NASA Contractor Report 3666

The Effectiveness of an Oculometer Training Tape on Pilot and Copilot Trainees in a Commercial Flight Training Program

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CONTRACT NAS1-15648
MARCH 1983

NASA

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Dennis H. Jones, Glynn D. Coates,
and Raymond H. Kirby
Old Dominion University Research Foundation
Norfolk, Virginia

Prepared for
Langley Research Center
under Contract NAS1-15648

NASA
National Aeronautics
and Space Administration

Scientific and Technical
Information Branch

1983

SUMMARY

The present research investigated the effects of an oculometer training tape produced by NASA-LRC on 27 pilot and copilot trainees undergoing a commercial flight training program. The trainees were randomly divided into control (n = 14) and experimental (n = 13) groups. The experimental group viewed the training tape at the beginning of simulator training. The control group was given the option of viewing the tape following their flight training. The results indicated that the training tape had little or no effect on actual performance or self-reported eye-scan behavior but was evaluated as potentially valuable for inclusion into the ground school program. The results are discussed in terms of the emphasis of the flight training program and the need for a more individually oriented feedback strategy.

This study also investigated the possibility, as suggested by the flight training personnel, that pilot and copilot trainees had a performance decrement on or about the third day of simulator training. The data provided little support for the "third day phenomenon". In fact, the data reveal that performance decrements (i.e., performance relative to Session 1 of simulator training) were predictable by performance in the preceding session. It was conjectured that a possible negative-transfer effect could account for the high percentage of pilot trainees showing performance decrements.

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THE EFFECTIVENESS OF AN OCULOMETER TRAINING TAPE ON PILOT AND COPILOT TRAINEES IN A COMMERCIAL FLIGHT TRAINING PROGRAM

INTRODUCTION

For over a century scientists have been interested in the role of eye movements in the performance of various tasks. Indeed, Pavlidis (1976) has compiled more than 2000 references of research involving eye movements. As may be expected, the extent of the research conducted was dependent on the technology of the time. Until recently, such research has been limited to tasks that 1) required little or no head movement by the subject and/or 2) required tedious, time consuming analyses by the researcher. (For a detailed review of these methodologies see Young & Sheena, 1975.) Although several attempts have been made to collect eye movement data on subjects performing complex tasks (e.g., Fitts, Jones, & Milton, 1949), the limitations mentioned above severely restricted the extent of applied research.

However, in 1966 a wide angle eye movement recorder was developed and later improved by Merchant (1969). The Honeywell oculometer (Merchant, Morrissette, & Porterfield, 1974) utilized corneal reflection and allowed one cubic foot of head movement by the subject (see Monty, 1975). By combining this recording device with advanced, on-line computers, the feasibility of expanded research increased dramatically. As Monty (1975) noted:

> One of the real benefits of the system is the ease and speed with which the raw data can be both processed and analyzed...A million frames of data can be reduced for statistical analysis on a given criterion in less than four hours, a task which if performed manually or even semimanually would take months...(p. 335)

With the development of an unobtrusive eye movement recording device and of microprocessors, researchers began to re-evaluate the role of eye movement in various applied situations. One line of research has been to study the instrument scan behavior of pilots.

Pilot Eye-Scan Behavior

Shortly after World War II, researchers attempted to evaluate pilot instrument scan performance to determine the optimal instrument arrangement. Jones, Milton, & Fitts (1950) used a motion picture camera that recorded the eye movements of several pilots during numerous flight maneuvers. By completing a frame by frame analysis, Jones *et al* were able to establish sequential link values between the instruments, and developed an arrangement criteria based on 1) instrument importance, 2) degree of relative use, 3) similarity of function and 4) sequence of use (McCormick, 1970). The result was the development of aircraft panel designs in the form of a basic "T". However, as Seeberger and Wierwille (1976) pointed out, these data may be insufficient for new and exceedingly complex aircraft instrument panel designs. They wrote:

> While a moderate amount of work has been conducted on the development of link value concepts and on their use in instrument arrangement, virtually no work exists on determining stable estimates of probabilities and link values for use in panel redesign. (p. 282)

Due to the limited technology of early research, there was insufficient precision necessary to provide definitive answers with respect to the types of information pilots require in order to fly an aircraft. As Harris and Christhilf (1980) wrote:

> Although we know a lot about the mechanics of a pilot scan, we know very little about what type of information they want or need. They may desire to know that the needle (attitude indicator) is simply oriented to the right, or the needle is between the "50" and "60" or that the needle is at "57". They may need to know both position and rate (the needle is at "57" and "slowly increasing") or perhaps position, rate, and acceleration (the needle is at "57" and "slowly increasing but the rate of movement is decreasing"). Pilot responses to answer this question would probably be as varied as the number of pilots if they could give an answer at all. And, in fact, pilots may need different information at different times. (p. 1)

Over the past five years, researchers at NASA's Langley Research Center have attempted to answer a variety of questions concerning instrument scan behavior and pilot performance (Wier & Klein, 1970; Middleton, Hurt, Wise, & Holt, 1977; Pennington, 1979; Dick, 1980; Spady & Harris, 1981; Harris & Christhilf, 1980). To date the most extensive investigation of pilot instrument scan behavior was by Spady (1978) who gathered performance data on seven commercial airline pilots. Spady used the Honeywell Oculometer System installed in the Boeing 737 simulator at Piedmont Airlines, Winston-Salem, NC to gather performance data on currently qualified Boeing 737 pilots. The pilots flew a series of coupled and manual approaches with and without an atmospheric turbulence condition. The purpose of the research was to gather a data base on experienced 737 pilots 1) to understand how pilots used various instruments under various flight conditions (i.e., coupled vs manual; turbulence vs no turbulence; landing; 2) to evaluate the various scan patterns and determine if an "optimal scan pattern" could be discovered, and 3) to evaluate the pilots qualitative ranking of instrument use with quantitative scan data from eye movement recordings.

The results of the research by Spady (1978) indicate that 1) 737 pilots used different scan pattern in the coupled and manual mode with atmospheric turbulence having no significant effect on scanning behavior, 2) although the 737 pilots tend to gather the same types of information, each pilot seemed to have a unique scan pattern, and 3) pilots could do an adequate job of ranking instruments from most used to least used, although they seemed to rank some instruments"in terms of their concern for information rather than according to their actual scan behavior" (p. 12).

Training Eye-Scan Behavior

An obvious advantage of a valid and precise measure of instrument scan behavior by experienced pilots lies in the potential use of such information in the design or operation of flight training programs. For example, Farrell and Fineberg (1976) found that navigational skills by experienced helicopter pilots (2000 hrs) could be matched by recent aviation school graduates after only 15 hours of specialized training. Similarly, Allen, Schroeder, & Ball (1978) reported that after short-term practice there was no significant difference between experienced and inexperienced drivers with respect to: (1) use of accelerator, (2) frequency of eye movements, (3) length of eye movements, (4) fixation errors, (5) driving errors, or (6) the relationship of control actions to driving errors.

The results from the study by Farrell & Fineberg paralleled the finding by Mourant and Rockwell (1972) that the scanning range of novice drivers were consistently narrower than those of experienced drivers. However, as the data from Farrell & Fineberg indicate, most of the eye scan differences disappear with short-term practice.

Since there is little doubt that significant differences exist between student and experienced pilots in their instrument scanning behavior, it would be important to know whether information concerning experienced pilots' scanning behavior would be beneficial to trainees involved in a flight training program.

Purposes of the Present Study

The major purpose of the present study was to assess the effects of a video tape on scanning behavior using pilot and copilot trainees completing a commercial flight training program. The dependent variables were:

1) instructor ratings of performance for trainees having been exposed to the training tape and those trainees in the control group.
2) changes in self-reported eye-scan patterns for control and experimental groups, and
3) student judgments concerning the effectiveness of the training tape in improving performance.

Third Day Phenomenon

The flight training personnel at Piedmont Airlines suggested that an unusually large number of pilot and copilot trainees showed a performance decrement on or about the third day of simulator training. They also suggested that their own attempts to find possible explanations for this had proven unsuccessful. They requested that this study incorporate some objective means of verifying the phenomena and, if possible, to provide recommendations for its amelioration.

An extensive review of the literature on human learning and skill acquisition failed to reveal any research that has found regular performance decrements during skill acquisition. Furthermore, there has been little or no basic research conducted for commercial flight training programs, so little is known about parameters that could affect performance. In view of this, the following dependent variables were used:

1) instructor ratings of performance,
2) task difficulty survey to determine if the tasks required on or around the third simulator session were significantly more difficult,
3) trainee activity survey that monitored the trainees activities during flight training, and
4) trainee feedback during debriefing concerning the "third-day phenomenon".

METHOD

Flight Training Program

The flight training program attended by each subject involved four weeks of training consisting of three weeks of ground school and one week of 737 flight simulator training. Simulator training was received by the subjects in pairs, each pair having the same instructor pilot (IP) for the entire week of simulator training. The daily simulator sessions lasted four hours for each pair of students, but the time of day at which the session was conducted was rotated among the pairs of subjects throughout the week. The first session of each day began at either 0600 or 0800 with subsequent sessions beginning every four hours after that until all subjects in a class had received training.

Subjects

The subjects were 27 pilot and copilot trainees undergoing the 737 flight training program at Piedmont Airlines Training Center, Winston-Salem, NC. Three different classes with 8-10 subjects each, were used for data collection. Table 1 presents the relevant demographic data on all subjects.

TABLE 1

Demographic Data for Pilot/Copilot Trainees*

	Control Group	Experimental Group	Mean Age	Mean Flight Time
Pilots n=9	2	7	40.3	7,250 hrs
Copilots n=18	12	6	30.2	3,627 hrs
TOTAL *n=27	14	13		

The second group of subjects consisted of seven IPs. All IPs were fully qualified pilots on the Boeing 737 and had been IPs for more than one year. Assignment of subjects to the control and experimental groups was done randomly except that two subjects who did not receive their simulator training in the same week as the other members of their class were arbitrarily assigned to the control group.

Oculometer Training Tape

The oculometer training tape was produced by NASA-LRC and contained a review of the research conducted by Spady (1978). While a review of previous research findings may not constitute "training" per se, the purpose of the tape was to provide information pertinent to performance in the 737 simulator.[1]

Eye-Scan Survey

The Eye Scan Survey was a paper and pencil task which presented 10 different flight situations (5 coupled and 5 manual approaches) and diagrams of an instrument panel. The trainee was asked to draw the "typical" instrument scan pattern for each flight situation for a 10-second period (see Attachment I). The order of presenting the flight situations was randomly arranged to control for order effects. Trainees were also asked about changes in their instrument scan behavior as a result of the flight training program.

Instructor Score Sheets

In order to obtain objective measures of trainee performance, instructor score sheets were developed based on the syllabus provided

[1] Inquiries concerning the content of the oculometer tape should be directed to the Automation Research Branch, NASA-LRC.

by administrative personnel in the flight training program. The syllabus provided a list of the tasks that each student would be required to perform during each session in the flight simulator. Instructors were asked to rate each trainee's performance on each task using a magnitude estimation scale of 0-100 (D'Amato, 1970), with a high score reflecting better performance. Attachment II shows the instructor score sheet for each of the six lesson plans.

Task Difficulty Survey

The Task Difficulty Survey (Attachment III) was devised to assess trainee and IP ratings of the difficulty of each of the tasks (n=78) the student would be asked to perform. Tasks were arranged in a random order and subjects (IPs and trainees) were asked to rate the difficulty of each task on a bi-polar, seven-point scale where"1" corresponded to "the student should perform this task easily", and "7" corresponded to "the student should have extreme difficulty with this task". These data provided information concerning the relative difficulty of each of the sessions of simulator training.

Activity Booklets

It was hypothesized that should a "third day phenomena" exist, there may be a relationship between the way a trainee structures his/her time outside the simulator and performance in the simulator. In order to test this hypothesis, an activity booklet was constructed. An example of the instructions and a page from the activity booklet is shown in Attachment IV. Each activity booklet consisted of seven pages, each containing an 8 x 24 matrix (activities x hours). The trainee was asked to place a check mark by the activity engaged in for each hour of the day. In addition, the trainee was asked to record all medication and alcohol used. Finally, the trainee was asked to rate his/her performance for each day using a magnitude estimation scale of 0-100. Trainees were given four one-week activity booklets for the three weeks of ground school and the week of simulator training and were asked to mail the booklets to NASA-LRC at the end of each week.

Procedure

The researchers met with the trainees on the first day of ground school. After a brief, limited explanation of the purposes of the research, demographic data were collected and activity booklets were distributed. Trainees were asked to use a four-digit code to identify their data sheets and to insure their anonymity throughout the experiment.

On the first day of simulator training, a researcher met with each pair of trainees and their IP. The trainees were shown the instructor score sheets and the data collection procedure was explained. Trainees in the experimental group were shown the oculometer training tape following the first simulator session. All trainees completed the Eye Scan Survey following the first simulator session.

Subsequent to Day Five of simulator training, trainees completed a second Eye Scan Survey, a task difficulty survey and trainees in the control group were allowed to see the training tape if they so desired. All trainees were briefed as to the exact nature of the research and were asked for feedback concerning 1) the training tape, 2) the flight training program, 3) the "third day phenomenon", and 4) suggestions for use of the oculometer system as a training aid.

RESULTS AND DISCUSSION

Because of the order in which it was necessary to analyze the data, the results from the analyses of the "third day phenomenon" data are more conveniently presented before the analyses of the oculometer training tape data.

Third Day Phenomenon

The absence of any literature that would suggest a consistent performance decrement during skill-acquisition limited the number of *a priori* hypotheses concerning factors that might contribute to such an occurence. However, in an attempt to isolate factors that might cause (or create the appearance of) a performance decrement, the researchers attempted to determine 1) whether the tasks the trainees were asked to perform on or around the third day of simulator training were more difficult than on other days of simulator training and 2) whether the workload requirements of the trainees during mid-training were substantially higher. It would have been highly informative if either or both of these factors would predict performance decrements on or around the third day of simulator training.

Task Difficulty Survey(TDS)---The TDS attempted to determine how pilot trainees, copilot trainees and IPs rated the difficulty of the simulator performance tasks. Attachment V presents the mean difficulty ratings and standard deviations for each task, and each lesson plan by each of the three groups. These data are summarized in Table 2.

TABLE 2

Mean Difficulty Ratings For Each Lesson Plan By Pilot Trainees (n=8), Copilot Trainees (n=14), and Instructor Pilots (n=9)*

		LESSON					
		1	2	3	4	5	6
Pilot Trainees	(mean)	2.192	2.667	2.518	2.692	2.963	3.450
	(S.D.)	.925	.825	.780	.537	.773	.575
CoPilot Trainees	(mean)	2.667	3.077	2.729	3.148	3.447	3.614
	(S.D.)	.505	.524	.612	.597	.669	.849
Instructor Pilots	(mean)	2.653	3.155	2.880	3.453	3.675	4.242
	(S.D.)	.757	.839	.896	.556	.997	.823

* Ratings are based on a seven point bi-polar scale where "1" corresponded to "the student should perform this task easily" and "7" corresponded to "the student should have extreme difficulty with this task".

As these data indicate, the copilot trainees rated each lesson plan more difficult than pilot trainees, however, the IPs rated each lesson plan except Lesson 1, more difficult than either of the trainee groups. This suggests that the IPs do not have unrealistic expectations of trainees and in some cases rate individual tasks substantially more difficult than do the trainees (e.g., Lesson 1-8; Lesson 2-10; Lesson 3-3; See Attachment V).

Furthermore, the data from Table 2 indicate that each of the three groups rated the overall difficulty of the tasks on Lesson 3 as easier than all other lesson plans except Lesson 1. In general, the lesson plans tended to become increasingly more difficult; however, these data indicate that no combination of tasks that the trainee encountered during the middle of the flight training program was substantially more difficult than any other combination of tasks.

<u>Trainee Workload</u>---The length of the flight training program differs for pilot and copilot trainees. In both cases, however, the IPs

attempt to complete all six lesson plans within the first five days of simulator training. Additional days, if necessary, are used for retraining various tasks. Therefore, in an attempt to complete six lesson plans in five simulator sessions, the trainee might have been subjected to an excessive workload on or around the third simulator session.

Table 3 shows the mean number of tasks the trainees were asked to perform during each simulator session. The data indicate that the trainees had a higher workload in sessions 3 through 5 than in earlier sessions. However, taken alone, conclusions from workload data are subject to only limited interpretation. The high variability in sessions 3 through 5 lends credence to the suggestion, originally made by one IP, that the trainees' progress in the flight training program was based on their successful performance of the tasks outlined by the lesson plans. Indeed, it may well be that the completion of a large number of tasks indicates a higher level of proficiency rather than an excessive workload demand.

TABLE 3

Mean Number Of Tasks Performed By Trainees
During Each Of The Five Simulator Sessions

	SIMULATOR SESSION				
	1	2	3	4	5
Mean number of tasks	13.00	12.75	13.30	15.60	14.76
S.D.	4.43	4.62	6.42	7.74	6.38

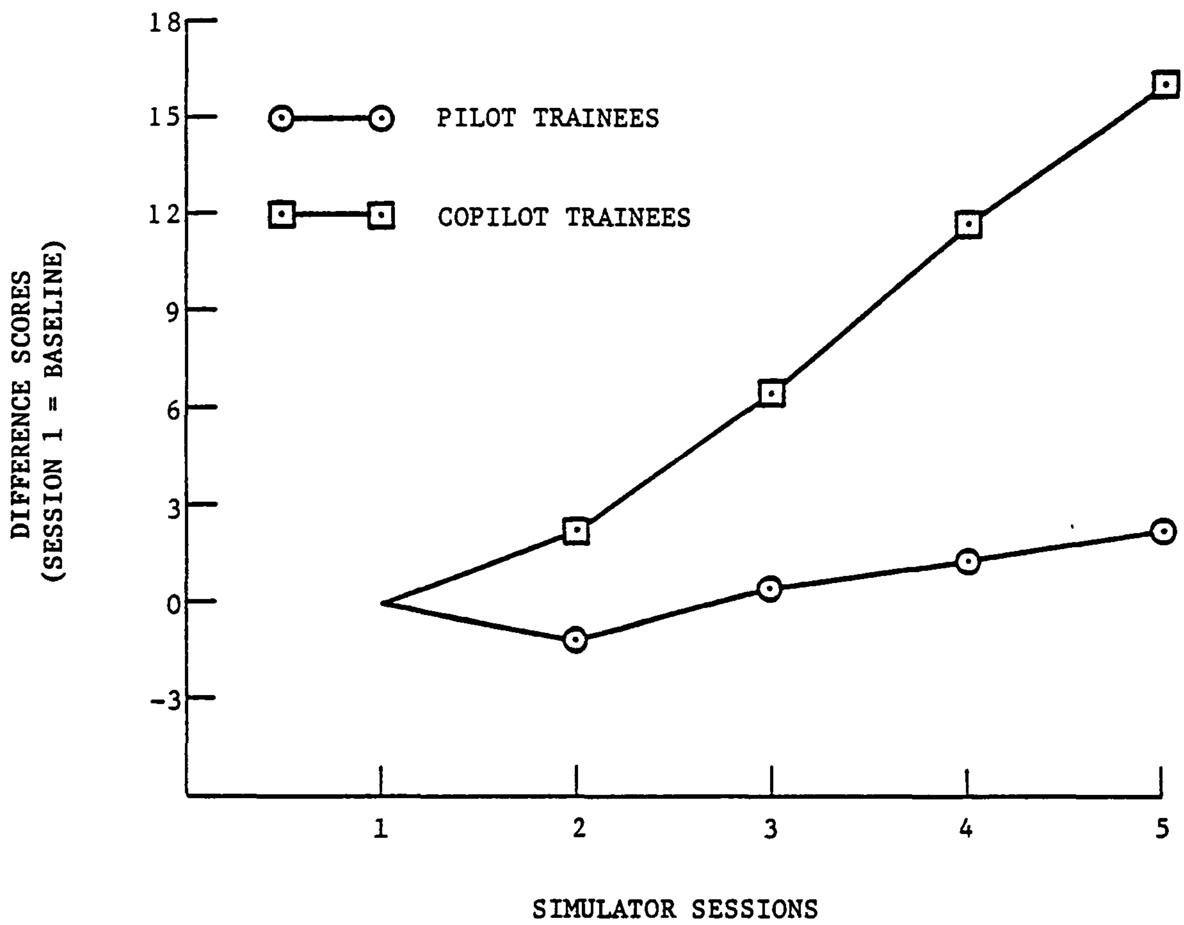
Taken together, the task difficulty analysis and the workload analysis show no evidence of performance decrements on or around the third day of simulator training.

Performance Measures---As indicated above, instructor ratings of trainee performance were made using a magnitude estimation scale of 0-100 (see Attachment VI). Since different IPs provided ratings of the subjects, raw scores could not be compared between subjects. However, since 1) the oculometer training tape was shown subsequent to session 1, and 2) since this investigation sought information about performance relative to session 1, the raw performance data were transformed into a matrix of data detailing performance relative to session 1. The different scores were computed by subtracting the performance rating in Session 1 from the performance rating in session of interest (for detailed data, see Attachment VII). As can be seen in a graphical presentation of the mean difference scores as a function of session and type of trainee, Figure 1, the copilot trainees showed a gradual improvement in performance (means = 2.194, 6.554, 11.928, and 16.757 respectively). However, the pilots showed a performance decrement during session 2 (means = -1.222, .897, 1.688 and 2.288 respectively) with gradual improvement in performance from session 3 through session 5.

By transforming these difference scores into a matrix showing performance as either an improvement (+) or a decrement (-), (see Attachment VIII), it was possible to determine how many trainees showed performance decrements relative to session 1 during the flight training program. It should be noted that these data show absolute differences from performance scores in session 1 and do not reflect statistically significant differences. As Table 4 indicates, eight of nine pilot trainees but only six of 15 copilot trainees showed a performance decrement during session 2. The number of trainees showing performance

FIGURE 1

Difference Scores Showing Performance Relative To Session 1 for Pilot and Copilot Trainees



decrements decreased with each simulator session. In no case did a trainee show a performance decrement after having shown an improvement in performance (see Attachment VIII). This indicates that performance decrements during session 2 were a major predictor of performance difficulties during the remainder of the flight training program.

TABLE 4

Number Of Trainees Showing Performance Decrements (relative to session 1) During Flight Training

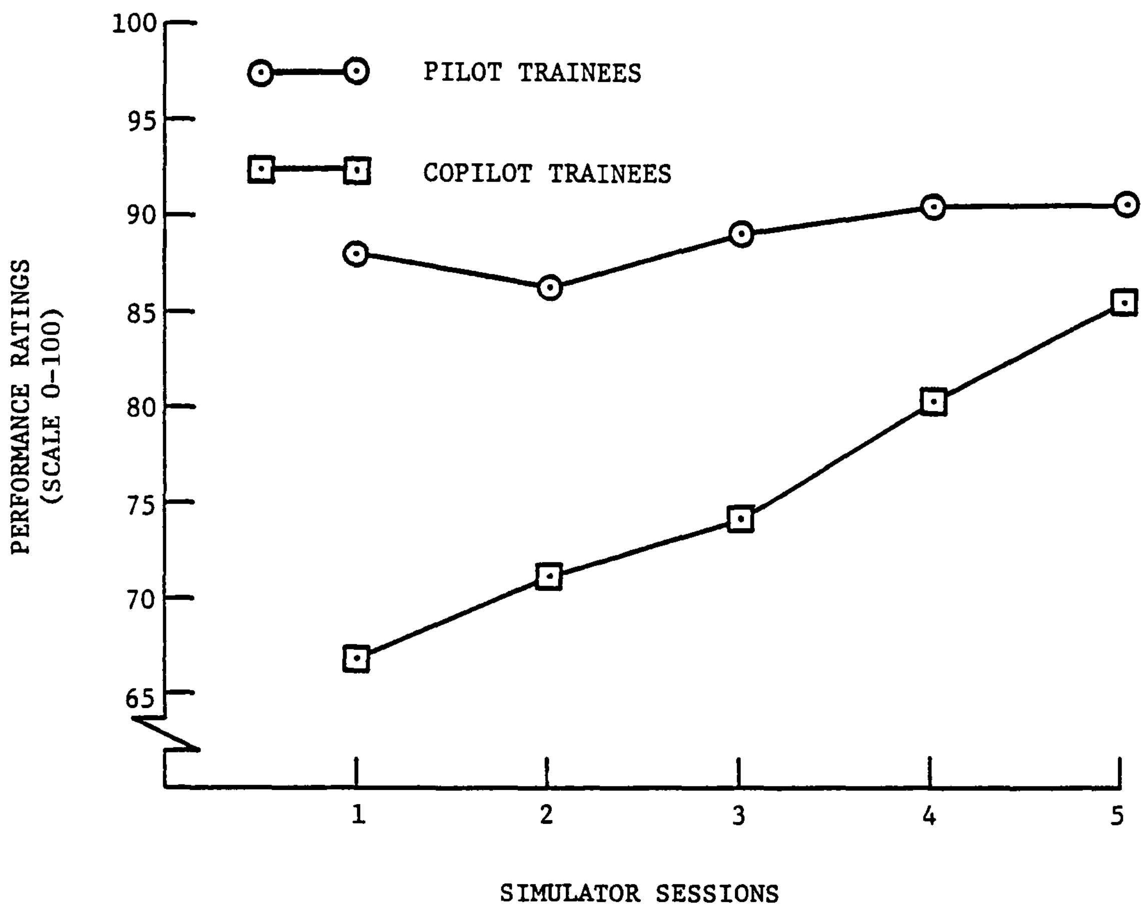
	SESSION			
	2	3	4	5
Pilots (n = 9)	8	4*	3	1
Copilots (n = 16)	6**	2**	2	2

* n = 7
** n = 15

Finally, it should be noted that the extent to which performance could have improved was largely a function of initial performance. It would be a serious error to infer from these data that the pilot trainees functioned less effectively than copilot trainees. As can be seen in Figure 2 the mean performance scores by pilot trainees (means = 88.557, 87.335, 89.434, 90.245, and 90.845, respectively) were substantially higher than copilot trainees (means = 68.369, 70.967, 73.754, 80.297, and 85.126, respectively). Since the pilot trainees' ratings were higher in session 1, there was less opportunity for improvement in sessions 2 through 5. Obvious, copilot trainees begin simulator training with less proficiency than pilot trainees and gradually develop the skills and knowledge necessary to perform the

FIGURE 2

Performance Ratings for Pilot and Copilot Trainees in Each Simulator Training Session



tasks required in the flight training program. Since the present research has concentrated on difference scores (i.e., performance relative to session 1) these facts may be lost to the casual reader. As Figure 2, clearly shows, the pilot trainees bring considerable skill to the flight training program, and the IPs have made clear quantifiable distinctions between the proficiencies of the pilot and copilot trainees.

Activity Booklet Data---The purpose of the activity booklets was 1) to compare performance data with activity (e.g., study habits), and 2) to compare a trainee's estimate of his/her performance with that of the IP. However, feedback from some of the trainees revealed that the sensitive nature of the questions within the Activity Booklet made them reluctant to respond. Indeed, there was less than one percent response rate for the week of the flight training program; therefore, these data were not anaylzed.

Trainee Feedback---Subsequent to session 5, the researchers met with the trainees to obtain feedback concerning the "third day phenomena". Most trainees suggested that their performance did deteriorate on or about the third simulator session. They indicated that the quality of their performance depended on whether they received training first or second in a particular simulator session. Their performance was reported as "less sharp" if they were second during a particular session. Data on which subject went first in each session was not kept so it was not possible to evaluate this suggestion; however, this issue should be addressed in future research.

A second comment by the trainees was that the rotating schedule of the time of day at which simulator training occurred during the week was a major contributor to performance problems. Given a volume of research on the effects of changes in work schedules on biological rhythms and on human performance (e.g., Colquhoun, 1971; Colquhoun, 1972), this possibility may be a valid one. However, the data from this research do not entirely support the conclusion that rotating shifts was a significant contributor to performance decrements since the performance decrements did not vary as a function of time of simulator training.

Finally, feedback from the pilot trainees sheds some light on a possible cause for so many pilot trainees showing performance decrements during session 2. The pilot trainees indicated that there was a significant difference in performing in the 737 simulator after having had experience on the aircraft itself. It is possible that the experienced 737 pilot trainee has learned to use a set of performance cues that are unavailable in the simulator. In other words, there may be a positive transfer effect (Ellis, Bennett, Daniel & Rickert, 1979) when going from the 737 simulator to the 737 aircraft but a negative transfer effect (Ellis et al., 1979) when going from the 737 aircraft to the simulator. However, no firm conclusion with regard to this possibility can be reached without extensive future research.

Conclusions---Taken together, the performance data fail to support the suggestion that pilot or copilot trainees show a performance decrement on or about the third day of the flight training program. The data indicate that the presence of a performance decrement by trainees from session 3 through session 5 was predictable from performance during the preceding session. The fact that a substantially higher percentage of pilot trainees showed performance decrements than copilot trainees may indicate a problem of negative transfer from the aircraft to the simulator; however, without further research, this is only speculative.

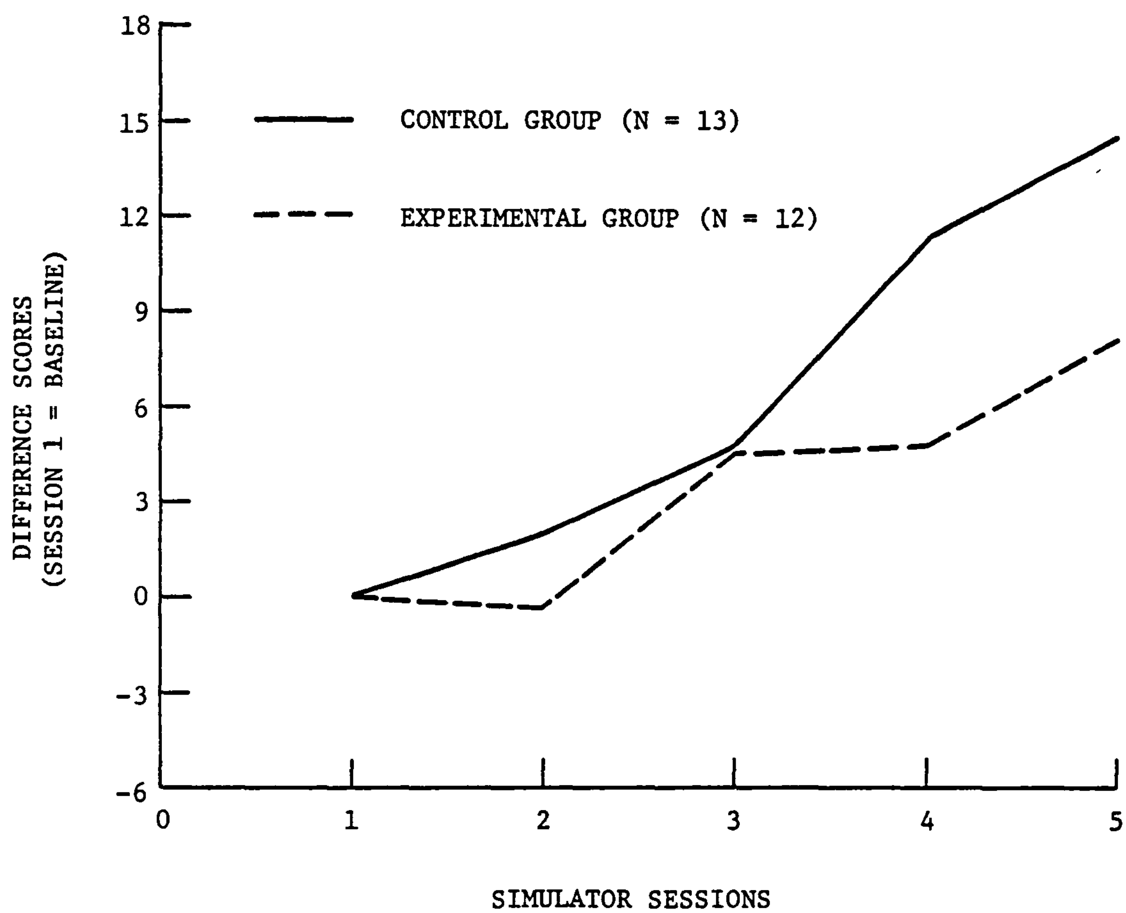
Oculometer Training Tape

During the flight training program the pilot and copilot trainee must learn to gather various types of information from the aircraft instruments. While the research by Spady (1978) indicated that there was no single optimal scan pattern, it was reported that certain scanning behavior was more appropriate under certain flight conditions. In order to determine if this information (Spady, 1978) would affect performance in the flight simulator the researchers attempted to determine 1) if there was any difference in performance ratings of the trainees who were exposed to the training tape (experimental group) and performance ratings of the trainees those who were not exposed to the tape (control group), and 2) if there was a significant difference in the self-reported scanning behavior (using a paper and pencil task, see Attachment I) of the two groups from session 2 through session 5.

Performance Measures---Since the oculometer training tape was not shown until after session 1 the analysis of performance differences by control and experimental groups concentrate on sessions 2 through session 5. Figure 3 shows difference scores for control and experimental groups. The graph appears to indicate that the control group (means = 1.972, 4.768, 11.395, and 14.666 respectively) performed better than the experimental group (means = -.146, 4.737, 4.825, and 8.170 respectively). However, since the experimental group had more pilots and the control group had more copilots, and since the pilots

FIGURE 3

Difference Scores Showing Performance Relative To Session 1 For Control and Experimental Groups



showed less improvement in each of the simulator sessions, the conclusion that the video tape led to less improvement is not valid.

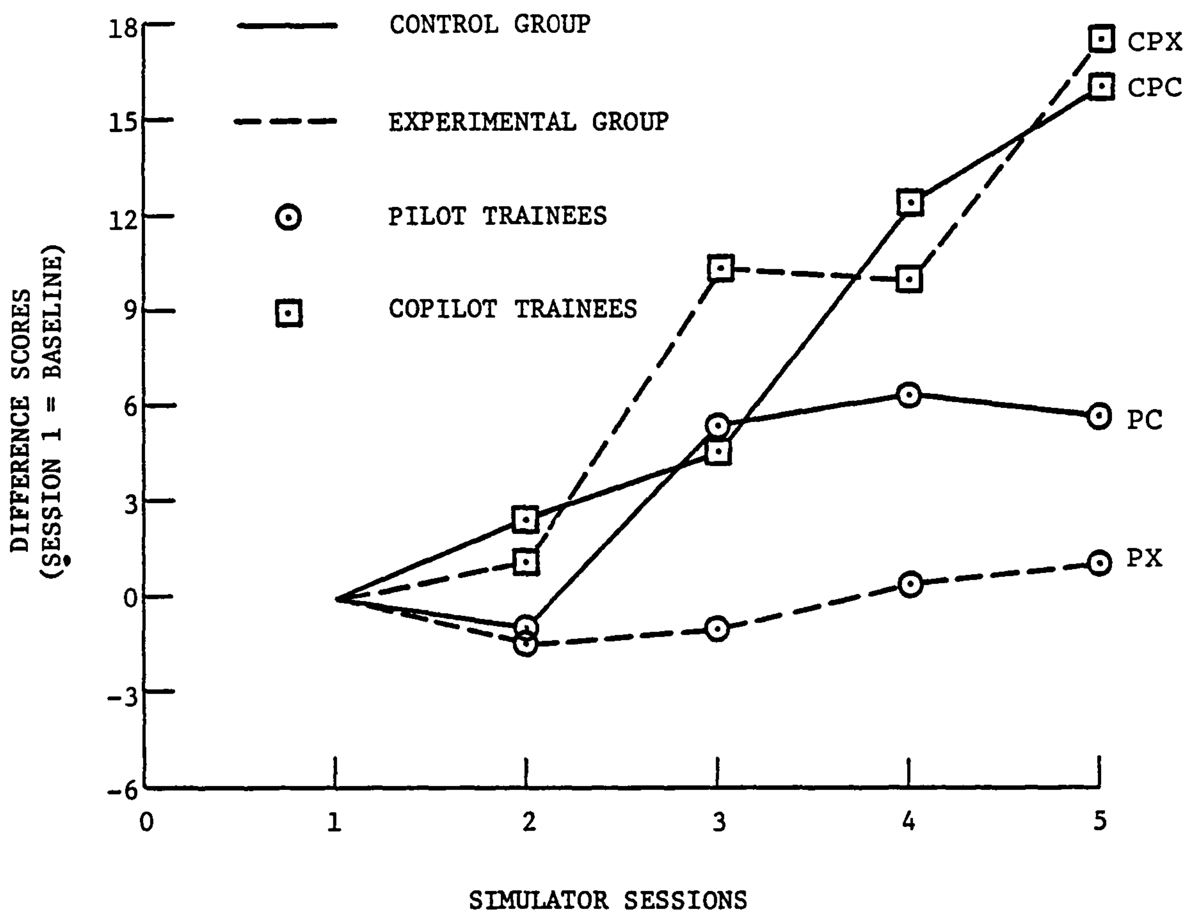
Figure 4 shows the mean difference scores for pilot controls (-1.181, 5.672, 6.181, and 5.875, respectively), copilot controls (2.603, 4.587, 12.343, and 16.265, respectively), pilot experimentals (-1.234, -1.013, .404, and 1.263), and copilot experimentals (1.376, 10.487, 11.015, and 17.841 respectively). These data indicate that the performance differences shown in Figure 3 were largely a function of the experimental group containing a majority of the pilot trainees. It must be concluded from these data that the oculometer training tape had no clear effect on the performance of the experimental group.

Eye Scan Survey Data---The eye-scan survey was developed for this project in an attempt to obtain subjective reports of the scan patterns of trained pilots (IPs), trainee pilots early in training, and trainee pilots at the completion of simulator training. It was to serve the purpose of describing how the pilots at these various stages of training viewed their scanning of the aircraft instruments. From the outset, the instrument was viewed as merely descriptive and no tests of significance were planned. Because of the developmental nature of this instrument, the reader is cautioned to view the following description of the results as purely descriptive.

To summarize the data of the eye-scan survey, the responses of each subject to the ten flight situations were summarized as a transition matrix presenting the frequency with which the subject shifted to instrument *X* at time, *t+1*, given that he/she was viewing instrument *Y* at time, *t*. The resulting matrices for the subjects of particular groupings were subsequently pooled to provide descriptions of the

FIGURE 4

Difference Scores Showing Performance Relative To Session 1 For Each of the Trainee Groups (PC = Pilot Control Group; PX = Pilot Experimental Group; CPC = Copilot Control Group; CPX = Copilot Experimental Group)



step-wise scan behaviors for those groups. The frequency matrices were converted to transition probability matrices in which the entries represent the conditional probabilities that the subjects shifted to instrument X at time t+1 given that they were viewing instrument Y at time t.

Table 5 presents the transition probability matrices for three such groups of subjects simultaneously for purposes of comparisons--the instructors (I), the trainees following Session 1 of the simulator training (A), and the trainees following the final session of simulator training (B). The instructors' matrix represents a summary of 5 IPs responses to the ten situations providing a total of 312 lookpoints for a mean of 6.24 lookpoints per situation. The trainees' A matrix represents a summary of 19 trainees' responses to the ten situations providing a total of 1478 lookpoints for a mean of 7.78 lookpoints per situation. The trainees' B matrix represents a summary of 19 trainees responses providing a total of 1529 lookpoints for a mean of 8.05 lookpoints per situation. The matrices present as rows the instrument indicated at time t with the columns presenting the instrument indicated at time t+1. For example, given that the instructors were viewing the Airspeed (AS) indicator at time t, the probability that the next instrument indicated was the Flight Director (FD) was .455, while for the trainee A, this conditional probability was .463 and the trainee B was .654. This suggests, therefore, that the trainees were responding very similarly to the instructors at Session 1 of the simulator training, but that the probability of scanning from the Airspeed indicator to the Flight Director had increased by the end of Session 5. It should be noted that the rightmost column presents the marginal probabilities associated with each of the instruments; for example, the instructors indicated that they spent .176 of the time viewing the Airspeed indicator, while the trainees at the end of Session 1 indicated .175 of the time on the Airspeed indicator, and the trainees at the end of Session 5 indicated .149 of the time on that instrument.

TABLE 5

Transition Matrix for Instructors (I), Trainees Session 1 (A), and Trainees Session 5 (B) Collapsed Across Situations and Subjects*

		Time t+1							
		AS	FD	ALT	ADF	HSI	VSI	Other	Marginals
	I	----	.455	.127	.018	.109	.127	.073	.176
AS	A	----	.463	.147	.066	.089	.182	.050	.175
	B	----	.654	.145	.022	.040	.088	.053	.149
	I	.381	----	.250	.000	.060	.226	.083	.269
FD	A	.395	----	.266	.019	.136	.158	.026	.283
	B	.311	----	.304	.052	.123	.175	.084	.362
	I	.125	.375	----	.000	.100	.325	.075	.128
ALT	A	.211	.362	----	.014	.151	.257	.005	.148
	B	.128	.795	----	.005	.132	.142	.009	.143
	I	.200	.600	.000	----	.200	.000	.000	.016
ADF	A	.135	.351	.081	----	.378	.054	.000	.025
	B	.128	.795	.026	----	.051	.000	.000	.026
	I	.000	.435	.174	.217	----	.174	.000	.074
HSI	A	.198	.364	.080	.179	----	.173	.006	.110
	B	.147	.588	.037	.110	----	.118	.000	.089
	I	.171	.342	.220	.049	.146	----	.073	.131
VSI	A	.088	.425	.269	.010	.202	----	.000	.131
	B	.025	.658	.120	.006	.184	----	.000	.103

*Note: AS = Airspeed Indicator
FD = Flight Director
ALT = Altimeter
ADF = Automatic Direction Finder
HSI = Horizontal Speed Indicator
VSI = Vertical Speed Indicator

In general, judging from the marginal probabilities of Table 5, initially the instructors and the trainees were spending approximately equivalent proportions of time on the respective instruments, with one possible exception being the HSI. However, by the end of Session 5, the differences between the instructors' responses and the trainees' responses were more marked, with the greatest change being on the Flight Director, where the trainees indicated a sizable increase in the proportion of time spent on the Flight Director, with decreases in the AS and the HSI. Similar shifts can also be observed in the respective transition probabilities, with most of the shifts being noted in the increased shifts to the Flight Director at time t+1. Again, caution should be urged as to the possible significance of these shifts; however, it does appear that the Flight Director has become more important to the trainees as a result of the simulator training.

It should be noted that these data are consistent with the finding by Spady (1978) that experienced pilots demonstrated more of a reliance on the FD when flying in the manual mode than when flying in the coupled mode. Since the trainees exclusively received experience in the manual mode, it appears that the instructor pilots properly emphasized the use of the FD during the flight training program. Future research may determine whether, with flight experience, the trainees would demonstrate more diversity in their scanning behavior and reduce their reliance on the FD.

Table 6 presents similar matrices for the trainees grouped according to the Control vs Experimental designation, presenting matrices for the Control subjects following Session 1 (CA), the

Controls following Session 5 (CB), the Experimental subjects following Session 1 (EA), and the Experimentals following Session 5 (EB). The CA data represent the responses of 8 control subjects providing a total of 637 lookpoints for a mean of 7.96 lookpoints per situation; the CB group represents the data of 8 controls providing a total of 676 lookpoints for a mean of 8.45 per situation. The EA group represents the data of 11 experimental subjects providing a total of 841 lookpoints for a mean of 7.65 per situation while the EB group represents the 11 subjects providing a total of 853 lookpoints for a mean of 7.75 per situation.

As one examines the data of Table 6, the patterns in the previous table are also evident here. Specifically, for both groups, experimental and control, the major shift between the responses of Session 1 and the responses of Session 5 appears to center on an increased reliance on the FD. While in both the marginal probabilities and the transition probabilities, there appear to be some shifts between the sessions, these shifts are in the direction of decreasing emphasis on other instruments and increasing emphasis on the Flight Director. On the other hand, there does not appear to be any distinguishing characteristics of these shifts that are associated with either of the two major groups--experimental and control.

In summary, the data of the eye-scan survey suggest that as a result of the simulator training, the responses of the trainees shift from being similar to that of the instructors to being more dissimilar with the major point of divergence being an increased emphasis on the use of the FD by trainees. This may have been caused by the trainees responding to all situations outlined in the eye-scan survey as if

TABLE 6

Transition Matrix for Control-Pre (CA), Control-Post (CB), Experimental-Pre (EA), and Experimental-Post (EB) Trainees Collapsed Across Situations and Subjects*

		Time t+1							
		AS	FD	ALT	ADF	HSI	VSI	Other	Marginals
AS	CA	----	.530	.159	.083	.038	.121	.060	.207
	CB	----	.764	.164	.000	.009	.036	.027	.163
	EA	----	.394	.134	.047	.142	.244	.039	.151
	EB	----	.551	.127	.042	.068	.136	.076	.138
FD	CA	.452	----	.233	.010	.126	.136	.044	.323
	CB	.346	----	.258	.044	.135	.171	.047	.407
	EA	.340	----	.297	.028	.146	.179	.009	.252
	EB	.277	----	.349	.061	.112	.180	.022	.326
ALT	CA	.250	.500	----	.000	.076	.163	.011	.144
	CB	.065	.804	----	.000	.033	.098	.000	.136
	EA	.183	.262	----	.024	.206	.325	.000	.150
	EB	.126	.472	----	.008	.205	.173	.016	.149
ADF	CA	.067	.600	.000	----	.333	.000	.000	.024
	CB	.000	1.000	.000	----	.000	.000	.000	.018
	EA	.182	.182	.136	----	.409	.091	.000	.026
	EB	.185	.704	.037	----	.074	.000	.000	.032
HSI	CA	.102	.551	.061	.143	----	.143	.000	.076
	CB	.068	.864	.000	.023	----	.046	.000	.065
	EA	.239	.283	.089	.195	----	.186	.009	.134
	EB	.185	.457	.054	.152	----	.152	.000	.108
VSI	CA	.123	.431	.354	.000	.092	----	.000	.102
	CB	.032	.823	.081	.000	.048	----	.016	.092
	EA	.070	.422	.227	.016	.258	----	.008	.152
	EB	.021	.552	.146	.010	.271	----	.000	.113

*Note: AS = Airspeed Indicator
FD = Flight Director
ALT = Altimeter
ADF = Automatic Director Finder
HSI = Horizontal Speed Indicator
VSI = Vertical Speed Indicator

they were flying in the manual mode, which has been shown (Spady, 1978) to increase a pilots reliance on the FD. Finally, there does not appear to have been any shifts that distinguished the experimental trainees from the control trainees.

Trainee Feedback---Pilot and copilot trainees were asked to provide feedback concerning changes in their instrument scan behavior as a result of the flight training program following session 1 in simulator (pre-eye scan survey comments) and following the entire simulator training program (post eye-scan survey comments; see Attachment IX). These comments seem to indicate that, for some of the trainees, there was a perceived change in their instrument scan behavior as a result of their simulator training; however, only the comments by trainees #2 and #19 seem to refer directly to the information in the oculometer training tape.

Another source of feedback was from the trainees and IPs during debriefing. Subjects were asked for their judgments concerning the efficacy of the oculometer training tape and suggestions for its use with future trainees.

The overall feedback from the trainees and IPs was excellent. However, the trainees and IPs seemed to agree that the tape should be incorporated as a part of the ground school rather than the flight training program. Finally, the IPs and trainees suggested that NASA-LRC consider reinstalling the oculometer system in the 737 simulator and establishing a procedure for its use as a training aid.

Conclusions---Taken together, these data indicated that the oculometer training tape, containing information about the scanning behavior of experienced pilots, had little or no effect on the performance or the self-reported eye-scan behavior of the pilot and copilot trainees; although, both groups recommended the inclusion of the tape into the ground school program. It may be that specific information contained in the training tape that might have impacted directly on performance or scanning behavior was redundant with information provided by the IPs during flight training since: 1) the experimental and control groups exhibited similar transitional probabilities for each instrument (see Table 6), and 2) both groups showed an increased reliance on the Flight Director following flight training.

Furthermore, the data from Spady (1978) showed that pilots' instrument scanning behavior was highly individualistic. That is, although pilots tended to gather the same types of information from the instrument panel, there was no apparent optimal scan-pattern for doing so. This suggests that the types of information that would be most helpful during flight training would involve a strategy of feedback concerning each trainee's scanning behavior rather than a more general type of intervention strategy. Ideally, this would involve the use of the oculometer system incorporated in the flight training program that would allow each trainee to view his/her own scanning behavior and receive immediate feedback from the IP concerning various strategies for improvement.

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ATTACHMENT I-1

EYE-SCAN SURVEY

INSTRUCTIONS

In this survey, we are attempting to identify the typical eye-scan patterns of pilots under a number of ILS approach situations. To do this. we are presenting on each page a schematic diagram of the instrument layout. With each schematic diagram there is a description of the conditions at a specific point in the approach, giving type of approach (manual or coupled), altitude, distance from touchdown, etc. We are asking you to assume these conditions, visualize your eye movements under these conditions, and describe the movement of your eyes for a "typical' 10-second period. We ask you to describe the movement of your eyes by starting at the darkened circle marked "Start' and draw the movement of your eyes as if they were at the START position at the beginning of the 10-second period. If your normal eye-movements would typically go beyond the scope of the schematic and return during this period, please feel free to trace it out.

On the last page of the survey, there is an additional question that we would like for you to answer in as much detail as you feel necessary.

Thank you for your assistance.

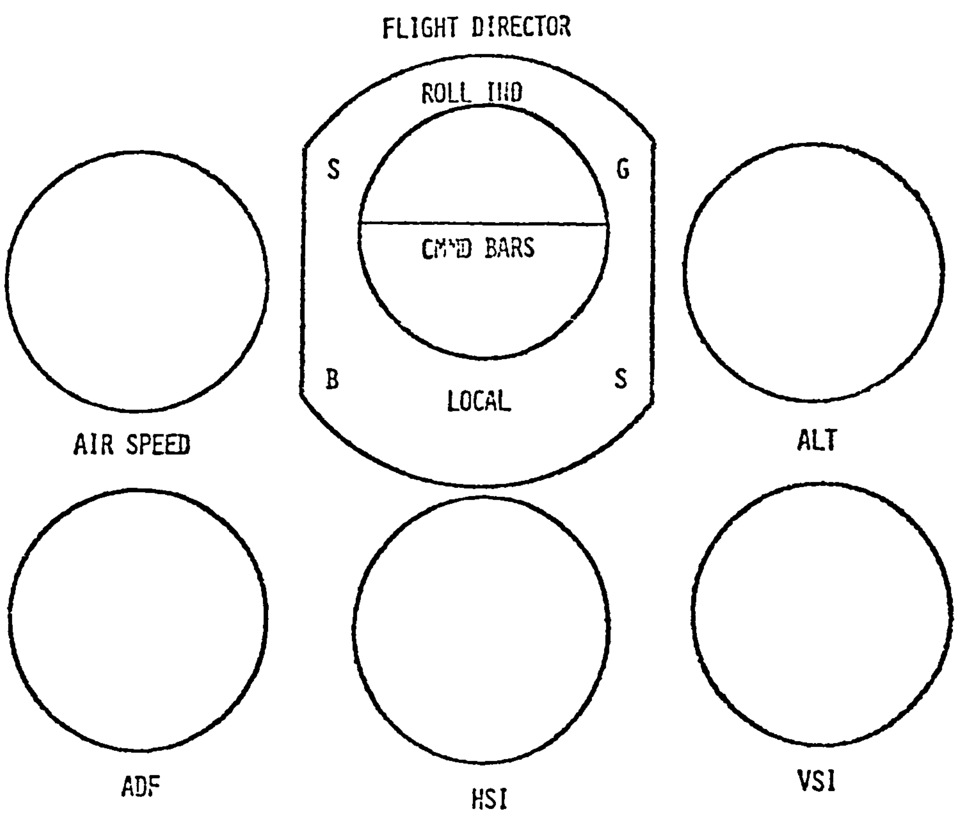
Identification Code ________

ATTACHMENT I-1(1)

SITUATION #1

Type of Approach: Manual ILS
Distance from Runway Threshold: 8 miles (13 km)
Altitude: 1500 feet
Airspeed: 150 knots
100-ft Ceiling
1200-ft RVR
Wind Conditions: zero
No Turbulence
Target Final Approach Speed: 128 knots
All Other Conditions: Nominal

● START

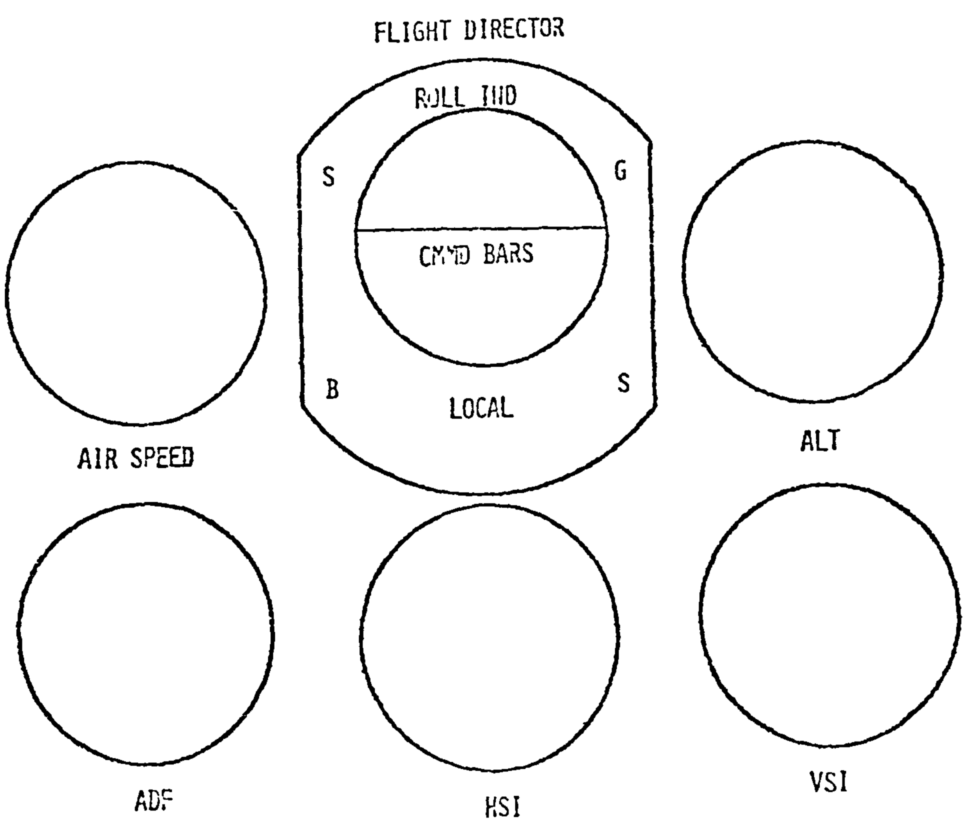


ATTACHMENT I-2

SITUATION #2

Type of Approach: Manual ILS
Distance from Runway Threshold: At Glide Slope Intercept
Altitude: 1500 feet
Airspeed: 138 knots
100-ft. Ceiling
1200-ft. RVR
Wind Conditions: zero
No Turbulence
Target Final Approach Speed: 128 knots
All Other Conditions: Nominal

● START

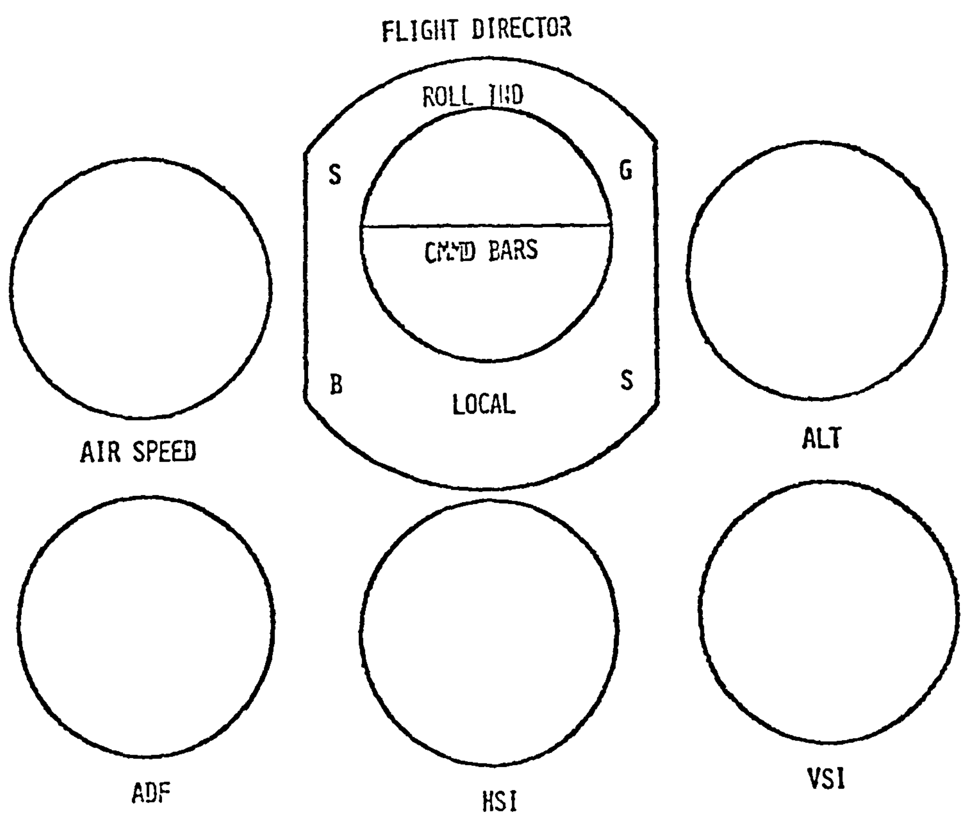


ATTACHMENT I-3

SITUATION #3

Type of Approach: Manual ILS
Distance from Runway Threshold: 3.4 miles on Glide Slope
Altitude: 1000 feet
Airspeed: 130 knots
100-ft. Ceiling
1200-ft. RVR
Wind Conditions: zero
No Turbulence
Target Final Approach Speed: 128 knots
All Other Conditions: Nominal

● START

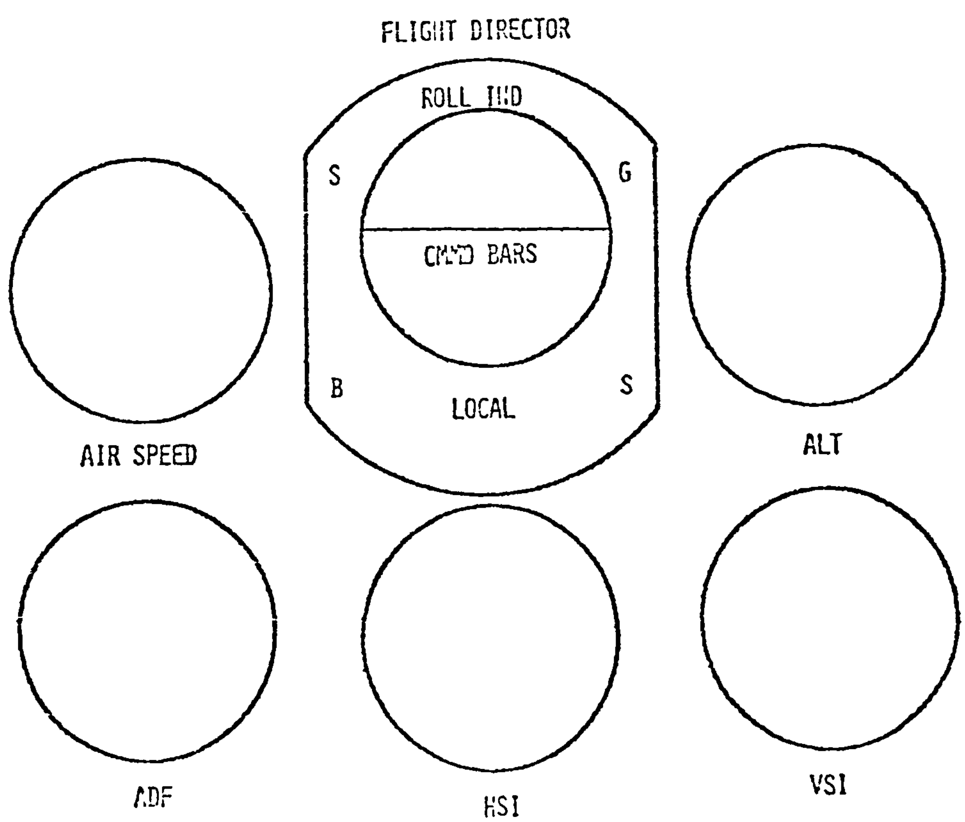


ATTACHMENT I-4

SITUATION #4

Type of Approach: Manual ILS
Distance from Runway Threshold 1.7 Miles on Glide Slope
Altitude: 500 feet
Airspeed: 128 knots
100-ft. Ceiling
1200-ft. RVR
Wind Conditions: zero
No Turbulence
Target Final Approach Speed: 128 knots
All Other Conditions: Nominal

● START

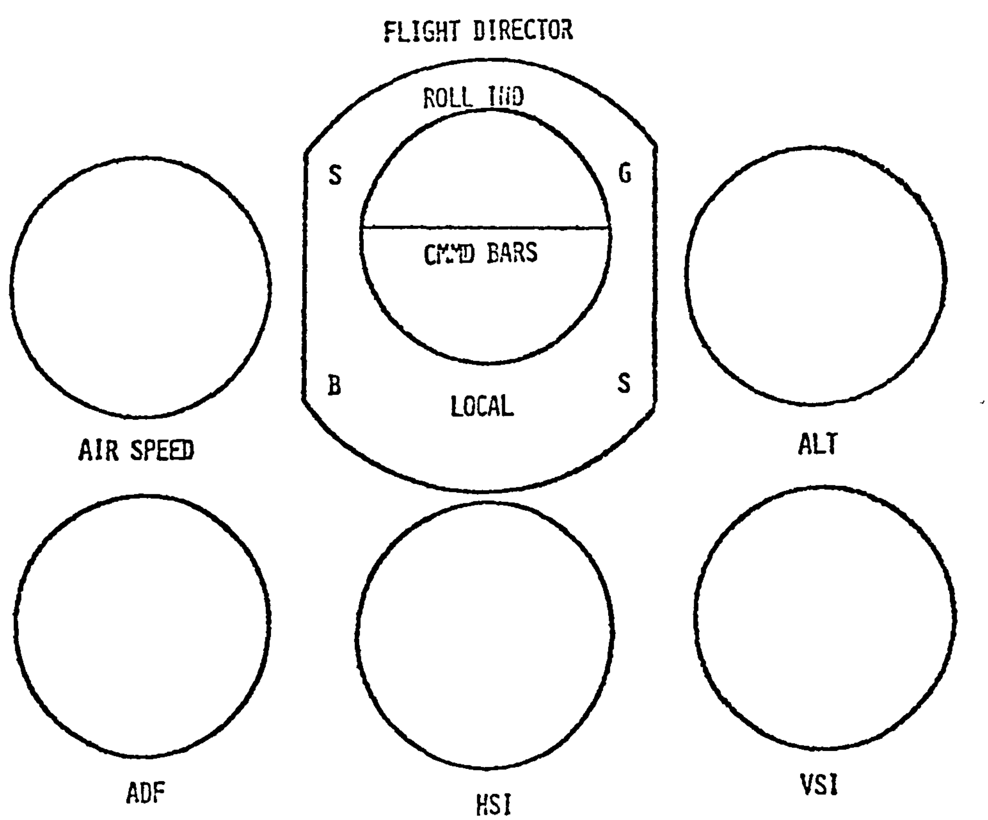


ATTACHMENT I-5

SITUATION #5

Type of Approach: Manual ILS
Distance from Touchdown: 2000 ft. on Glide Slope
Altitude: 100 feet
Airspeed: 128 knots
100-ft. Ceiling
1200-ft. RVR
Wind Conditions: zero
No Turbulence
Target Final Approach Speed: 128 knots
All Other Conditions: Nominal

● START

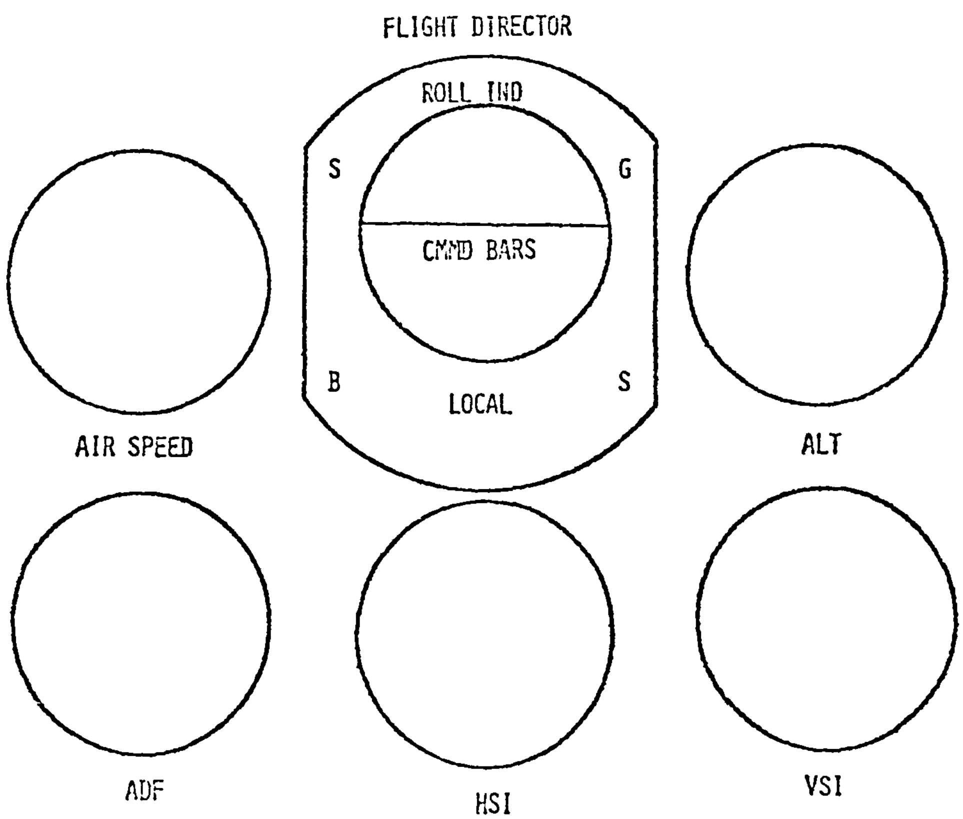


ATTACHMENT I-6

SITUATION #6

Type of Approach: Coupled ILS (Autopilot with Manual Throttle)
Distance from Runway Threshold: 8 miles (13 km)
Altitude: 1500 feet
Airspeed: 150 knots
100-ft. Ceiling
1200-ft. RVR
Wind Conditions: zero
No Turbulence
Target Final Approach Speed: 128 knots
All Other Conditions: Nominal

● START

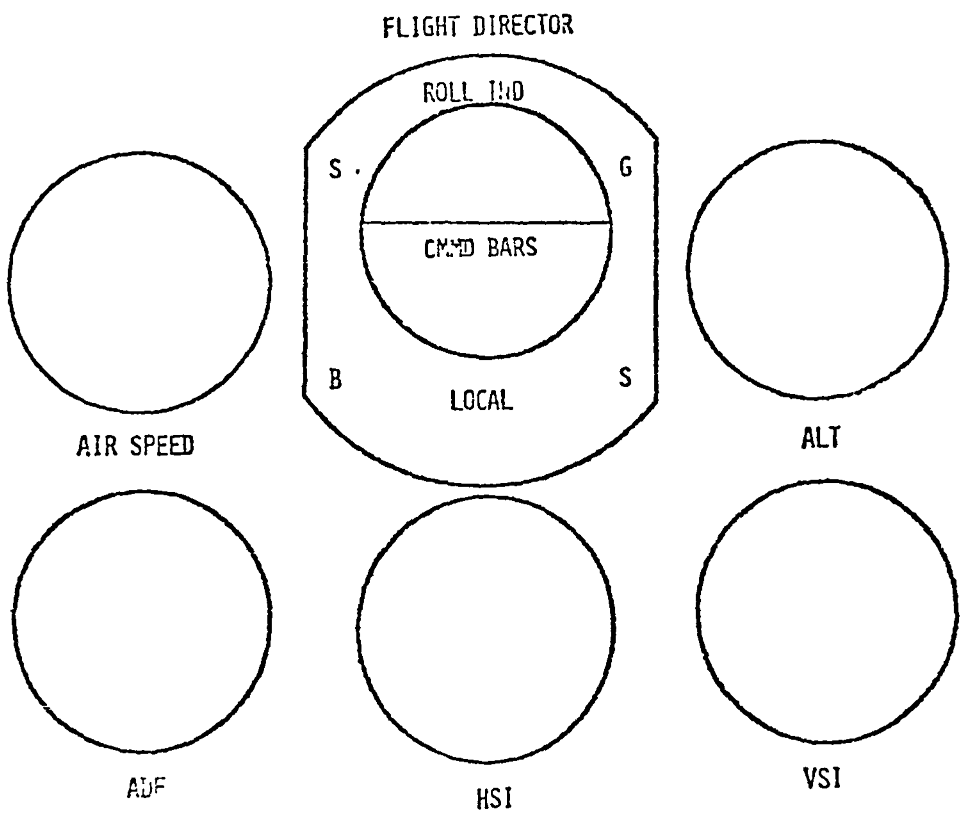


ATTACHMENT I-7

SITUATION #7

Type of Approach: Coupled ILS (Autopilot with Manual Throttle)
Distance from Runway Threshold: At Glide Slope Intercept
Altitude: 1500 feet
Airspeed: 138 knots
100-ft. Ceiling
1200-ft. RVR
Wind Conditions: zero
No Turbulence
Target Final Approach Speed: 128 knots
All Other Conditions: Nominal

● START

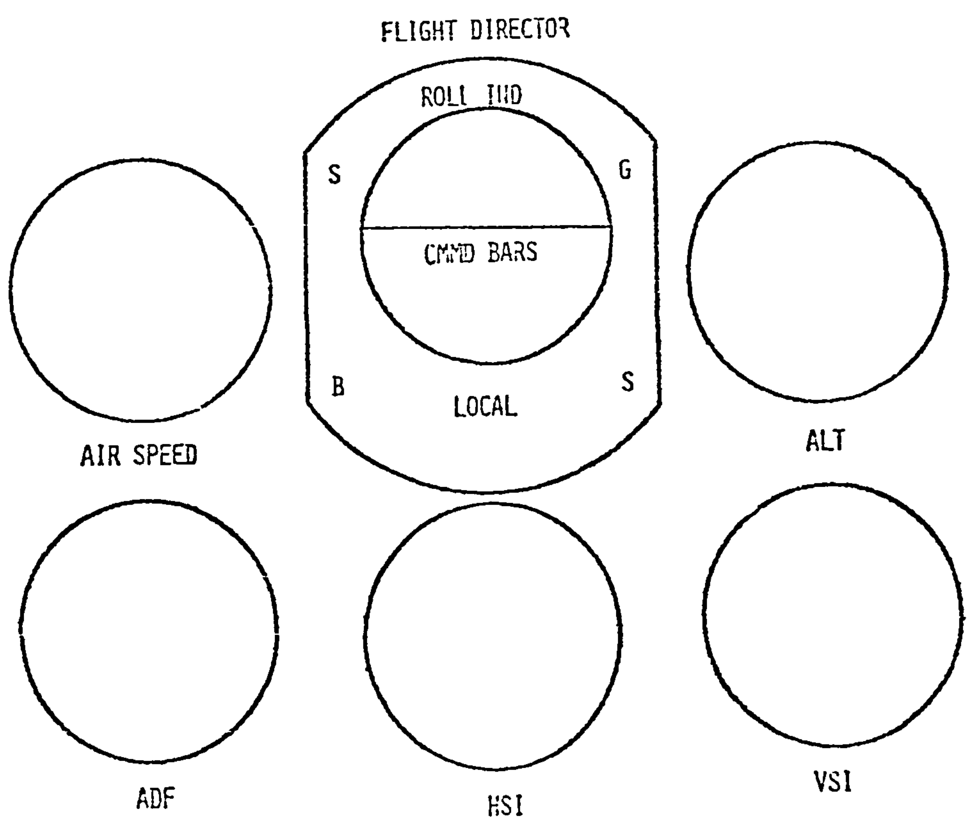


ATTACHMENT I-8

SITUATION #8

Type of Approach: Coupled ILS (Autopilot with Manual Throttle)
Distance from Runway Threshold: 3.4 miles on Glide Slope
Altitude: 1000 feet
Airspeed: 130 knots
100-ft Ceiling
1200-ft RVR
Wind Conditions: zero
No Turbulence
Target Final Approach Speed: 128 knots
All Other Conditions: Nominal

● START

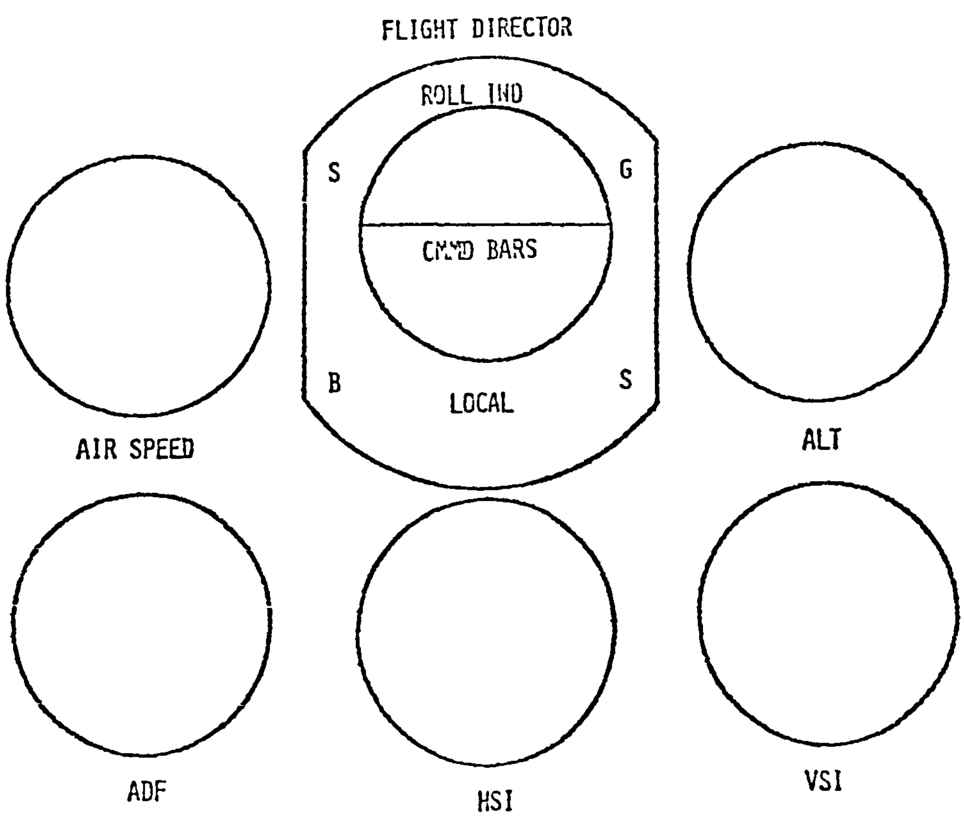


ATTACHMENT I-9

SITUATION #9

Type of Approach: Coupled (Autopilot with Manual Throttle)
Distance from Runway Threshold: 1.7 Miles on Glide Slope
Altitude: 500 feet
Airspeed: 128 knots
100-ft. Ceiling
1200-ft. RVR
Wind Conditions: zero
No Turbulence
Target Final Approach Speed: 128 knots
All Other Conditions: Nominal

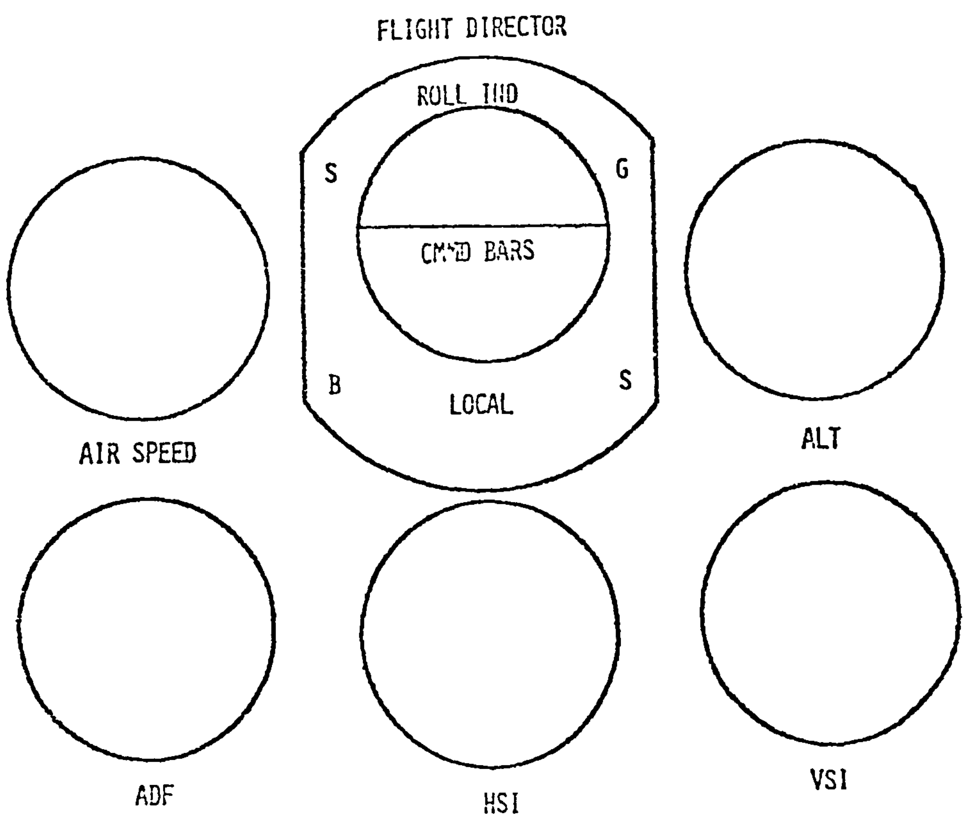
● START



SITUATION #10

Type of Approach: Coupled ILS (Autopilot with Manual Throttle)
Distance from Touchdown: 2000 ft. on Glide Slope
Altitude: 100 feet
Airspeed: 128 knots
100-ft. Ceiling
1200-ft. RVR
Wind Conditions: zero
No Turbulence
Target Final Approach Speed: 128 knots
All Other Conditions: Nominal

● START



ATTACHMENT I-11

QUESTION

As you think about the way you scan the instrument panel, do you find that your scanning behavior or procedures has changed any as a result of what you have done or heard during this school? ______Yes ______No

If "Yes", please elaborate in as much detail as you can.

ATTACHMENT II-1

INSTRUCTOR'S SCORESHEET - PROJECT NASA

INSTRUCTOR (3 DIGIT CODE ONLY)

LESSON ONE

		SCALE: 0 - 100		
		TRIALS		
		1	2	3
1.	ENGINE START	___	___	___
2.	AFTER START, TAXI AND T.O. CHECK LIST	___	___	___
3.	INSTRUMENT T.O.	___	___	___
4.	AFTER T.O. CHECKLIST	___	___	___
5.	CLIMB PROCEDURE	___	___	___
6.	DEMONSTRATE MACH BUFFET AND G BUFFET	___	___	___
7.	DECELERATION WITH AND WITHOUT SPEED BRAKES	___	___	___
8.	EMERGENCY DESCENT	___	___	___
9.	TURNS WITH AND WITHOUT SPOILERS	___	___	___
10.	STEEP TURNS	___	___	___
11.	APPROACH TO STALLS	___	___	___
12.	HIGH SINK RECOVERY	___	___	___
13.	DEMONSTRATION OF AUTO PILOT INCLUDING COUPLED APPROACH	___	___	___

ATTACHMENT II-2

INSTRUCTOR'S SCORESHEET - PROJECT NASA

INSTRUCTOR (3 DIGIT CODE ONLY) ______

LESSON TWO

SCALE: 0 - 100

		TRIALS 1	2	3
1.	NORMAL ENGINE START	___	___	___
2.	HOT START AND HUNG START	___	___	___
3.	AFTER START, TAXI AND T.O. CHECKS	___	___	___
4.	INSTRUMENT T.O.	___	___	___
5.	AREA DEPARTURE AND HOLDING	___	___	___
6.	ILS APPROACH	___	___	___
7.	MISSED APPROACH	___	___	___
8.	VOR APPROACH	___	___	___
9.	MISSED APPROACH	___	___	___
10.	ADF APPROACH	___	___	___
11.	APPROVED MISSED APPROACH PROCEDURE	___	___	___
12.	NORMAL ILS AND LANDING	___	___	___

INSTRUCTOR'S SCORESHEET - PROJECT NASA

INSTRUCTOR (3 DIGIT CODE ONLY) ______

LESSON THREE

SCALE: 0 - 100

		TRIALS		
		1	2	3
1.	NORMAL ENGINE START	___	___	___
2.	CROSS BLEED START	___	___	___
3.	ENGINE FIRE DURING START	___	___	___
4.	NORMAL T.O. WITH CLOSE-IN TURN	___	___	___
5.	HOLDING WITH EFFICIENT USE OF INSTRUMENTS	___	___	___
6.	VECTORS FOR ASR APPROACH	___	___	___
7.	MISSED APPROACH	___	___	___
8.	CLIMB TO 10,000 FEET	___	___	___
9.	STEEP TURNS	___	___	___
10.	STALLS	___	___	___
11.	ENGINE SHUTDOWN	___	___	___
12.	ENGINE RESTART	___	___	___
13.	ILS APPROACHES	___	___	___
14.	MISSED APPROACHES	___	___	___

INSTRUCTOR'S SCORESHEET - PROJECT NASA

INSTRUCTOR (3 DIGIT CODE ONLY) ______

LESSON FOUR

SCALE: 0 - 100

		TRIALS 1	TRIALS 2	TRIALS 3
1.	BATTERY START	___	___	___
2.	STARTER FAILS TO DISENGAGE	___	___	___
3.	IN FLIGHT ENGINE FIRE	___	___	___
4.	ENGINE OUT ILS APPROACH	___	___	___
5.	PRESSURIZATION, PNEUMATIC OR A C ABNORMALITY	___	___	___
6.	FUEL ABNORMALITY	___	___	___
7.	ELECTRICAL ABNORMALITY	___	___	___
8.	HYDRAULIC ABNORMALITY	___	___	___
9.	FLIGHT CONTROLS ABNORMALITY	___	___	___
10.	ANTI-ICING AND DE-ICING	___	___	___
11.	AUTO PILOT, FLIGHT DIRECTOR, FLIGT INST.	___	___	___
12.	ALTERNATE EXTENTION OF FLAPS AND GEAR	___	___	___
13.	EVACUATION PROCEDURE AND CREW DUTIES	___	___	___

ATTACHMENT II-5

INSTRUCTOR'S SCORESHEET - PROJECT NASA

INSTRUCTOR (3 DIGIT CODE ONLY) ______

LESSON FIVE

SCALE: 0 - 100

		TRIALS 1	2	3
1.	NORMAL AND MISCELLANEOUS ABNORMAL STARTS	___	___	___
2.	AREA DEPARTURE	___	___	___
3.	ILS APPROACH AND MISSED APPROACH	___	___	___
4.	CLEARANCE TO INT LOM	___	___	___
5.	"A" FAILURE ENROUTE	___	___	___
6.	ADF APPROACH AND LANDING	___	___	___
7.	T.O. AND CLIMB TO 10,000 FEET	___	___	___
8.	STEEP TURNS AND STALLS	___	___	___
9.	START CLIMB TO FL 250	___	___	___
10.	ELECTRICAL SMOKE AND FIRE PROCEDURE	___	___	___
11.	SMOKE REMOVAL PROCEDURE	___	___	___
12.	RAPID DEPRESSURIZATION--EMERGENCY DESCENT	___	___	___
13.	ARC APPROACH TO RUNWAY 23--LAND	___	___	___
14.	T.O. WITH ENGINE FAILURE AFTER GEARUP	___	___	___
15.	VECTORS TO INT ILS FOR ENGINE OUT APPROACH	___	___	___
16.	ENGINE OUT MISSED APPROACH	___	___	___

ATTACHMENT II-6

INSTRUCTOR'S SCORESHEET - PROJECT NASA

INSTRUCTOR (3 DIGIT CODE ONLY)

LESSON SIX

		TRIALS 1	TRIALS 2	TRIALS 3
	SCALE: 0 - 100	1	2	3
1.	V, ENGINE CUTS	___	___	___
2.	V, ENGINE FIRE	___	___	___
3.	ENGINE OVERHEAT PROCEDURE	___	___	___
4.	WHEEL WELL FIRE	___	___	___
5.	STEEP TURNS AND STALLS	___	___	___
6.	RAPID DEPRESSURIZATION AND EMERGENCY DESCENT	___	___	___
7.	MANUAL REVERSION APPROACH	___	___	___
8.	ZERO FLAP APPROACH	___	___	___
9.	REJECTED LANDING PROCEDURE	___	___	___
10.	ELECTRICAL FAILURES	___	___	___

TASK DIFFICULTY SURVEY

THIS SURVEY IS DESIGNED TO ASSESS YOUR VIEW OF THE DIFFICULTY A STUDENT MAY HAVE PERFORMING VARIOUS TASKS IN THE FLIGHT SIMULATOR. LISTED BELOW ARE THE TASKS THE STUDENTS WILL BE ASKED TO PERFORM. YOU ARE ASKED TO RATE EACH TASK ON A SCALE OF 1 TO 7 WHERE 1 = THE STUDENT SHOULD HANDLE THIS TASK EASILY AND 7 = THE STUDENT WILL HAVE EXTREME DIFFICULTY WITH THIS TASK.

ITEM #	TASK	
01101	ENGINE START	______
02109	TURNS WITH AND WITHOUT SPOILERS	______
03212	NORMAL ILS AND LANDING	______
04296	ILS APPROACH	______
05303	ENGINE FIRE DURING START	______
06311	ENGINE SHUTDOWN	______
07405	PRESSURIZATION, PNEUMATIC OR A C ABNORMALITY	______
08409	FLIGHT CONTROLS ABNORMALITY	______
09509	START CLIMB TO FL 250	______
10514	T.O. WITH ENGINE FAILURE AFTER GEARUP	______
11501	NORMAL AND MISCELLANEOUS ABNORMAL STARTS	______
12604	WHEEL WELL FIRE	______
13607	MANUAL REVERSION APPROACH	______
14610	ELECTRICAL FAILURES	______
15512	RAPID DEPRESSURIZATION--EMERGENCY DESCENT	______
16504	CLEARANCE TO INT LOM	______
17413	EVACUATION PROCEDURE AND CREW DUTIES	______

ATTACHMENT III-2

ITEM #	TASK	
18402	STARTER FAILS TO DISENGAGE	______
19308	CLIMB TO 10,000 FEET	______
20301	NORMAL ENGINE START	______
21211	APPROVED MISSED APPROACH PROCEDURE	______
22204	INSTRUMENT T.O.	______
23107	DECELERATION WITH AND WITHOUT SPEED BRAKES	______
24105	CLIMB PROCEDURE	______
25201	NORMAL ENGINE START	______
26313	ILS APPROACHES	______
27411	AUTO PILOT, FLIGHT DIRECTOR, FLIGHT INST.	______
28516	ENGINE OUT MISSED APPROACH	______
29505	"A" FAILURE ENROUTE	______
30502	AREA DEPARTURE	______
31601	V, ENGINE CUTS	______
32511	SMOKE REMOVAL PROCEDURE	______
33408	HYDRAULIC ABNORMALITY	______
34306	VECTORS FOR ASR APPROACH	______
35302	CROSS BLEED START	______
36210	ADF APPROACH	______
37207	MISSED ILS APPROACH	______
38113	DEMONSTRATION OF AUTO PILOT INCLUDING COUPLED APPROACH	______
39110	STEEP TURNS	______
40202	HOT START AND HUNG START	______
41305	HOLDING WITH EFFICIENT USE OF INSTRUMENTS	______

ATTACHMENT III-3

Item #	Task	
42406	FUEL ABNORMALITY	________
43401	BATTERY START	________
44507	T.O. AND CLIMB TO 10,000 FEET	________
45515	VECTORS TO INT ILS FOR ENGINE OUT APPROACH	________
46606	RAPID DEPRESSURIZATION AND EMERGENCY DESCENT	________
47508	STEEP TURNS AND STALLS	________
48412	ALTERNATE EXTENTION OF FLAPS AND GEAR	________
49310	STALLS	________
50209	MISSED VOR APPROACH	________
51104	AFTER T.O. CHECKLIST	________
52208	VOR APPROACH	________
53304	NORMAL T.O. WITH CLOSE-IN TURN	________
54410	ANTI-ICING AND DE-ICING	________
55506	ADF APPROACH AND LANDING	________
56603	ENGINE OVERHEAT PROCEDURE	________
57609	REJECTED LANDING PROCEDURE	________
58102	AFTER START, TAXI AND T.O. CHECK LIST	________
59108	EMERGENCY DESCENT	________
60205	AREA DEPARTURE AND HOLDING	________
61307	MISSED ASR APPROACH	________
62407	ELECTRICAL ABNORMALITY	________
63510	ELECTRICAL SMOKE AND FIRE PROCEDURE	________
64605	STEEP TURNS AND STALLS	________
65602	V, ENGINE FIRE	________
66513	ARC APPROACH TO RUNWAY 23--LAND	________
67404	ENGINE OUT ILS APPROACH	________

ATTACHMENT III-4

ITEM #	TASK	
68309	STEEP TURNS	________
69203	AFTER START, TAXI AND T.O. CHECKS	________
70112	HIGH SINK RECOVERY	________
71103	INSTRUMENT T.O.	________
72312	ENGINE RESTART	________
73314	MISSED ILS APPROACHES	________
74403	IN FLIGHT ENGINE FIRE	________
75503	ILS APPROACH AND MISSED APPROACH	________
76608	ZERO FLAP APPROACH	________
77111	APPROACH TO STALLS	________
78106	DEMONSTRATE MACH BUFFET AND G BUFFET	________

ATTACHMENT IV

Instructions

This booklet is designed to record your daily activities while attending the flight training school. The information will be used for research and will be held in the strictest confidence. The identification code on the cover sheet is determined by you. However, it is requested that you use a four-digit code (e.g. 6215) and that you use the same code throughout the five week training program. You have been given four booklets, one for each week of training. You should mail the booklets to NASA on Monday mornings before 10 a.m. using the envelopes provided.

The booklet divides each day into 24 one hour blocks and eight activity blocks. You indicate the type of activity at each time by placing a check in the appropriate block. (See next page for an example). For the questions at the bottom of each page, please try to be specific when indicating the type of medication, alcohol or health problem. (Also, please remember to indicate the times using the appropriate letter (see example)). The final question asks you to rate your performance for the day on a scale from 0 to 100. A score of 100 would indicate that you completed or understood all tasks for the day with perfection.

Once again, this information is for research purposes only. No one at the flight training school can obtain any information about any one individual. Your cooperation in this research is greatly appreciated.

	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Sleeping	✓	✓	✓	✓	✓																			✓
Eating							✓					✓					✓							
Studying								✓															✓	
Class									M ✓	✓	✓		✓	✓	✓	✓								
Simulator																								
R & R (alone)																		M ✓						
R & R (not alone)																			A ✓	A ✓	A ✓	A ✓		
Exercise						✓																		

Medication? (Yes) No Type SINUS Dosage 5MG Indicate times taken with letter M

Alcohol? (Yes) No Type BEER Amount 4 (ozs) Indicate times taken with letter A

Health Problems? Yes (No) Type ________ Indicate times of illness with letter H

Performance? Score 87 (Scale 0-100; 100 - perfection)

ATTACHMENT V-1

Mean Difficulty Ratings For Each Task In Lesson 1*

		PILOT TRAINEES (n=8)	COPILOT TRAINEES (n=14)	IPs (n=9)
1. Engine start	Mean	2.000	2.214	2.111
	S.D.	1.309	1.251	1.269
2. After start, taxi and T.O check list	Mean	1.500	2.000	2.167
	S.D.	.535	1.090	.753
3. Instrument T.O	Mean	2.125	2.929	2.444
	S.D.	.614	.997	1.130
4. After T.O checklist	Mean	1.500	2.214	2.600
	S.D.	.535	1.311	.894
5. Climb procedure	Mean	1.500	2.286	1.889
	S.D.	.756	.914	1.537
6. Demonstrate mach buffet and G buffet	Mean	1.625	2.143	2.167
	S.D.	.518	1.292	.983
7. Deceleration with and without speed brakes	Mean	1.250	2.500	1.833
	S.D.	.463	1.286	.753
8. Emergency descent	Mean	3.500	3.429	4.500
	S.D.	1.690	1.399	1.069
9. Turns with and without spoilers	Mean	2.750	2.429	2.286
	S.D.	1.982	1.222	1.113
10. Steep turns	Mean	3.875	3.143	3.444
	S.D.	1.959	1.406	1.333
11. Approach to stalls	Mean	3.625	3.429	3.375
	S.D.	1.685	1.453	.744
12. High sink recovery	Mean	1.750	3.143	2.667
	S.D.	.463	1.167	1.211
13. Demonstration of auto pilot including coupled approach	Mean	1.500	2.818	3.000
	S.D.	.535	1.328	.894
Mean for Lesson 1		2.192	2.667	2.653
S.D.		.925	.505	.757

*Ratings based on a seven-point bi-polar scale where "1" correponded to "the student should perform this task easily" and "7" corresponded to "the student should have extreme difficulty with this task".

ATTACHMENT V-2

Mean Difficulty Rating For Each Task in Lesson 2*

			PILOT TRAINEES (n=8)	COPILOT TRAINEES (n=14)	IPs (n=9)
1.	Normal engine start	Mean	1.125	2.000	1.286
		S.D.	.354	1.240	.756
2.	Hot start and hung	Mean	3.125	2.500	3.000
	start	S.D.	1.246	1.092	.866
3.	After start, taxi,	Mean	1.250	2.357	2.000
	and T.O. checks	S.D.	.463	1.216	.707
4.	Instrument T.O.	Mean	2.125	3.071	2.778
		S.D.	.835	1.141	1.394
5.	Area departure and	Mean	3.125	3.500	3.889
	holding	S.D.	.835	1.286	1.167
6.	ILS approach	Mean	2.625	3.214	3.125
		S.D.	1.408	1.251	1.126
7.	Missed approach	Mean	3.125	3.500	3.667
		S.D.	.991	1.160	1.000
8.	VOR approach	Mean	2.375	3.000	3.111
		S.D.	1.061	1.177	.782
9.	Missed approach	Mean	3.125	3.214	3.667
		S.D.	.991	.975	1.000
10.	ADF approach	Mean	3.750	3.571	4.222
		S.D.	.886	1.505	.833
11.	Approved missed	Mean	3.500	3.571	3.889
	approach procedure	S.D.	.926	1.158	1.054
12.	Normal ILS and landing	Mean	2.750	3.429	3.222
		S.D.	1.282	1.284	.833
Mean for Lesson 2			2.667	3.077	3.155
S.D.			.825	.524	.839

*Ratings based on a seven-point bi-polar scale where "1" correponded to "the student should perform this task easily" and "7" corresponded to "the student should have extreme difficulty with this task".

ATTACHMENT V-3

Mean Difficulty Rating For Each Task in Lesson 3*

			PILOT TRAINEES (n=8)	COPILOT TRAINEES (n=14)	IPs (n=9)
1.	Normal engine start	Mean	1.000	1.857	1.375
		S.D.	0.000	1.292	1.061
2.	Cross bleed start	Mean	2.500	2.643	2.778
		S.D.	.926	1.082	.833
3.	Engine fire during start	Mean	3.125	3.286	4.222
		S.D.	1.553	1.590	.441
4.	Normal T.O. with close-in turn	Mean	2.125	3.000	3.333
		S.D.	.991	1.414	1.093
5.	Holding with efficient use of instruments	Mean	3.375	3.643	4.222
		S.D.	.744	1.336	1.093
6.	Vectors for ASR approach	Mean	2.125	2.143	2.000
		S.D.	.991	1.099	1.195
7.	Missed approach	Mean	2.750	2.917	3.250
		S.D.	.707	.996	1.035
8.	Climb to 10,000 feet	Mean	1.375	2.214	1.375
		S.D.	.518	1.051	.518
9.	Steep turns	Mean	3.500	3.143	3.500
		S.D.	1.927	1.406	1.069
10.	Stalls	Mean	3.750	3.357	3.444
		S.D.	1.669	1.550	.527
11.	Engine shutdown	Mean	2.375	1.571	2.375
		S.D.	1.768	.085	1.302
12.	Engine restart	Mean	2.000	2.429	2.444
		S.D.	.756	1.089	1.130
13.	ILS approaches	Mean	2.500	2.786	3.000
		S.D.	1.069	1.251	.866
14.	Missed approaches	Mean	2.750	3.214	3.000
		S.D.	.707	.975	.535
Mean for Lesson 3			2.518	2.729	2.880
S.D.			.780	.612	.896

*Ratings based on a seven-point bi-polar scale where "1" correponded to "the student should perform this task easily" and "7" corresponded to "the student should have extreme difficulty with this task".

ATTACHMENT V-4

Mean Difficult Rating For Each Task in Lesson 4*

			PILOT TRAINEES (n=8)	COPILOT TRAINEES (n=14)	IPs (n=9)
1.	Battery start	Mean	2.625	3.143	3.889
		S.D.	1.061	1.167	1.167
2.	Starter fails to	Mean	2.750	2.857	3.667
	disengage	S.D.	1.282	1.351	.500
3.	In flight engine	Mean	2.750	3.286	3.111
	fire	S.D.	1.035	1.139	1.167
4.	Engine out ILS	Mean	3.375	3.857	4.111
	approach	S.D.	1.302	1.351	.928
5.	Pressurization, pneu-	Mean	3.250	3.500	2.889
	matic or AC abnormality	S.D.	1.488	1.401	.601
6.	Fuel abnormality	Mean	2.250	2.714	2.667
		S.D.	.463	1.069	.707
7.	Electrical abnormality	Mean	2.625	3.429	3.667
		S.D.	.744	1.697	.707
8.	Hydraulic abnormality	Mean	2.500	3.143	3.667
		S.D.	1.195	1.231	.707
9.	Flight controls	Mean	3.500	4.429	4.000
	abnormality	S.D.	1.414	1.742	.707
10.	Anti-icing and	Mean	1.750	2.000	3.222
	de-icing	S.D.	.707	.961	.667
11.	Auto pilot, FLT	Mean	2.375	2.929	3.222
	director, and FLT Inst.	S.D.	.926	1.072	.667
12.	Alternate extention	Mean	2.000	3.000	3.778
	of flaps and gear	S.D.	.756	1.414	.883
13.	Evaluation procedure	Mean	3.250	2.643	3.889
	and crew duties	S.D.	2.053	1.447	1.054
Mean for Lesson 4			2.692	3.148	3.453
S.D.			.537	.597	.556

*Ratings based on a seven-point bi-polar scale where "1" correponded to "the student should perform this task easily" and "7" corresponded to "the student should have extreme difficulty with this task".

ATTACHMENT V-5

Mean Difficulty Rating For Each Task in Lesson 5*

			PILOT TRAINEES (n=8)	COPILOT TRAINEES (n=14)	IPs (n=9)
1.	Normal and miscellaneous	Mean	3.000	3.000	3.222
	abnormal starts	S.D.	1.309	1.301	1.093
2.	Area departure	Mean	2.500	3.071	3.333
		S.D.	1.069	1.542	1.500
3.	ILS approach and	Mean	2.875	3.357	3.375
	missed approach	S.D.	1.126	1.008	.744
4.	Clearance to INT LOM	Mean	2.286	2.286	1.875
		S.D.	1.380	1.383	1.356
5.	"A" failure enroute	Mean	2.750	3.143	3.222
		S.D.	1.035	1.351	1.202
6.	ADF approach and	Mean	3.500	3.714	4.250
	landing	S.D.	1.414	1.326	.886
7.	T.O. and climb to	Mean	1.500	2.615	2.125
	10,000 feet	S.D.	.535	.961	.991
8.	Steep turns and stalls	Mean	3.625	3.286	4.000
		S.D.	1.768	1.383	1.069
9.	Start climb to FL 250	Mean	1.875	2.643	2.000
		S.D.	.991	1.692	1.095
10.	Electrical smoke and	Mean	3.000	3.615	4.444
	fire procedure	S.D.	1.690	.870	.726
11.	Smoke removal procedure	Mean	3.000	3.500	4.111
		S.D.	1.773	1.286	.928
12.	Rapid depressurization	Mean	3.250	4.071	5.333
	emergency descent	S.D.	1.832	1.385	.866
13.	ARC approach to runway	Mean	3.250	4.000	4.250
	23--land	S.D.	.707	1.519	.707
14.	T.O. with engine	Mean	4.250	4.500	4.111
	failure after gearup	S.D.	1.581	1.454	1.537
15.	Vectors to INT ILS for	Mean	2.625	3.643	3.111
	engine out approach	S.D.	1.302	1.216	1.269
16.	Engine out missed	Mean	4.125	4.714	4.444
	approach	S.D.	1.553	1.326	1.235
Mean for Lesson 5			2.963	3.447	3.576
S.D.			.773	.669	.997

*Ratings based on a seven-point bi-polar scale where "1" correponded to "the student should perform this task easily" and "7" corresponded to "the student should have extreme difficulty with this task".

ATTACHMENT V-6

Mean Difficulty Rating For Each Task in Lesson 6*

			PILOT TRAINEES (n=8)	COPILOT TRAINEES (n=14)	IPs (n=9)
1.	V_1 engine cuts	Mean	4.000	3.714	4.889
		S.D.	2.138	1.684	1.054
2.	V_1 engine fire	Mean	3.875	3.714	4.778
		S.D.	1.885	1.383	.667
3.	Engine overheat procedure	Mean	2.500	2.462	3.556
		S.D.	.926	1.050	1.333
4.	Wheel well fire	Mean	2.875	2.643	2.667
		S.D.	1.356	1.216	1.225
5.	Steep turns and stalls	Mean	3.750	3.462	3.625
		S.D.	1.982	1.391	1.061
6.	Rapid depressurization and emergency descent	Mean	3.500	3.500	5.125
		S.D.	1.512	1.454	.835
7.	Manual reversion approach	Mean	4.250	5.429	5.333
		S.D.	2.252	1.453	.866
8.	Zero flap approach	Mean	3.750	4.071	4.333
		S.D.	1.581	1.492	.500
9.	Rejected landing procedure	Mean	3.125	3.000	4.000
		S.D.	1.808	1.240	.866
10.	Electrical failures	Mean	2.875	4.143	4.111
		S.D.	.835	1.406	.782
Mean for Lesson 6			3.450	3.614	4.242
S.D.			.575	.849	.823

*Ratings based on a seven-point bi-polar scale where "1" correponded to "the student should perform this task easily" and "7" corresponded to "the student should have extreme difficulty with this task".

ATTACHMENT VI

Performance Ratings For Pilot and Copilot Trainees (magnitude estimation scale: Ø-1ØØ)

TRAINEE	GROUP	TRAINING FOR	IP	SIMULATOR SESSION 1	2	3	4	5
1	EXP	Pilot	A	93.684	91.923	9Ø.5ØØ	93.542	94.444
2	EXP	Pilot	A	93.75Ø	92.ØØØ	9Ø.25Ø	93.269	93.889
3	EXP	Pilot	B	86.154	83.ØØØ	85.556	91.25Ø	89.Ø91
4	EXP	Pilot	B	86.154	85.ØØØ	9Ø.ØØØ	86.25Ø	9Ø.ØØØ
5	EXP	Pilot	D	88.5ØØ	88.26Ø	M*	88.75Ø	9Ø.476
6	EXP	Pilot	D	88.75Ø	88.33Ø	M	88.864	89.773
7	EXP	Pilot	A	92.1Ø5	91.944	9Ø.476	9Ø.ØØØ	9Ø.263
8	CTRL	Pilot	H	86.667	81.667	89.545	86.778	92.ØØØ
9	CTRL	Pilot	H	81.25Ø	83.889	89.714	93.5ØØ	87.667
1Ø	CTRL	Copilot	C	62.3Ø8	M	69.348	84.783	75.ØØØ
11	CTRL	Copilot	E	85.333	83.333	9Ø.ØØØ	9Ø.769	92.3Ø8
12	CTRL	Copilot	E	83.636	83.333	9Ø.ØØØ	91.154	92.115
13	EXP	Copilot	A	89.722	88.462	89.286	88.261	89.118
14	CTRL	Copilot	F	61.923	69.333	66.ØØØ	8Ø.682	81.429
15	CTRL	Copilot	F	62.692	64.545	68.Ø77	78.Ø95	84.556
16	CTRL	Copilot	G	46.667	5Ø.ØØØ	52.5ØØ	65.714	71.667
17	CTRL	Copilot	G	52.5ØØ	55.ØØØ	54.ØØØ	68.571	8Ø.714
18	EXP	Copilot	D	76.154	76.25Ø	82.692	86.923	85.ØØØ
19	EXP	Copilot	D	76.538	75.833	82.692	87.3Ø8	85.ØØØ
2Ø	CTRL	Copilot	F	61.923	7Ø.ØØØ	7Ø.765	8Ø.ØØØ	87.636
21	CTRL	Copilot	F	62.692	7Ø.5ØØ	65.188	78.875	85.125
22	EXP	Copilot	G	51.429	57.5ØØ	78.75Ø	67.5ØØ	89.123
23	EXP	Copilot	G	48.571	51.25Ø	61.429	67.5ØØ	83.333
24	CTRL	Copilot	E	85.9Ø9	84.583	85.577	83.235	9Ø.625
25	CTRL	Copilot	E	85.9Ø9	84.583	M	85.385	89.231

*M = missing data

ATTACHMENT VII

Difference Scores For Pilot and Copilot Trainees

TRAINEE	GROUP	TRAINING FOR	IP	SIMULATOR SESSION 2	3	4	5
1	EXP	Pilot	A	-1.761	-3.184	-.143	.760
2	EXP	Pilot	A	-1.750	-3.500	-.481	.139
3	EXP	Pilot	B	-3.154	-.598	5.096	2.937
4	EXP	Pilot	D	-1.154	3.846	.096	3.846
5	EXP	Pilot	D	-.239	M*	.250	1.976
6	EXP	Pilot	D	-.417	M	.114	1.023
7	EXP	Pilot	A	-.161	-1.629	-2.105	-1.842
8	CTRL	Pilot	H	-5.000	2.879	.111	5.333
9	CTRL	Pilot	H	2.639	8.464	12.250	6.417
10	CTRL	Copilot	C	M	7.040	22.475	12.692
11	CTRL	Copilot	E	-2.000	4.667	5.436	6.974
12	CTRL	Copilot	E	-.303	6.364	7.571	8.479
13	EXP	Copilot	A	-1.261	-.437	-1.461	-.605
14	CTRL	Copilot	F	7.410	4.077	18.759	19.505
15	CTRL	Copilot	F	1.853	5.385	15.403	21.863
16	CTRL	Copilot	G	3.333	5.833	19.048	25.000
17	CTRL	Copilot	G	2.500	1.500	16.071	28.214
18	EXP	Copilot	D	.096	6.538	10.769	8.846
19	EXP	Copilot	D	-.705	6.154	10.769	8.469
20	CTRL	Copilot	F	8.077	8.842	18.077	25.713
21	CTRL	Copilot	F	7.808	2.495	16.183	22.433
22	EXP	Copilot	G	6.071	27.321	16.071	37.738
23	EXP	Copilot	G	2.697	12.857	18.929	34.762
24	CTRL	Copilot	E	-1.326	-.332	-2.674	4.716
25	CTRL	Copilot	E	-1.326	M	-.524	3.322

*M = missing data

ATTACHMENT VIII

Summary of Performance Relative To Session 1

TRAINEE	GROUP	TRAINING FOR	737 EXP	SIMULATOR SESSION 2	3	4	5
1	EXP	Pilot	Yes	-	-	-	+
2	EXP	Pilot	Yes	-	-	-	+
3	EXP	Pilot	Yes	-	-	+	+
4	EXP	Pilot	Yes	-	+	+	+
5	EXP	Pilot	Yes	-	M**	+	+
6	EXP	Pilot	Yes	-	M	+	+
7	EXP	Pilot	Yes	-	-	-	-
8	CTRL	Pilot	Yes	-	+	+	+
9	CTRL	Pilot	No	+	+	+	+
1Ø	CTRL	Copilot	No	M	+	+	+
11	CTRL	Copilot	No	-	+	+	+
12	CTRL	Copilot	No	-	+	+	+
13	EXP	Copilot	No	-	-	-	-
14	CTRL	Copilot	Yes	+	+	+	+
15	CTRL	Copilot	No	+	+	+	+
16	CTRL	Copilot	No	+	+	+	+
17	CTRL	Copilot	No	+	+	+	+
18	EXP	Copilot	NJ*	+	+	+	+
19	EXP	Copilot	NJ	-	+	+	+
2Ø	CTRL	Copilot	Yes	+	+	+	+
21	CTRL	Copilot	NJ	+	+	+	+
22	EXP	Copilot	NJ	+	+	+	+
23	EXP	Copilot	NJ	+	+	+	+
24	CTRL	Copilot	NJ	-	-	-	+
25	CTRL	Copilot	NJ	-	M	-	+

*NJ = no jet experience
**M = missing data

ATTACHMENT IX-1

Pilot and Copilot Trainee Responses To Question
At End of Eye Scan Survey (See Attachment I-11)

As you think about the way you scan the instrument panel, do you find that your scanning behavior or procedures has changed as a result of what you have heard or done during this school? ______ yes ______ no

If "yes", please elaborate as much detail as you can.

TRAINEE	TRAINING FOR	GROUP	737 EXP	PRE EYE-SCAN SURVEY COMMENTS	POST EYE-SCAN SURVEY COMMENTS
1	Captain	Exp.	Yes	No	No
2	Captain	Exp.	Yes	"Just more conscious of the fact that scan needs to be faster in the simulator due to no 6 forces, etc."	"I've been made more aware of scan patterns and realize that scan is wider with coupled approach".
3	Captain	Exp.	Yes	N/A*	No
4	Captain	Exp.	Yes	"IVSI is very important in scan pattern".	"IVSI could be used to better use".
5	Captain	Exp.	Yes	No	No
6	Captain	Exp.	Yes	No	No
7	Captain	Exp.	Yes	No	"Less attention to IVSI during ILS approach than previously thought. More attention to FDI along with HSI, ALT & Airspeed".
8	Captain	Ctrl	No	"Before I don't pay enough attention to vertical speed".	"Change the scan".
9	Captain	Ctrl	No	No	N/A
10	Copilot	Ctrl	Yes	No	N/A

ATTACHMENT IX-2

11	Copilot	Ctrl	No	No	"Because of A/C speed I have had to increase my scan speed and pay more attention to certain instruments more often".
12	Copilot	Ctrl	Yes	No	No
13	Copilot	Ctrl	Yes	N/A	No
14	Copilot	Exp.	No	No	"Scanning more"
15	Copilot	Ctrl	No	N/A	No
16	Copilot	Ctrl	No	N/A	N/A
17	Copilot	Ctrl	No	No	N/A
18	Copilot	Ctrl	No	No	N/A
19	Copilot	Exp.	No	"My last aircraft had a very good attitude indicator with headings on it. The scan pattern was back to the ADI after looking at only one or two other instruments. The 737 has a better IVSI which I should use more. In general, I need to rely on the aptitude indicator a little less".	"Better awareness of what to look at on various approaches and positions. Better situational awareness".
2Ø	Copilot	Exp.	No	"Actually, my scanning procedures haven't changed any perse, but there is much more to look at within some individual instruments".	"I have changed my scan to include much more IVSI scan in 737".

ATTACHMENT IX-3

21	Copilot	Exp.	No	"Because of flight director".	"The flight director."
22	Copilot	Ctrl	No	"Not yet. Scanning pattern I use is one I developed during Air Force flying. No particular sequence, just rapid fire from ADI in all directions.	No
23	Copilot	Ctrl	No	No	No
24	Copilot	Exp.	No	No	"I seem to return to the flight director more often, i.e., glance at the flight director, out to another instrument then back to the flight director, etc".
25	Copilot	Exp.	No	"The VSI I have been accustomed to has not been instantaneous and they have explained that this one used here is more useful to determine pitch".	"I feel that I am having to include all flight instruments more frequently due to the speed of this aircraft on approach as compared to the slower airplanes I have previously been accustomed to".
26	Copilot	Ctrl	No	No	No
27	Copilot	Ctrl	No	No	No

* N/A = no answer

1 Report No NASA CR-3666	2 Government Accession No	3 Recipient's Catalog No
4 Title and Subtitle THE EFFECTIVENESS OF AN OCULOMETER TRAINING TAPE ON PILOT AND COPILOT TRAINEES IN A COMMERCIAL FLIGHT TRAINING PROGRAM		5 Report Date March 1983
		6 Performing Organization Code
7 Author(s) Dennis H. Jones, Glynn D. Coates, and Raymond H. Kirby		8 Performing Organization Report No 81-25
		10 Work Unit No
9 Performing Organization Name and Address Old Dominion University Research Foundation P. O. Box 6369 Norfolk, Virginia 23508		11 Contract or Grant No NAS1-15648
12 Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546		13 Type of Report and Period Covered Contractor Report
		14 Sponsoring Agency Code

15 Supplementary Notes
Langley Technical Monitor: Amos A. Spady, Jr.
Final Report

16 Abstract
A study was designed to evaluate the effectiveness of a video tape detailing the various aspects of instrument scanning by experienced pilots on performance by pilots and copilots undergoing flight training in a Boeing 737 flight simulator. The performance ratings by instructor pilots (IP's) and self-reported instrument scan behavior by trainees were compared with those of a control group. The results indicated that the training tape had little or no effect on performance by trainees in the experimental group. Feedback from the IP's and trainees suggested that a feedback strategy providing each trainee's individual instrument scan behavior might be more beneficial in flight training than the general instructional strategy of the oculometer training tape.

In addition, this study sought to investigate flight training personnel and trainees' reports of performance decrements on or around the third day of flight simulator training. The IP's performance ratings of 27 pilot and copilot trainees failed to reveal a systematic performance decrement; however, feedback from the trainees revealed that their own attribution of performance decrements was associated with the order in which their training occurred within a session. Further research was suggested.

17 Key Words (Suggested by Author(s)) Pilot training instrument scanning Pilot performance	18 Distribution Statement Unclassified - Unlimited Subject Category - 53

19 Security Classif (of this report)	20 Security Classif (of this page)	21 No of Pages	22 Price*
Unclassified	Unclassified	78	A05

* For sale by the National Technical Information Service, Springfield Virginia 22161

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