified mechanic. He discussed the conditions under which he would and would not fly the aircraft; EP1 commented:

That's OK [certified mechanic was able to retract flaps but was unable to guarantee they would extend]. I don't need flaps to land. I'd go. I'd bring the plane back and then send it into the maintenance shop at that facility and say 'fix the thing.' But as far as the attendant doing the same thing. The attendant? You mean the guy that's out there pumping gas? Phsshhh. Come on now. It's like the janitor coming into your class and saying, 'Hey, you need to' — no thank you. He may be all well intended but 'no.' It's my decision to make, that the plane is airworthy and it's the consequence is mine and I cannot relinquish that authority to somebody else.  
(Appendix G: page 169, 198-214)

### Student and Expert In-flight Decision-making

Student subjects in-flight decision-making processes reflected distinct characteristics. Although they tended at times to base decisions on their experiences, SPs typically were able to recognize few, in-flight alternatives. Such was the case with SP4 in his response to questions related to landing in a cross-wind (SC1). SP4 indicated that he had experienced landing in cross-winds but seemed hesitant about landing in a cross-wind of the magnitude stated in the scenario (ten knots with gusts to seventeen knots). Despite his apprehensions, he seemed determined to attempt a landing on the runway with the cross-wind and to repeat the process if he was unsuccessful; SP4 stated:

The worse thing you'll do is to do a 'go-around' [abort the landing attempt and try again]. And that's, you know, and do it that way. You know, you can, as you're coming down you can kind of pull out and just go around...  
(Appendix I: page 264, 429-435)

Expert pilots' in-flight decision-making reflected their ability to recognize relevant cues based on their prior experiences. They also demonstrated the ability to form priorities quickly and to establish back-up plans in the event that their primary alternative was unsuccessful. EP4 exhibited these characteristics in response to the cross-wind landing scenario (SC1). When asked

about his thought process regarding landing in a cross-wind that he felt was beyond his or his airplane's capabilities, EP4 commented:

I mean you always land into the wind if you can do it. If you can't do it, then make the best that you can. But if you, even in this situation if you were to say, it's against, it's beyond your ability, you have to make that assessment. And if you say, 'this is something I can't do.' For whatever reason, I'm not comfortable with it, well, then yeah, go someplace else where the wind is right down the runway. I mean I think about that all the time here, [at Montgomery County Airpark] if I can't get in, I know I can get into Frederick [airport]. Cause if the wind is a cross-wind here, it's gonna be right down the runway at Frederick. So I have that in the back of my head that I will, again, have an escape route.  
(Appendix G: page 205, 250-269)

### Student In-flight and Expert Pre-flight Decision-making

The student pilot subjects often displayed hesitancy in their in-flight decision-making processes. They seemed to waiver as to the proper course of action and talked about the importance of calming down and attempting to determine what they hoped would be an appropriate course of action. Such was the case with SP3. In his comments with regard to the aircraft with an engine problem (SC2), the subject stated:

So actually, ahhh, you know, well, OK we've got some problems. I, as soon as ahhh, I probably would have a look out the window, right at the beginning and say, 'OK, is there a field nearby?' You know, hopefully, there's something around [to land on] then I'd get on the radio with the tower, so... But I, you know, important not to , not to get too excited, you know, about being into them. This is bad but you don't have to start freaking out.  
(Appendix G: pages 258-259, 115-127)

Expert subjects often spoke of the effects of stress and fatigue during their pre-flight decision-making process. They discussed how these factors could cause them to decline to fly and how they would attempt to avoid taking what they considered to be excessive risks. For example, when asked about the "go/no-go" decision, EP4 provided an example of a flight from Salt Lake City to Montgomery County Airpark (MD). Faced with unfavorable weather conditions, EP4 and the owner of the aircraft decided to stop in Indianapolis, refuel, and discuss whether or not to continue to Montgomery County Airpark:

...and I said, 'you know, we're flying into an unknown situation.' I mean, I can't, there's, you know, I can't get the AWOS [Automated Weather Observation Station] you know, you call the AWOS on a cell phone at Gaithersburg. I can't get them, they're not coming up — I don't hear anything. And I said, 'we have massive ice storm, snow storm, you know, chances are we're gonna be shooting an approach to minimums [minimum descent altitude]. There is what other considerations? I said, 'We're gonna, you know, we're gonna be tired, it's gonna be night, it's gonna be minimum conditions, we don't know the conditions of the runway at Gaithersburg. There's no one there, no one's answering the phone. So what does that mean when no-one is answering the phone? It means they're not there. This airport, like a lot of airports, they don't plow the runways until the snow stops. So you could have, you could be flying into a situation where you have twenty inches of snow on the runway. Everything points to us spending the night here... (Appendix H: page 214, 936-964)

### Student Pre-flight and Expert In-flight Decision-making

Student pre-flight decision-making was characterized by adherence to rules and procedures. These rules and procedures involved those imposed by the students' instructors as well as a variety of other sources that were previously cited (e.g., FAA, Pilot's Operating Handbook, etc.). In addition, SPs realized their inexperience but were not deterred from choosing alternatives that could be difficult or even dangerous. SP2 provided an example of this type of thought process in his response to the problematic flap scenario (SC3). In this exchange, SP2 made it clear that he has been taught not to fly in adverse weather but despite that, and after acknowledging his inexperience, contemplates taking what can only be considered a risky flight:

No, I still wouldn't, I still would feel very uncomfortable flying it [his airplane with flaps extended]. And at this point in my experience, I wouldn't do it. Not with the weather the way it was. I mean it's one thing if it was clear sky, sunny day and I can just slow flight [flying at or slightly above minimum controllable air-speed] for thirty-five miles. But, ahmm, you know, with the weather. It says [in the written scenario] that the weather is deteriorating. Thirty-five mile flight doing 65-70 knots. You're talking forty minutes to get there, whatever that is. Ahmm, you don't know, you know, rain hits or winds start hitting and that kind of thing. I'm not ahhh, it, to me it's a no brainer. I wouldn't even think about making this flight.

ELD: And that would be primarily because of the weather?

No, I wouldn't say primarily. Certainly weather would certainly attribute to that, contribute to that decision. Ahmm, well, I would say if the weather was a beautiful day and that kind of thing, I would consider it [taking off with flaps fully extended]. I didn't say I would do it, I would consider it.  
(Appendix I: page 243, 72-104)

Expert pilot in-flight decision-making was characterized by subjects establishing the context within which the scenarios occurred. In addition, the experts took time to define the specific situation. The experts also tended to rely on themselves when experiencing in-flight problems. They frequently spoke of their authority as Pilot in Command and did not hesitate to exert their authority and responsibility when experiencing problems. EP3 provided an example of these characteristics when he responded to a query about his decision-making process with regard to the aircraft with an engine problem (SC2); EP3 stated:

Well, the first thing — we're at 4,500' VFR which is Visual Flight Rules on top of haze. Now haze, you know, it's still Visual Flight Rules and you add haze to that, it's still difficult to see. You can make out things on the ground, you can see them, however, you almost have to be right on top of them. Ahhh, first, the engine slowly starts to losing RPM. Or fuel, oil, after pulling the carburetor heat [EP3 is reviewing the written scenario] ahh the engine backfires. At that point I would look below where I was at the time and see if there was a suitable place to land. Ahh, being another runway, ahhh, at that point I would just look for another airstrip. I wouldn't necessarily consider landing at a field, on a field or a highway yet cause the engine is still running. So, if I did see a runway below me or very close to me I would opt for that, to land. However, if there was not anything, I would, meaning there is no runway below me or close by...ahhh, it's fifteen miles from the nearest airport [referring to written scenario] with a control tower. I would continue pressing onto that airport, even though I was losing RPM, the engine is still running — meaning it's producing power. And I have pretty good altitude, 4,500. I would press on to there. With the alternator problem, with the electrical problem — let's see, we have assuming we have a bad alternator, I would go ahead and turn off non-essential [electrical] equipment; lights, the second radio, ADF [Automatic Direction Finder] things of that sort, CD player, whatever you have. And just use one radio for communication and navigation and at that point call the tower and advise them, 'I have a rough engine, running engine and I'm inbound from point A to wherever their airport is and not necessary to declare an emergency at that point. But might put it, consider it if it gets worse. Actually, would declare an emergency if it gets worse. And the

reason for that is is says here [referring to the scenario] ‘You’re in an area of heavy traffic’ [numerous other aircraft]. Well, that’s the whole idea is to competing for a runway when I have a problem — competing for a runway. When there’s heavy traffic, I want the [control] tower to clear them out of the way so I can get on the ground.  
(Appendix G: pages 192-193, 16-79)

### Discussion of Major Findings

The EP subjects demonstrated characteristics that were found to be present in previous studies mentioned in Chapter Two (e.g., Dreyfus and Dreyfus, 1986; Klein, 1989; O’Hare, 1997 etc.). For example, Klein (1989) discussed how experts in naturalistic environments tended to rely on recognition of cues from their prior experiences to help them resolve problems. Expert subjects in my study had developed “cognitive maps” that appeared to spark mental cues that were used to help them resolve similar scenarios. When faced with scenarios involving assessment of risks, the experts were quick to fill in the gaps (with additional information) on their respective cognitive maps. That process appeared to assist them in developing a more focused picture of viable alternatives. All of the EPs in my study demonstrated that characteristic. The ability to assess quickly and associate current scenarios with past experiences and to develop viable and safe alternatives, was perhaps the most dominant EP characteristic of this study.

The student subjects had no such maps to assist them in their decision-making. Their ADM thought processes were generally limited to an evaluation of the scenarios based on rules and procedures. Although the SPs had acquired experiences and relevant information during their flight and ground instruction to comprehend fully the scenarios, their cognitive maps were not developed to the extent necessary to address pertinent issues safely and competently. Nevertheless, student subjects attempted to link scenarios to their previous experiences that were, in their view, relevant (e.g., relating issues in scenarios to driving automobiles and, in a few cases, relating relevant flight experiences to the scenarios).

It should be noted that student pilot subjects appeared to vary in their predisposition to develop and use cognitive maps. For example, SP3 seemed particularly inclined to make use of his prior experiences in his attempt to resolve issues. In responding to the scenario regarding the flap problem (SC3), SP3 discussed how he had experienced a similar problem and how that incident was useful in helping him choose an appropriate course of action (he decided not to fly).

Additionally, SP3 indicated that this lesson would have far reaching applications. SP3 could have been alluding to the development of a cognitive map when he remarked:

...it didn't, wouldn't matter really if there was a problem with the flaps. It could be a problem with something else and it [the airplane] would still be grounded. I mean, there's — even things that you'd think were inconsequential that aren't working, it could be a problem later on.

(Appendix I: page 262, 308-316)

Two of the SP themes seemed to represent a contradiction. Although SPs emphasized adherence to rules and procedures in their ADM thought processes, they also displayed hazardous attitudes. Despite their flight and ground instruction, all of the SPs exhibited at least one of the previously noted hazardous attitudes in their decision-making. This apparent contradiction might be interpreted in terms of their (SPs) lack of relevant experiences since no hazardous attitudes were detected during the EP interviews. There appeared, therefore, to be a connection (in this group of subjects) between hazardous attitudes and experience. It is possible that student pilot subjects, while attempting to “do the right thing” (adhere to rules and procedures and make the “right” choices), were unable to overcome completely the effects of their inexperience (an indication of which were their expressions of hazardous attitudes).

I found it interesting that several of the student subjects expressed a desire to limit the number of factors purposely to consider prior to making a decision. That process was evident only in scenarios involving in-flight decision-making. In such environments the ability to identify pertinent factors becomes critical. That ability was not consistently evident in student responses to the in-flight scenarios.

Early in this study, I spoke informally to EP1 about his acquisition of decision-making skills. EP1 remarked that he had learned through a trial-and-error process that was not, in his opinion, a very efficient or safe way to become a more proficient aeronautical decision-maker. Are there better methods to help student pilots become more efficient and safe decision-makers? Is it possible to train student pilots to acquire the decision-making skills of experts? Could *knowledge* be used as a substitute for *experience* in attempting to improve student pilot ADM? If so, how and under what conditions could one best accomplish these goals? It is to these questions that I now turn.