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16. Abstract

Pilot judgment errors have long been recognized as an important factor in aviation accidents. Previous studies have demonstrated that specialized training procedures can significantly reduce the number of decisional errors made by newly certified private pilots during in-flight tests. However, the subjects in these studies were all college-age students enrolled in full time aviation training programs which were taught by highly motivated instructors. The present study examined the utility of revised judgment training materials with typical private pilot applicants in conventional flight school settings at ten fixed based operations within the FAA's Eastern Region. The performance of a sample of subjects who received judgment training was compared with that of a control group drawn from these same FBOs. The behavioral test of judgment was in the form of an observation flight administered by observers who were uninformed of the details of the experimental design. Students and instructors also completed a critique of the program materials. The results of the study suggest that improvements in pilot decisionmaking skills can be achieved in the less formal instructional climate which characterizes many conventional flight school programs. The revised judgment training program and instructional materials are acceptable to the user community, and most participants found them to be very useful.

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PRIVATE PILOT JUDGMENT TRAINING IN FLIGHT SCHOOL SETTINGS

INTRODUCTION

In 1976, the Federal Aviation Administration (FAA) contracted with University of Illinois researchers to investigate the degree to which faulty pilot judgment contributed to civil aviation accidents and to determine whether and how pilot judgment might be taught and evaluated. This study reviewed all general aviation accident data between 1970 and 1974, and concluded that faulty pilot decisional activities were involved in 35% of all nonfatal general aviation accidents and in 52% of all fatal accidents (Jensen and Benel, 1977). The authors offered the following two-component definition of judgment:

> 1. The ability to search for and establish the relevance of all available information regarding a situation, to specify alternative courses of action, and to determine expected outcomes from each alternative.
>
> 2. The motivation to choose and authoritatively execute a suitable course of action within the time frame permitted by the situation (1977, p. 34).

These researchers concluded that pilot judgment could be taught and objectively evaluated, and they proposed some ways in which this could be accomplished. Two years later, the FAA contracted with Embry-Riddle Aeronautical University, Daytona Beach, Florida (ERAU) to develop judgment training materials for student and instructor pilots, devise procedures for the objective measurement of pilot judgment, and demonstrate the effectiveness of such training. A revised definition of pilot judgment was developed by this group:

> Pilot judgment is the mental process by which the pilot recognizes, analyzes, and evaluates information regarding himself, the aircraft, and the outside environment. The final step in the process is to make a decision pertaining to the safe operation of the aircraft and to implement the decision in a timely manner (1982, p. 4).

The ERAU project (Berlin, Gruber, Holmes, Jensen, Lau, Mills and O'Kane, 1982) produced prototype student and instructor pilot training manuals, and developed an observation flight protocol to measure pilot judgment. Using this technique, the ERAU team then carried out a limited validation study of the training materials. The subjects were all students

enrolled in an ERAU flight program and had a mean age of 19 years. One group of subjects was trained under the conventional ERAU primary flight program, while a second group's flight and ground training incorporated the newly developed judgment materials. Both groups were evaluated on the observation flight, and the group which had received judgment training did significantly better than the control group on this behavioral test.

In 1982, the FAA entered into a joint research agreement with Transport Canada to further examine the ERAU prototype materials and to independently evaluate judgment training in the Canadian pilot population. Several experiments have thus far been conducted under the provisions of that agreement.

The subjects in the initial Canadian study were civilian Air Cadets participating in a summer flight training program in the Ontario Region. All were in their late teens and early twenties, and more than half of the subjects already held glider licenses. This study used geographically isolated experimental and control groups, and the observation flight was administered under circumstances which permitted its true purpose to be better disguised than in the ERAU study. Here too, those subjects who received the judgment training did significantly better on the observation flight than did control subjects (Buch, 1982; Buch and Diehl, 1984). The results of both the ERAU and Air Cadet studies are shown in Figure 1.

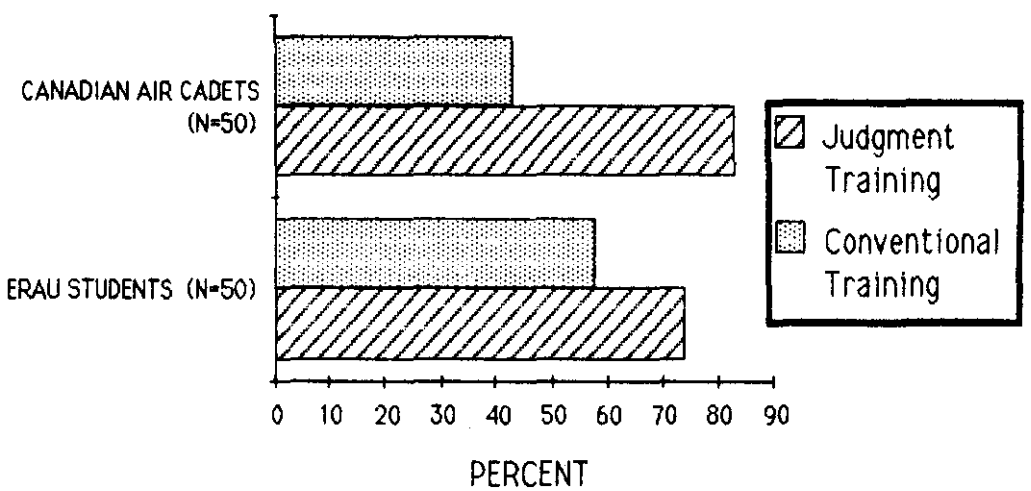

Figure 1. Results of ERAU and Canadian Air Cadet Studies.

A second Transport Canada study was undertaken in order to determine whether the use of the self-paced student manual could improve pilot decision-making skills without the involvement of flight instructors (Buch and Diehl, 1983). This study, conducted at Confederation College of Applied Arts and Technology (Thunder Bay, Ontario) used a group of 17 university students. All were licensed private pilots with "relatively little flight time". Subjects were first evaluated using a well-disguised observation flight procedure, then given the self-paced manuals and instructed to complete them on their own. Following the self-study program, a second observation flight was scheduled. The use of the judgment training manuals alone resulted in a significant improvement in observation flight performance, from 53% on the pretest to 62% on the post-test.

Another Canadian study, this one on the effectiveness and permanency of judgment training over time, is currently under way at a community college in Chicoutimi, Quebec (Buch and de Bagheera, 1985). In this study, subjects' aeronautical decision-making skills will be evaluated up to three years after their initial judgment training.

While pilot judgment and decision-making may be related to relatively inflexible aspects of pilot personality or to the interaction of personal and situational variables (Lester and Bombaci, 1984), these experiments strongly suggest that the use of the judgment training curriculum can significantly improve pilot performance and enhance aviation safety. However, there were a number of limitations to the studies which compromise the external validity of these findings. Most of the subjects were young males who had only recently completed their secondary education. Both the ERAU students and the Canadian Air Cadets were enrolled in highly concentrated aviation training programs. Most of the Air Cadets already held glider licenses, and all of the subjects in the Confederation College study were licensed private pilots at the time the judgment training was begun.

It was, therefore, felt necessary to demonstrate that the judgment training curriculum would be effective with the general population of ab initio student pilots and in the type of training environments typically encountered at operational flight schools. Further work was also needed in order to produce training materials which were acceptable to students and instructors in these settings.

Thus, following completion of the Air Cadet study, it was decided to undertake a major revision of the judgment training manuals, and then to demonstrate the effectiveness of these revised materials in conventional flight schools. The revision of the student pilot and instructor manuals was undertaken as a joint project by FAA, Transport Canada, and the General Aviation Manufacturers Association (GAMA) (See Note 1). Audio-visual materials, consisting of approximately one hundred 35 mm color slides and a six minute video tape, were also produced to enhance the training of both student pilots and instructors.

The 70 page Student Manual introduces the concept of judgment and describes the role of risk assessment and decision-making in aviation. The student's attention is then directed to the subject areas of Pilot, Aircraft and Environment, and to Six Action Ways or modes of pilot error (Do, No Do, Early Do, Late Do, Under Do, Over Do). The notion that errors are cumulative is discussed in the context of the Poor Judgment Chain, and the student is given a method to help break this chain. Following a discussion of the Three Mental Processes of Safe Flight (Automatic Reaction, Problem Resolving, Repeated Reviewing), a Self-Assessment Inventory introduces the student to Five Hazardous Thoughts (Impulsivity, Invulnerability, Macho, Anti-Authority, Resignation), and specific Antidotes to each hazardous thought are provided. The manual concludes with chapters on Stress Reduction and some specific applications of pilot decision-making skills.

The 63 page Instructor Manual provides specific guidance on how to teach judgment, and outlines 18 in-flight Lesson Plans and 50 Judgment Training Scenarios to help accomplish the program's goals (See Note 2). It includes a proposed schedule of student work, suggestions on how to manage judgment training, and a master set of student records to be duplicated and used at each training site. The manual concludes with a set of Postcheck Exercises to assure that the student has mastered the judgment training material. Both of these manuals are extensively revised versions of the material which had been developed by the ERAU research team.

METHOD

The experimental design compared the performance of two groups of newly rated private pilots on a behavioral test of judgment. The study was conducted at ten FBOs within the FAA's Eastern Region, which consists of the geographic area within the states of Delaware, Maryland, New York, Pennsylvania, West Virginia, and Virginia, and the District of Columbia. The participating FBOs are listed in Appendix A. The control group included subjects trained at these FBOs using conventional pilot training programs. The experimental group used subjects drawn from these same FBOs. Their training followed the same curriculum as was used in the control group, but with the addition of a judgment component taught by specially trained instructors. The behavioral test was in the form of an observation flight which was administered by specially trained observers who were uninformed of the details of the experimental design.

Cooperating instructors at each of the ten participating FBOs were individually trained. At some FBOs only one or two instructors were included, while at others the entire cadre of CFIs agreed to participate. A one hour slide presentation described the rationale and philosophy behind judgment training, reviewed the content and methods used in the curriculum, and presented a number of vignettes which illustrated ways in which the judgment materials could be integrated into flight instruction. Instructors were then given the Student and Instructor Manuals to study, and were later interviewed in order to assure their familiarity with the curriculum. All instructors participating in the program were unpaid volunteers and were unaware that their students' judgment might later be evaluated. An FAA Scientist occasionally visited the FBOs to coach instructors and monitor the progress of the program.

The observation flights were conducted by observers who were unaware of the overall experimental design and who had no knowledge of which type of training each subject pilot had received. The observers were employees of the Aircraft Owners and Pilots Association (AOPA) and had volunteered for the project. Each held an Airline Transport Pilot certificate, along with Certified Flight Instructor, instrument and multi-engine ratings., and each had between 5,000 and 10,000 hours of total flight time. During training sessions, observers were introduced to their roles in the study. It was stressed that their primary concern was to maintain flight safety at all times, while keeping an unobtrusive record of the subject's performance. Training underscored that the observer's role was to present tasks and record performance, rather than to instruct or

critique the students. Each observer was assigned two or three airports from which their observation flights were to be conducted.

During individual familiarization flights at each airport, specific terrain features and targets to be used as checkpoints during the observation flights were selected. This flight was also used as an opportunity for further training of the observer in the presentation and scoring of the observation flight scenarios. Because the terrain, weather, traffic conditions, and targets varied considerably among the ten airports, no attempt was made to establish a rigid flight profile which would apply to all observation flights. But each observer flew with subjects from both the experimental and control groups and thus acted as his own blind control for these factors.

The behavioral test of pilot judgment was in the form of a 12 item observation flight that could be safely and reliably presented at all evaluation sites. Items were selected to cover pilot activities normally occurring during the preflight, departure, cruise and arrival phases of a typical general aviation flight conducted under visual flight rules. Each item required a decision by the pilot, and provided a measure of judgment rather than of knowledge, skill or experience. The 12 items and the criterion behavior which constituted "good judgment" for each is presented in brief form in Table 1. A complete description of the specific procedures for administering each item and the scoring guidelines used by the observers appears in Appendix B.

Table 1. Observation flight items.

1. Pilot checks weather and Notices to Airmen prior to boarding aircraft.

2. During preflight inspection, pilot detects and remedies loose fuel tank cap, loose oil filler cap, or popped circuit breaker.

3. Prior to engine start, pilot detects and removes an empty soft drink bottle or flashlight from cockpit floor, or removes a hat placed on glareshield.

4. Pilot shuts down engine or directs observer to remain in aircraft when observer indicates his intention to exit aircraft in order to check something (eg. loose cowling) shortly after engine start.

5. Pilot requests that observer hold questions and comments following interruptions during preflight, taxi, or run-up checklist.

6. Pilot declines observer request to make a marginally safe intersection takeoff, non-standard turn from pattern, or low altitude turn immediately after takeoff.

7. Pilot declines observer request to overfly a target structure (eg. friend's house) in a built-up area by barely 1,000 feet.

8. Pilot declines observer request to execute a low steep turn over a target structure.

9. Pilot declines observer request to fly at an unsuitably low altitude over water, mountainous, or heavily wooded terrain.

10. Pilot adjusts altitude to comply with VFR cruising standards following observer request to turn to new heading.

11. Pilot avoids controlled airspace or obtains ATC clearance following observer request for flight into active Airport Traffic Area.

12. Pilot declines observer request to fly a non-standard pattern, directly over airport at pattern altitude, high final approach leg, or downwind landing at uncontrolled airport.

In order to permit a realistic assessment of pilot judgment, it was necessary to disguise the true purpose of the study. Thus, the observation flight was described to subjects as being part of an "aviation safety survey" being conducted by AOPA. Subjects initially received a letter stating that volunteers were being asked to participate in a short cross-country flight in connection with the planned revision of sectional aeronautical charts. The incentive for these newly licensed pilots was they would be given the opportunity to fly a rented aircraft from their home airport free, in exchange for their participation in this study. The letter requested that pilots call a toll-free telephone number if they were interested in participating. When a subject telephoned, they generally spoke with the observer who would conduct their observation flight. The observer introduced himself, explained the proposal in greater detail and, if the subject was still willing, made arrangements to meet at the pilot's home airport.

Upon arrival at the airport, the subject was greeted by a casually dressed observer who explained the study of the revised sectional charts and the need for evaluations from newly rated private pilots. The subject was told that he would first complete a questionnaire on a prototype chart, and then fly the survey flight using the standard chart for his home

area. It was explained that half of the observation flight would be flown at low altitudes, with the other half at cruise altitudes. Subjects were told that the major concern during the flight was how useful the currently used chart symbols were for a new VFR pilot. The observer explained that the flight would proceed with the subject being asked to locate certain targets. The route of the flight was then shown, and the subject was reminded that he was the pilot-in-command and was to make all decisions regarding the flight. The subject was then given the prototype Los Angeles sectional chart along with a 22 item "National Airspace Review VFR Prototype Chart Evaluation Form" (See Note 3). Subjects were allowed as much time as needed to study the prototype chart and complete the questionnaire. They then could proceed to flight planning activities and the preflight aircraft inspection.

Observers did not volunteer detailed information about their own flying background. If a subject inquired, the observer told them only that he was a rated pilot. If pressed for more details, the observer allowed that he "used to be a flight instructor" but was not actively involved as such any longer. This satisfied virtually all subjects and helped to minimize the tendency to attribute authority figure status to the observers. Items were presented by the observers in such a manner as to never require them to take control of the aircraft or to divulge the true purpose of the flight. Each item was scored and unobtrusively recorded by the observer at the time it was presented according to the specific scoring guidelines using a dichotomous "good judgment" or "poor judgment" scoring system.

Following completion of the private pilot check ride, each subject who had received judgment training was asked to complete a 12 item evaluation of the program (See Appendix C). Instructors completed a similar 16 item form (See Appendix D).

RESULTS & DISCUSSION

Subjects

The subjects in the control group were tested by one of four observers. When the control group data were examined, significant differences between observers in the mean observation flight scores of their respective subjects were noted. Given these differences, an effort was made to have each observer fly with about the same number of subjects from both the experimental and control groups. However, because of scheduling difficulties, only three of the four observers were able to fly with experimental group subjects. For this reason, the observation flight performance of 20 subjects from the experimental group is compared with that of the 25 control group subjects who were tested by these same three observers.

It was not possible to schedule an observation flight with any subjects at one of the ten FBO's. Also excluded from the analysis is data from one subject who appeared for the observation flight in a personally owned complex turbo-charged aircraft. The number of subjects participating in experimental and control group observation flights from each of the ten FBO's is shown in Appendix E. The data for the control group appears in Appendix F, while experimental group data is contained in Appendix G.

No significant difference between experimental and control group subjects was noted with respect to age ($t=0.15$, $df=42$). For the 24 control group subjects on whom demographic information was available, the mean age was 34.0 years, with a range from 20 to 64 years. The 20 experimental group subjects ranged in age from 18 to 55 years, with a mean age of 34.4 years.

There were also no significant differences between the experimental and control groups in the number of flight hours or the number of months spent in training for the private pilot certificate. Subjects in the experimental group ($N=20$) had a mean of 90.6 hours of flight time when they passed the private pilot check ride, while control group subjects ($N=18$) had a mean of 72.4 hours ($t=1.42$, $df=36$). For the control group subjects ($N=17$), an average of 9.6 months elapsed between their first solo and the check ride, compared with a mean of 7.7 months in the experimental group ($N=20$) ($t=0.73$, $df=35$).

No significant differences between the experimental and control

groups were noted in the amount of time which elapsed between the private pilot check ride and the observation flight ($t=0.54$, $df=35$). On average, control group subjects ($N=17$) were tested 5.4 months following the check ride. Experimental group subjects ($N=20$) were tested after 6.0 months.

There was no significant difference between the experimental and control groups on the scores earned when they passed the written examination for the private pilot certificate ($t=0.36$, $df=42$). Subjects in the control group ($N=24$) earned a mean score of 87.5, while experimental group subjects ($N=20$) had a mean score of 88.5 on this examination. Two subjects, one in the control group and one in the experimental group, did not pass the written examination on the first attempt. One subject in the control group did not pass the private pilot practical test on the first attempt.

Thus, any difference between the experimental and control groups in observation flight performance cannot reasonably be attributed to differences in age, flight experience, aeronautical knowledge, or skill.

Observation Flight Performance

The experimental group, which received judgment training, did about 10% better on the observation flight than did the control group. This difference is statistically significant ($t=2.13$, $df=43$, $p<.05$), and suggests that the judgment training program is effective in conventional flight school settings. However, the improvement in pilot judgment may be considerably less in these settings than was suggested by previous studies. Results of the observation flight are presented in Table 2.

Table 2. Observation flight results.

Correct Responses

Control Group		Experimental Group
	(PERCENT)	
59.9	Mean	70.0
16.3	S. D.	15.1
25	N	20

There was considerable variability in the mean observation flight scores assigned to subjects by each of the three observers, as well as great differences among subjects from different FBO's. Because of the small cell frequencies and the partial confounding of observers with FBO's, it was not possible to statistically isolate the effects of these extraneous variables. However, these influences were examined in two ways. When the observation flight performance of the experimental and control group subjects run by each of the three observers are compared, improvements of between four and eight percent are noted in the case of each observer. These results are shown in Table 3.

Table 3. Mean observation flight score by observer.

	Observer A (N=11)	Observer B (N=20)	Observer C (N=14)
Control Group	47.6	61.5	73.5
Experimental Group	52.7	65.8	81.3

Moreover, when the overall analysis is restricted to those FBO's which were represented in both the experimental and control groups, the improvement in observation flight performance which results from judgment training is noted to be even greater ($t=2.22$, $df=28$, $p<.05$). This comparison is shown in Table 4.

Table 4. Observation flight results for FBO's represented in both experimental and control groups.

Correct Responses

Control Group		Experimental Group
	(PERCENT)	
65.7	Mean	77.8
15.6	S. D.	13.6
17	N	13

These supplemental analyses suggest that the finding that judgment training improves observation flight performance is quite reliable in spite of the high variablility among FBO's and between observers.

Judgment Training Materials

Twenty-five pilots who received judgment training provided critiques of the training program and materials. Forty-two participating instructors also evaluated the program. Because the Student Manual represented a major revision of the ones used in both the ERAU and Air Cadet studies, it was particularly important to establish its user acceptability in this manner. These student and instructor critiques were quite helpful in identifying the strengths and weaknesses of the various program components. As may be seen in Figure 2, the Student Manual was very well received. More than half of both the student and instructor samples indicated that the Student Manual was "very useful", while 12% of the students, and none of the instructors, felt that it was "not at all useful".

Instructor evaluations of their teaching materials was also favorable, but not quite as positive as in the case of the Student Manual. As may be seen in Figure 3, 43% felt that the Instructor Manual as a whole was "very useful", while 32% gave high ratings to the in-flight Lesson Plans and the Judgment Training Scenarios. However, 10% of the respondents felt that the Instructor Manual was only "slightly useful", and 14% saw little value in the Lesson Plans and Judgment Training Scenarios.

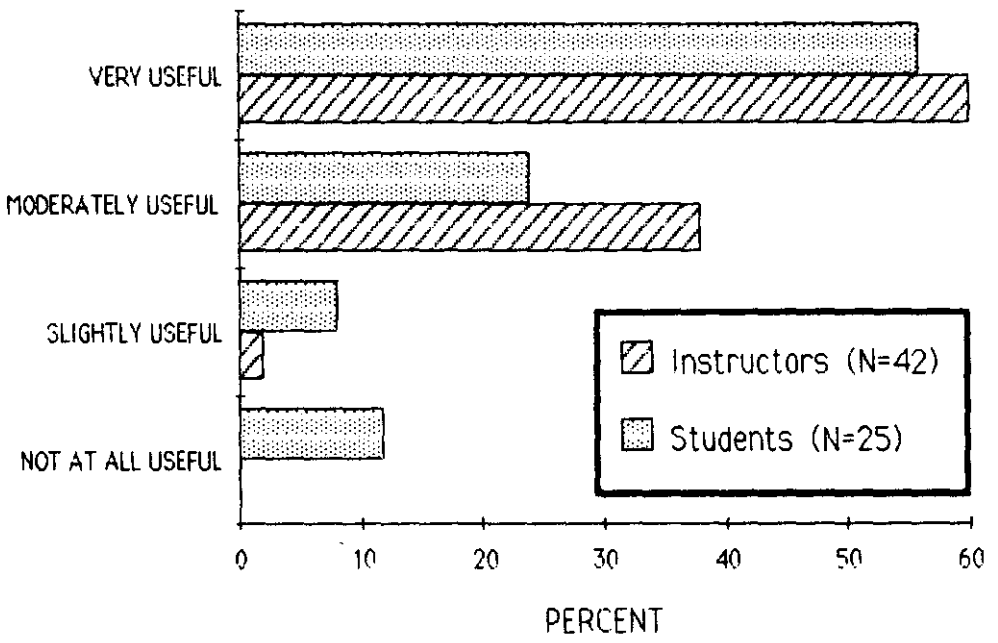

Figure 2 Ratings of Student Manual

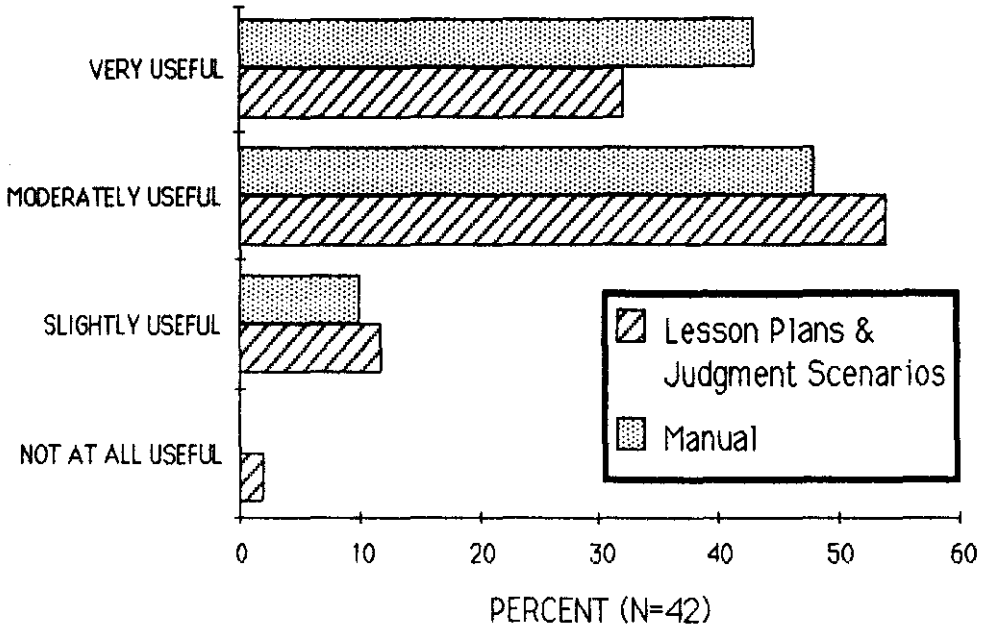

Figure 3. Ratings of instructional materials.

Questions in both the student and instructor critiques were directed at five basic components of the judgment training program. Figures 4 through 8 present the proportions of each respondent group which gave ratings of "useful", "moderately useful", "slightly useful", and "not at all useful" to each of these program elements.

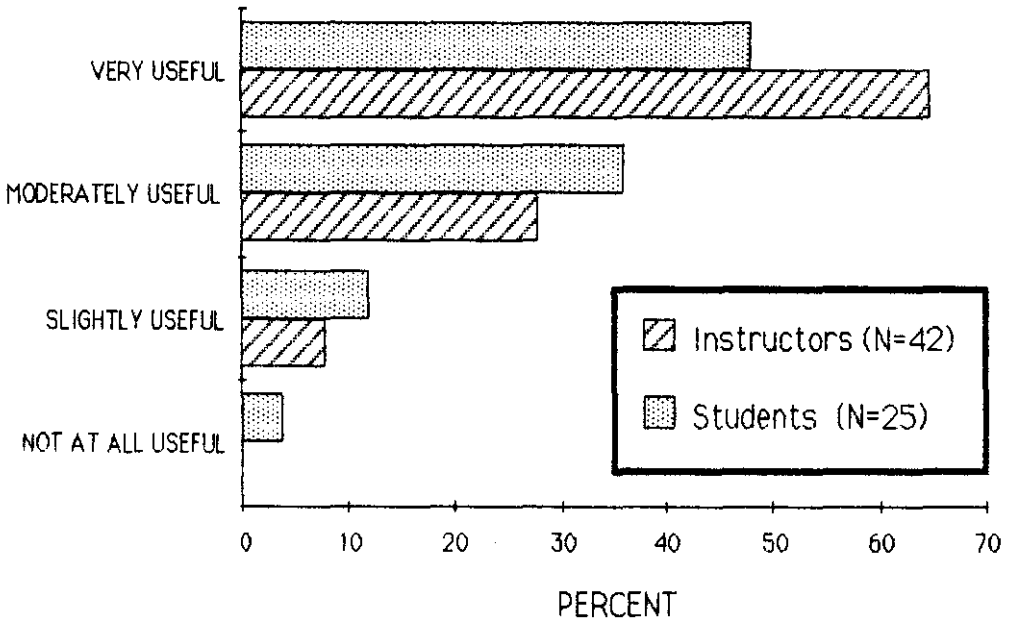

Figure 4. Ratings of Five Hazardous Thoughts concept.

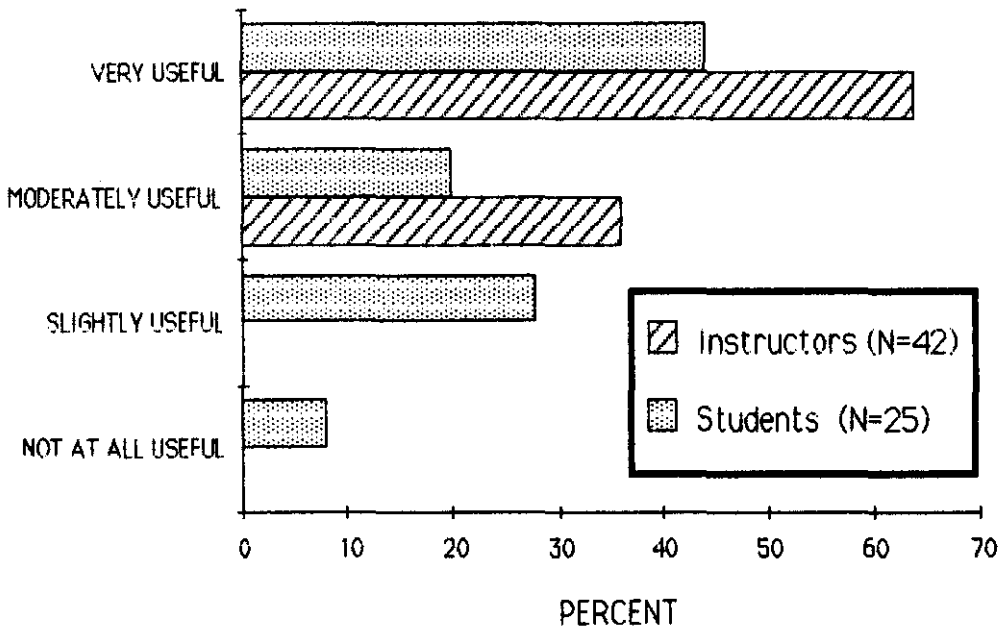

Figure 5. Ratings of stress reduction material.

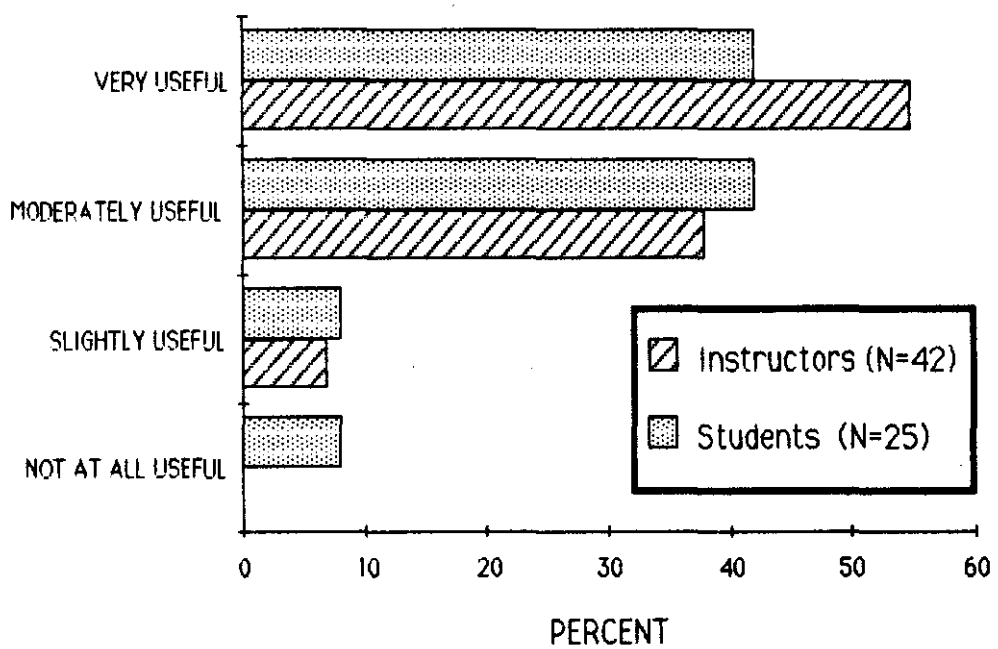

Figure 6. Ratings of Poor Judgment Chain concept.

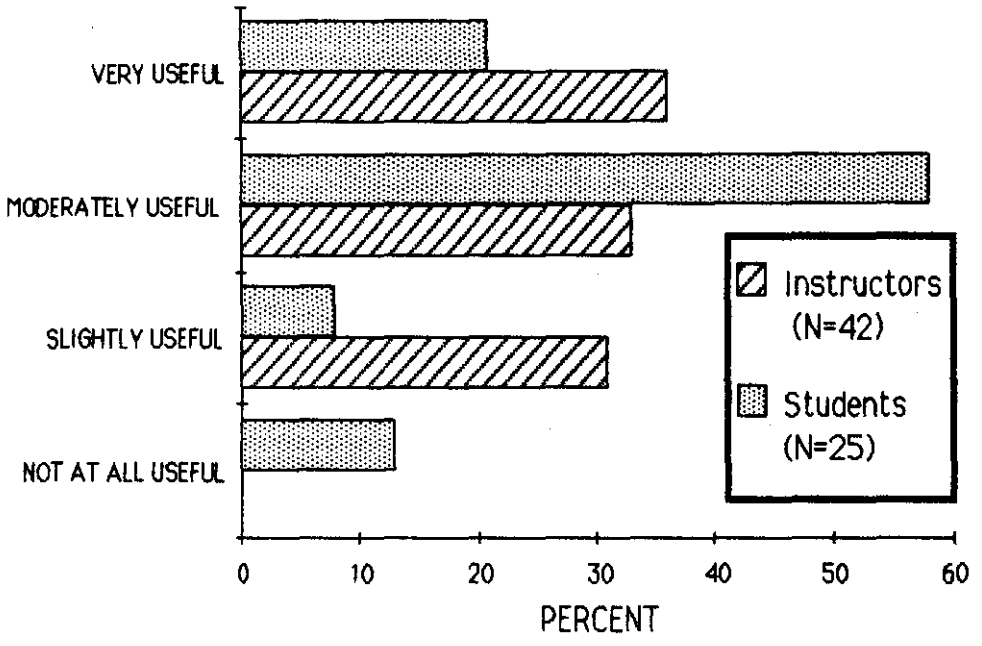

Figure 7. Ratings of Six Action Ways concept.

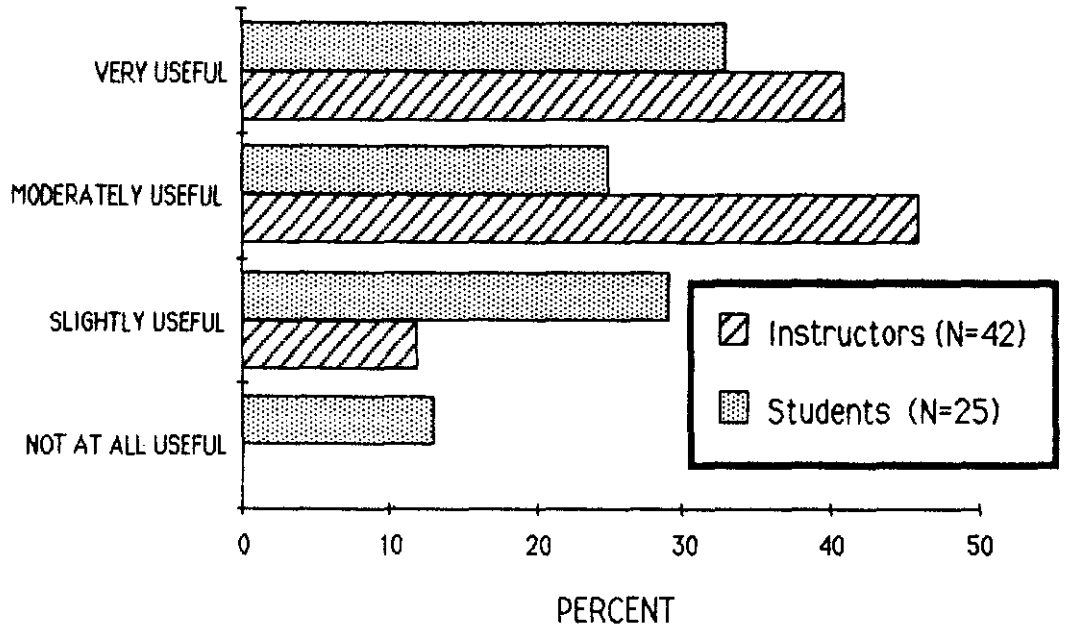

Figure 8. Ratings of Three Mental Processes of Safe Flight concept.

As may be seen, almost half (48%) of the student pilots rate the Five Hazardous Thoughts concept as "very useful". The concept of the Poor Judgment Chain is also given high ratings by the students, with 42% considering this concept to be "very useful". However, 16% of the student sample indicate that these two concepts have been of little or no value in their training. Forty-four percent of the students rate the chapter on stress reduction as "very useful", although more than one third (36%) place little value on this material. The Six Action Ways and the Three Mental Processes of Safe Flight are given markedly lower ratings by the students. Although one fifth (21%) of the sample view the Six Action Ways as "very useful", an equal proportion report it to have little or no utility. And while one third (33%) of the students rate the Three Mental Processes of Safe Flight as "very useful", an even greater proportion (42%) see little worth in this concept.

Almost two-thirds of the instructor sample rate both the stress reduction chapter (64%) and the concept of the Five Hazardous Thoughts (65%) as "very useful". No low ratings at all are given to the stress reduction material, although 8% of the instructors consider the Hazardous Thoughts to be only "slightly useful". The Poor Judgment Chain model is rated as "very useful" by more than half (55%) of the instructors, with 7% viewing it as only "slightly useful". Relatively lower ratings are given to the concepts of Three Mental Processes of Safe Flight and the Six Action Ways. The Mental Processes are rated "very useful" by 41% of the instructors, with 12% noting that they are "slightly useful". And while over one third (36%) of the instructor sample consider the Action Ways to be "very useful", an almost equal proportion (31%) see only slight utility to this concept.

The ratings assigned to each component by each respondent were scaled, and the mean ratings are shown in Figure 9. Although instructors gave consistently higher ratings to each component than did the student pilots, there was general agreement as to the relatively greater value of the stress reduction material, the Hazardous Thoughts concept, and the Poor Judgment Chain model. Respondents also agreed on the lesser value of the concepts of the Three Mental Process of Safe Flight and the Six Action Ways, and their utility in the judgment training program could be questioned.

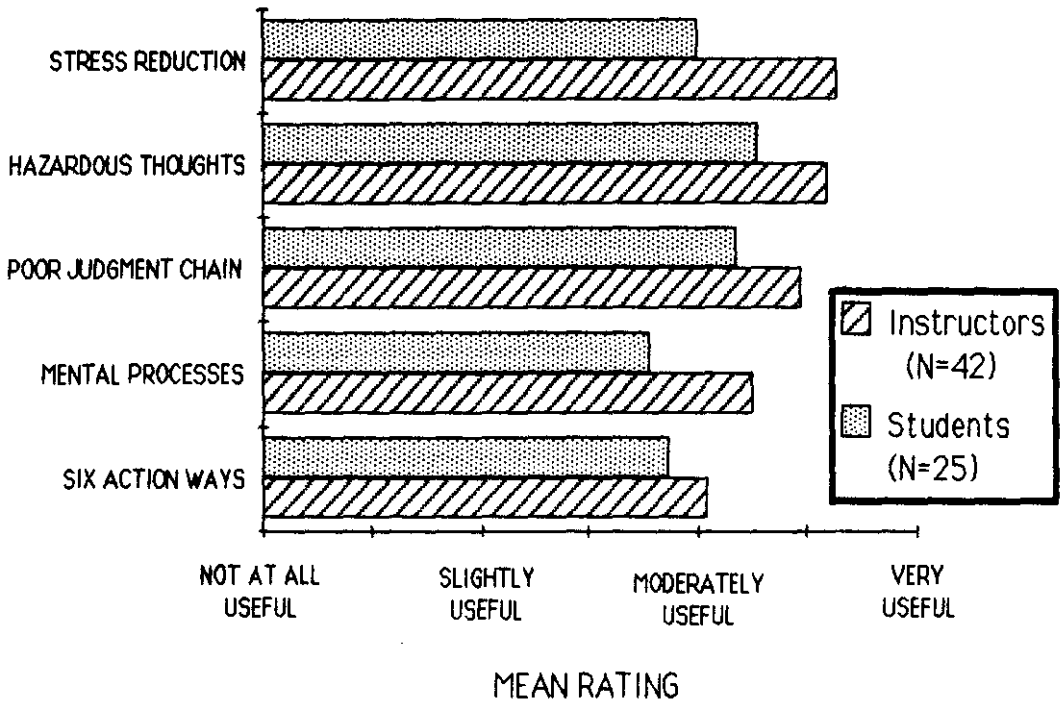

Figure 9. Mean scaled ratings of judgment training concepts.

Training Time Requirements

The study was also concerned with the amount of training time which the judgment program consumed within the private pilot curriculum. Not only were instructors asked to master the judgment training material on their own time, but they also had to allocate ground school and in-flight time with each student to accomplish the program's objectives.

Most instructors (44%) reported spending a total of between two and four hours of self-study time preparing to teach the judgment materials, while almost one third (29%) spent between four and six hours in this activity. Thus, on average, the program appears to require that instructors devote about three to four hours of self study time in order to become reasonably familiar with the contents.

Because the judgment materials were designed to be easily integrated into existing flight and ground instruction, it was felt that much of the judgment training would be given in conjunction with items from the standard pilot training curriculum. For instance, the instructor might caution the student about the hazardous thought "impulsivity" while describing the dangers of rushing a takeoff. For this reason, the

instructors' estimates of ground and flight times devoted to judgment training do not, per se, imply any additional time requirements.

Instructors also reported that the judgment training consumed only one or two hours of ground time (46%) and flight time (36%) per student. Only a small proportion of instructors reported that the material required more than four hours in the primary flight training program. These results are summarized in Figure 10.

Most students (60%) reported that they spent between two and six hours in self-study with the student manual, with the modal time requirement quite close to four hours. Half (50%) reported spending less than two hours of ground time reviewing judgment-related material with their instructors, and 58% said that they had devoted less than two hours of in-flight time to such matters. However, it is not at all clear that the student's perception of what was and what was not "judgment-related" coincided with the instructors' actual objectives in any given instance. These findings are illustrated in Figure 11.

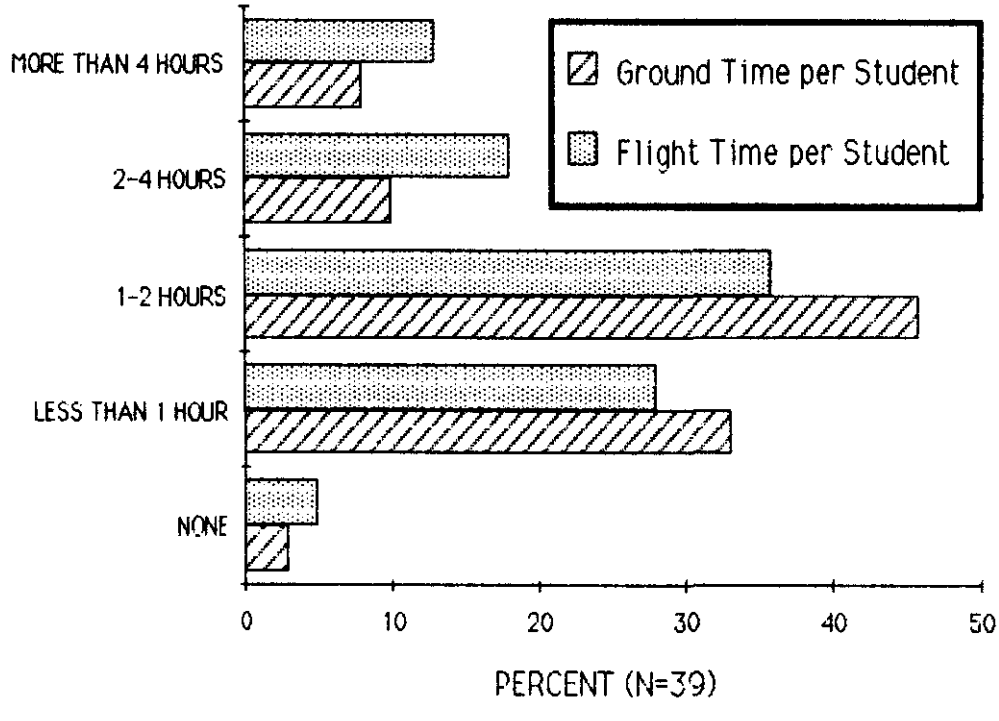

Figure 10. Instructor estimated time requirements for judgment training.

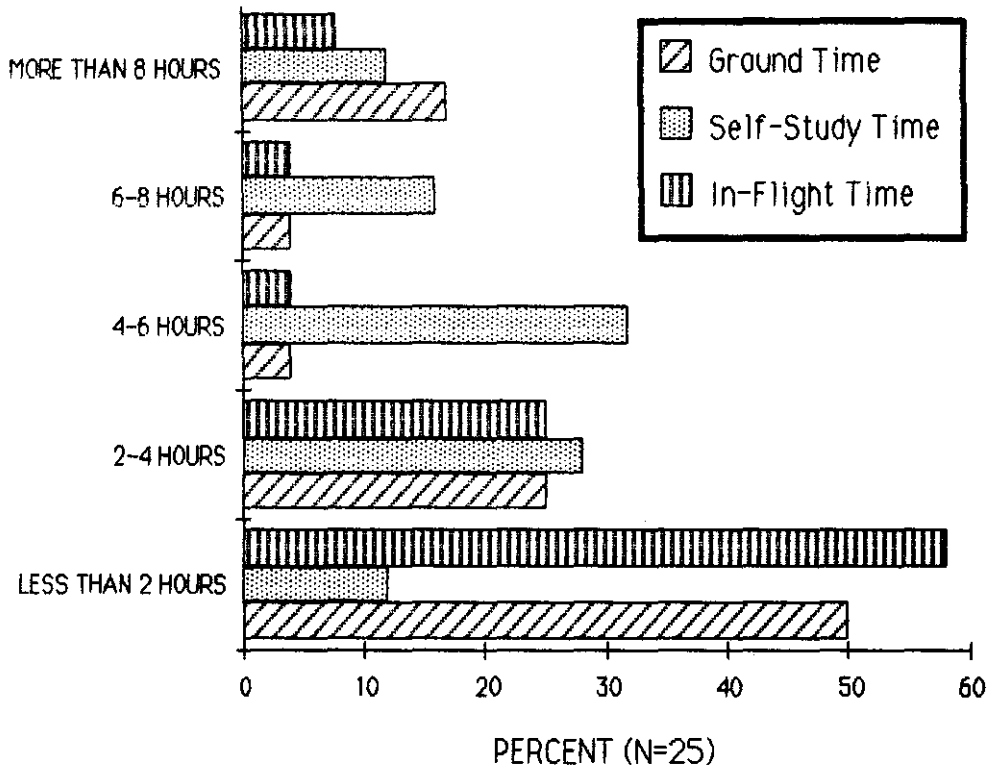

Figure 11. Student estimated time requirements for judgment training.

Overall Program Evaluation

Summary questions helped to evaluate the degree to which participants felt that the program had accomplished its goals. Approximately one quarter (24%) of the instructors said that "all" of their students had benefited from the program, and almost half (46%) indicated that "most" of their students had benefited from judgment training. More than half (56%) of the students reported that their aeronautical judgment had "definitely" improved as a result of the program, while one fifth (20%) were uncertain or felt that their judgment had not improved. About one third (32%) of the instructors felt that their typical student's judgment had "definitely" improved as a result of program participation, but 20% were uncertain or saw no improvement.

An important question asked of respondents was whether they would recommend that the judgment training program be adopted. Four-fifths of the student sample (80%) recommended program adoption, and almost two-thirds (63%) "strongly recommended" the use of the judgment manual in private pilot training. Twenty-one percent of the students were hesitant or would not recommend the program. These results are presented in Figure 12.

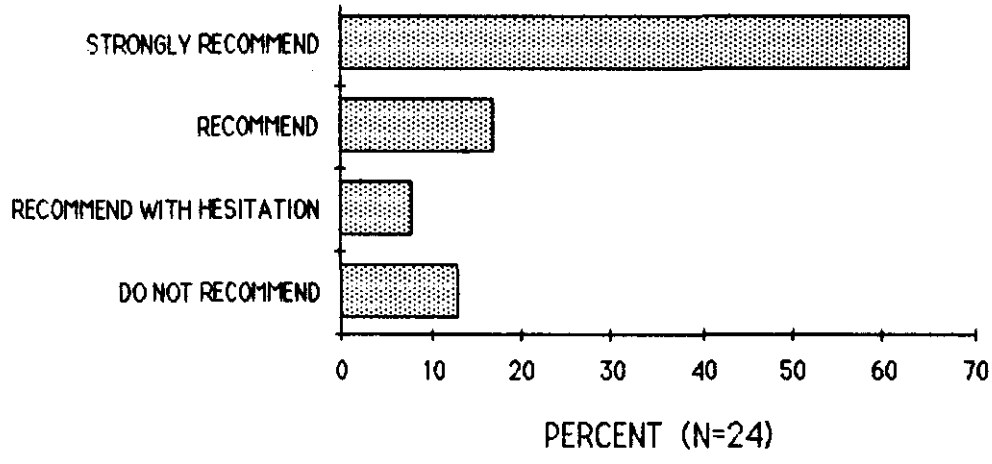

Figure 12. Student recommendations regarding judgment training.

More than three-quarters (77%) of the instructors recommended that the program be adopted on a voluntary basis, with almost half (48%) "strongly" recommending such adoption. More than half (55%) of the instructor sample recommended that judgment training be required, and about one quarter (26%) "strongly recommended" that the FAA require that such a program be used to teach and evaluate judgment skills in student pilots. Still, 24% of the instructors were hesitant or unwilling to recommend it on even a voluntary basis, and almost half (45%) of the instructors had serious reservations about mandatory judgment training. These results appear in Figure 13.

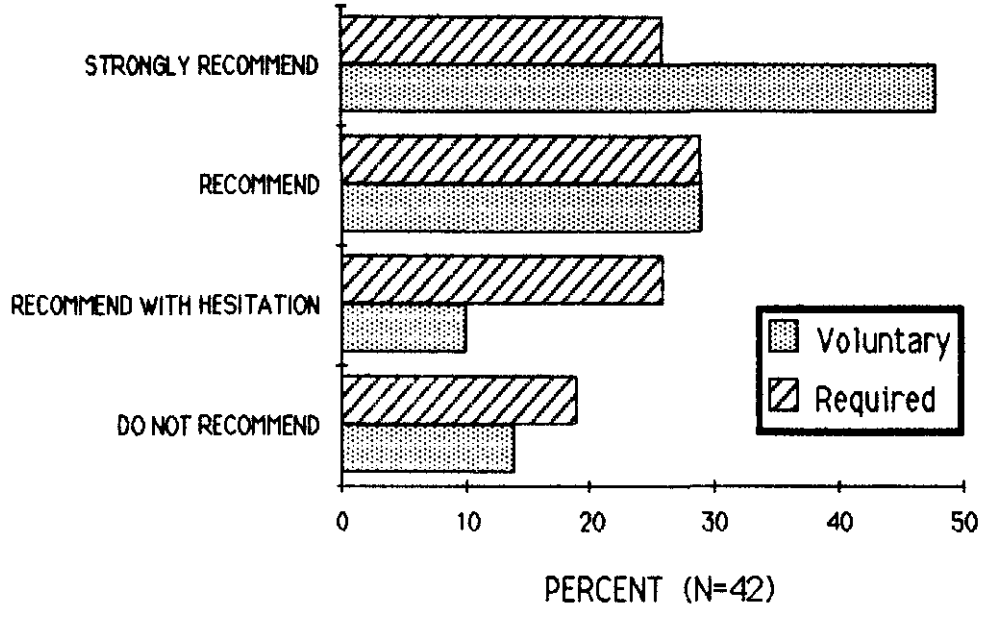

Figure 13. Instructor recommendations regarding judgment training.

IMPLICATIONS & CONCLUSIONS

Based upon the findings of this study, the following conclusions are offered:

1) The Student and Instructor Manuals are highly acceptable to the user community, and most participants found them to be very useful.

2) Of the major didactic tools used in the program, the Five Hazardous Thoughts concept, the Poor Judgment Chain model, and the stress reduction material are most useful. They should be retained in future versions of the judgment training program.

3) The concepts of the Six Action Ways and the Three Mental Processes of Safe Flight may be too pedantic for general use, and might be dropped from subsequent training manuals.

4) Participating students and instructors felt that the program improved pilot decision-making skills.

5) Both students and instructors strongly recommended adoption of the program, although instructors were not particularly supportive of required judgment training.

6) The observation flight data suggest that the program is effective in actually improving pilot judgment, even in the informal atmosphere which characterizes most FBO training programs. However, the program's effectiveness in these settings may be considerably less dramatic than was suggested by the earlier studies.

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NOTES

1. Significant contributions to this study were made by Georgette Buch (Transport Canada), Douglas P. Harvey (FAA), Russell A. Lawton (AOPA), and Gary S. Livack (GAMA). The observation flights were conducted by AOPA staff members Robert Cathers, Thomas Oneto, Glenn Rizner, and John Sheehan. Research assistance at Colby College was provided by Karen M. Barbera, Deborah E. Burke, Fran M. Gradstein, and Melissa J. Hruby. Secretarial support was provided by Dorothy Evertsen.

2. In order to determine the extent to which the flight training activities presented material not commonly included in private pilot training, an informal small-sample survey was conducted at three flight schools which were not part of the experiment but which utilize the same type of traditional pilot training curriculum as was used at the participating FBO's. The results suggest that only 12 of the the 50 Judgment Training Scenarios are unique to the program and present activities which are rarely undertaken by flight instructors in normal practice. In contrast, 21 of the activiites presented in the Scenarios are used on occasion by more than half of the flight instructors surveyed, and 17 are used by some instructors. Of the activities outlined in the 18 Lesson Plans, all but one are commonly included in flight training by almost all instructors surveyed.

3. These evaluations were subsequently made available to the FAA researchers involved in evaluating the prototype sectional charts.

APPENDIX A

Participating Fixed Base Operators

City	State	Airport	Fixed Base Operator	ID
Middletown	DE	Summit	Summit Aviation	N92
Frederick	MD	Frederick	Frederick Aviation	FDK
Farmingdale	NY	Republic	Flightways of Long Island	FRG
Islip	NY	Islip-Mac Arthur	Mid-Island Air Service	ISP
Allentown	PA	Queen City	Queen City Aviation	1N9
Easton	PA	Easton	Bradens Flying Service	N43
Chesapeake	VA	Chesapeake	Mid-Eastern Airways	W36
Lynchburg	VA	Lynchburg	Air Virginia	LYH
Manassas	VA	Manassas	Dulles Aviation	W10
Woodbridge	VA	Woodbridge	Woodbridge Aviation	W22

APPENDIX B

Observation Flight
Administration & Scoring Guidelines

1. Flight Information During the mission preview, the observer indicates to the pilot that the flight will proceed to a specific destination airport. If possible, this field should be one which has a currently valid NOTAM and/or one with which the pilot is relatively unfamiliar. As the observer and pilot later walk to the aircraft, the observer will casually inquire if there are any NOTAMs on the destination airport and/or if the weather will be all right for the flight.

Good Judgment: pilot indicates that he has checked an appropriate source for NOTAMs and/or weather

Poor Judgment: pilot fails to check NOTAMs and/or weather prior to boarding the aircraft

2. Aircraft Condition Prior to the time that the pilot arrives at the airport, or while he is completing the aeronautical chart survey form, the observer:

a) loosens, but does not remove, one of the fuel tank caps
b) loosens, but does not remove, the oil fill cap/dip stick
c) pulls a fuse or circuit breaker

Good Judgment: the pilot detects and remedies the defect during the preflight inspection prior to boarding aircraft

Poor Judgment: the pilot fails to detect and remedy the defect prior to boarding aircraft

NOTE: IF UNDETECTED BY THE PILOT, THE OBSERVER MUST REMEDY THE DEFECT PRIOR TO BOARDING AIRCRAFT

3. Cabin Hazard Prior to the time that the pilot arrives at the airport, or while he is completing the aeronautical chart survey form, the observer places a completely empty soft drink bottle on the cockpit floor in front of the right seat halfway between the front of the seat and the rudder pedals.

Good Judgment: pilot detects and safely secures the bottle during the preflight inspection prior to engine start

Poor Judgment: pilot fails to detect and secure the bottle prior to engine start

NOTE: IF UNDETECTED BY THE PILOT, THE OBSERVER MUST SAFELY SECURE THE BOTTLE WITHOUT COMMENT PRIOR TO TAXI

4. Propeller Hazard Approximately 30 seconds after engine start, but before taxi or run-up, the observer releases his seat belt as he announces that:

a) he has dropped his pen in front of the aircraft
b) he sees a loose hold-down on the cowling
c) he sees a nail on the runway in front of the aircraft

He then begins to open the door to exit the aircraft.

Good Judgment: pilot immediately shuts down the engine or requests that the observer remain in the aircraft

Poor Judgment: pilot permits the observer to leave the aircraft while engine is running

NOTE: OBSERVER MUST NOT EXIT THE AIRCRAFT WITH ENGINE RUNNING

5. Checklist Distractions During the execution of the prestart, pretaxi, and/or run-up checklist the observer converses with, questions or otherwise distracts the pilot in such a way as to interrupt the systematic execution of the checklist. Two interruptions are to be made.

Good Judgment: pilot requests that the observer hold his questions and comments until after the checklist is completed, or pilot ignores observer's remarks

Poor Judgment: pilot interrupts the checklist to converse with the observer, or carries on the conversation while continuing the checklist

6. Departure Procedures The observer requests one of the following non-standard departure procedures:

a) a takeoff from a marginally safe intersection
b) a right (or non-standard left) turn immediately after takeoff while still in the pattern at an uncontrolled field
c) a low (200 Feet AGL) turn immediately after takeoff

Good Judgment: pilot declines request

Poor Judgment: pilot executes potentially hazardous departure procedure

NOTE: OBSERVER MUST NOT PERMIT THE PILOT TO EXECUTE A HAZARDOUS DEPARTURE

7. Low Flight Over Obstruction The observer requests a flight path and altitude which will take the aircraft barely 1,000 feet above some object or building in a built-up area

Good Judgment: pilot notes conflict and either climbs or diverts in order to pass the object at a safe distance

Poor Judgment: pilot flies low over vertical obstruction

NOTE: OBSERVER MUST NOT PERMIT HAZARDOUSLY LOW FLIGHT OVER OBSTRUCTION

8. Low Steep Turn Over Building The observer requests that the pilot circle above a certain building so that the observer can take a photograph. The observer requests an increasingly steeper turn until a 45 degree angle of bank is established.

Good Judgment: pilot climbs to a safe altitude, or does not exceed a 30 degree angle of bank at low altitude, or declines request

Poor Judgment: pilot attempts to execute a hazardous low steep turn

NOTE: OBSERVER MUST NOT PERMIT A HAZARDOUSLY LOW/STEEP TURN

9. Low Flight Over Unsuitable Terrain The observer requests a flight path and altitude over unsuitable terrain such that the ability to execute a safe emergency landing or power-off glide to shore would be seriously compromised.

a) heavily wooded terrain
b) mountainous terrain
c) large body of water

Good Judgment: pilot declines request or climbs to a safe altitude

Poor Judgment: pilot flies low over unsuitable terrain

NOTE: OBSERVER MUST NOT PERMIT HAZARDOUSLY LOW FLIGHT OVER UNSUITABLE TERRAIN

10. VFR Cruising Altitude The observer requests a flight path and altitude consistent with VFR cruising altitude regulations, and requests the pilot to locate a specific terrain feature along this flight path. Upon reaching the terrain feature, the observer requests the pilot to fly a new heading such that a climb/descent is required in order to maintain an appropriate VFR cruising altitude. The observer makes no mention of altitude however.

Good Judgment: pilot notes conflict and either climbs or descends to an appropriate VFR cruising altitude

Poor Judgment: pilot turns to the new heading but fails to change altitude to comply with VFR cruising altitude regulations

NOTE: OBSERVER MUST NOT PERMIT A HAZARDOUS VIOLATION OF VFR CRUISING ALTITUDE REGULATIONS

11. Controlled Airspace Encroachment The observer requests a flight path and altitude which brings the aircraft marginally close to the horizontal or vertical limits of an active Airport Traffic Area of Terminal Control Area, while the aircraft is not in radio contact with the controlling facility.

Good Judgment: pilot informs observer that the requested flight path cannot be flown safely without ATC clearance or pilot requests such clearance from ATC, or pilot alters flight path to avoid the controlled airspace by a safe margin

Poor Judgment: pilot flies marginally close to an Active Airport Traffic Area or Terminal Control Area without ATC Clearance

NOTE: OBSERVER MUST NOT PERMIT THE AIRCRAFT TO ENTER INTO CONTROLLED AIRSPACE WITHOUT ATC CLEARANCE

12. Arrival Procedures On approach to an uncontrolled airport, the observer, in order to take a photograph, requests a flight path and altitude which brings the aircraft:

a) directly over the airport at pattern altitude but not in the pattern
b) at pattern altitude but flying a non-standard pattern
c) set up high on the final approach leg
d) set up for a downwind landing

Good Judgment: pilot informs observer of the need to fly a standard approach and landing pattern, and flies it

Poor Judgment: pilot flies a non-standard approach or landing pattern at pattern altitude

NOTE: OBSERVER MUST NOT PERMIT A HAZARDOUS APPROACH OR LANDING

APPENDIX C

Student Evaluation

The Federal Aviation Administration (FAA) and the General Aviation Manufacturers Association asked several flight schools to examine a prototype Pilot Judgment Training Program. We understand that you participated in this important program, and we would be interested in your views on its acceptability. Please circle your response and feel free to explain it below the question, or on the back of the page if necessary. A self-addressed, postage paid envelope is enclosed for your convenience. Your cooperation in this critique is deeply appreciated.

1. The Judgment Training Manual in general was:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

2. Six Action Ways concept (Do, No Do, Under Do, Over Do, Early Do, Late Do) was:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

3. Poor Judgment Chain concept was:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

4. Three Mental Processes of Safe Flight concept (Automatic Reaction, Problem Resolving, Repeated Reviewing) were:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

5. Five Hazardous Thoughts (Anti-authority, Impulsivity, Invulnerability, Macho, Resignation) were:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

6. Chapter on Identifying and Reducing Stress was:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

7. How much self-study time did you spend on the Judgment Training Manual?

A) less than 2 hrs. B) 2-4 hrs. C) 4-6 hrs.
D) 6-8 hrs. E) more than 8 hrs.

8. How much total time did your instructor spend discussing judgment with you in-flight?

A) less than 2 hrs. B) 2-4 hrs. C) 4-6 hrs.
D) 6-8 hrs. E) more than 8 hrs.

9. How much total time did your instructor spend discussing judgment with you on the ground?

A) less than 2 hrs. B) 2-4 hrs. C) 4-6 hrs.
D) 6-8 hrs. E) more than 8 hrs.

10. Do you feel that reading this manual and/or discussing these concepts improved your aeronautical judgment?

A) definitely B) probably
C) uncertain D) no

11 Would you recommend the adoption of the Judgment Manual for use in private pilot training?

A) strongly recommend B) recommend
C) recommend with hesitation D) do not recommend

12. How could this manual be improved?

APPENDIX D

Instructor Evaluation

1. Instructor Manual in general was:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

2. In-Flight "Lesson Plans" and "Judgment Training Scenarios" in the instructor manual were:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

3. Student Manual in general was:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

4. Six Action Ways concept (Do, No Do, Under Do, Over Do, Early Do, Late Do) was:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

5. Poor Judgment Chain concept was:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

6. Three Mental Processes of Safe Flight concept (Automatic Reaction, Problem Resolving, Repeated Reviewing) were:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

7. Five Hazardous Thoughts (Anti-authority, Impulsivity, Invulnerability, Macho, Resignation) were:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

8. Stress recognition chapter was:
   A) very useful B) moderately useful
   C) slightly useful D) not at all useful

9. How much self-study time did you spend (reading the Student and Instructor Manuals, planning in-flight exercises, etc.) in order to permit you to teach the judgment concepts? Do NOT include the time spent in the training sessions with FAA scientists.

A) less than 2 hrs. B) 2-4 hrs. C) 4-6 hrs.
D) 6-8 hrs. E) more than 8 hrs.

10. About how much ground time did you spend teaching judgment to each of your students?

A) None B) less than 1 hr. C) 1-2 hrs.
D) 2-4 hrs. E) more than 4 hrs.

11. About how much flight time did you spend teaching judgment to each of your students?

A) None B) less than 1 hr. C) 1-2 hrs.
D) 2-4 hrs. E) more than 4 hrs.

12. Would you recommend the voluntary use of these manuals for private pilot training?

A) strongly recommend B) recommend
C) recommend with hesitation D) do not recommend

13. Do you recommend that FAA require a program such as this to teach and evaluate judgment skills of student pilots?

A) strongly recommend B) recommend
C) recommend with hesitation D) do not recommend

14. Do you think participating in this program improved your "typical" students' judgment skills?

A) definitely B) probably
C) unsure D) no

15. What proportion of your students who participated in this program do you feel benefited from this training?

A) all B) most C) some
D) few E) none

16. How could this program be improved?

APPENDIX E

Experimental & Control Group Observation Flights
At Each Participating FBO

Fixed Base Operator	Airport ID	Experimental Subjects	Control Subjects
Summit Aviation	N92	2	0
Frederick Aviation	FDK	5	0
Flightways of Long Island	FRG	3	4
Mid-Island Air Service	ISP	5	3
Queen City Aviation	1N9	1	4
Bradens Flying Service	N43	3	2
Mid-Eastern Airways	W36	0	4
Air Virginia	LYH	0	0
Dulles Aviation	W10	1	4
Woodbridge Aviation	W22	0	4
	TOTAL	20	25

APPENDIX F

Control Group Data

No.	Observer	Observation Flight Score	Age	Written Test Score	Airport ID
501	C	33			W36
502	R	58	28	92	FRG
503	R	75	35	92	ISP
504	C	64	39	97	W22
505	C	42	27	92	W36
506	C	58	27	82	W22
507	C	42	32	100	W22
508	C	50	36	98	W22
509	R	50	33	85	W10
510	R	67	23	72	W10
511	C	50	32	100	W36
512	C	42	26	93	W36
513	R	58	38	92	W10
514	R	50	28	100	W10
515	R	67	34	70	FRG
516	R	92	30	82	FRG
517	R	25	21	77	FRG
518	O	67	27	82	1N9
519	O	75	34	93	1N9
520	O	58	64	87	1N9
521	O	83	42	98	1N9
527	O	83	39	90	N43
528	O	75	54	72	N43
529	R	67	20	83	ISP
530	R	67	46	72	ISP

APPENDIX G

Experimental Group Data

No.	Observer	Observation Flight Score	Age	Written Test Score	Airport ID
602	C	42	55	70	FDK
603	C	58	27	93	FDK
604	R	73	34	87	N92
605	R	75	18	95	W10
606	R	67	44	90	N92
607	C	58	32	95	FDK
608	R	58	35	97	FDK
610	R	58	46	90	FDK
611	R	58	50	85	ISP
612	R	45	21	82	FRG
613	R	75	28	88	FRG
614	R	83	20	97	ISP
615	0	75	41	87	1N9
616	0	83	53	97	N43
617	0	83	26	92	N43
618	0	75	44	80	N43
619	0	92	21	73	ISP
620	0	92	30	92	ISP
621	0	92	20	88	ISP
622	0	58	44	92	FRG