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Transfer of Instrument Training and the Synthetic Flight Training System

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16. Abstracts

One phase of an innovative flight training program, its development, and initial administration is described in this paper. The operational suitability test activities related to a determination of the transfer of instrument training value of the Army's Synthetic Flight Training System (SFTS) Device 2B24. Sixteen active Army members of an Officer Rotary Wing Aviator Course who had completed primary training and 9 Instructor Pilots participated in the study. Instrument training was conducted in the SFTS on a proficiency basis. Aircraft checkrides were administere by independent evaluator personnel. Checkride times and grades showed that much of the training now conducted in aircraft could be conducted more efficiently on the ground.

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Prefatory Note

This paper was presented at the Fifth Naval Training Device Center and Industry Conference in Orlando, Florida, in February 1972. The research reported was performed at the Human Resources Research Organization Division No. 6 (Aviation), Fort Rucker, Alabama, under Work Unit SYNTRAIN, Modernization of Synthetic Training in Army Aviation. Dr. Caro is a Senior Staff Scientist with the HumRRO Division.

TRANSFER OF INSTRUMENT TRAINING AND THE SYNTHETIC FLIGHT TRAINING SYSTEM

Paul W. Caro

The Army's Synthetic Flight Training System (SFTS), Device 2B24, incorporates both automated training features and manual features that can facilitate the conduct of nonautomated training.[1] The device is unique in the Army's history of training device development in the extent to which it incorporates such features.

Army regulations require that newly acquired equipment of the complexity of the SFTS undergo engineering and extended service tests prior to type classification. Type classification is a step necessary to the introduction of such equipment on an Army-wide basis. An important part of extended service testing involves a determination of the operational suitability of the equipment. The Human Resources Research Organization's Aviation Division is supporting the SFTS service test, to be conducted by the U.S. Army Test and Evaluation Command, by developing and conducting an SFTS Operational Suitability Test. The present paper describes one portion of the SFTS suitability test, dealing specifically with transfer of instrument training from the SFTS to the aircraft.

Because the SFTS is unique, its suitability testing is difficult. It is not a replacement for existing equipment, and much of the training possible with it has not previously been possible for the Army, even when using operational aircraft. Thus, past approaches used for training device suitability testing are inappropriate for the SFTS. A test that failed to build upon the unique features of the device probably would produce evidence that would appear to indicate that the device is unsuitable to fulfill the Army's requirement. A test that asked of the SFTS no more than is provided by existing Army flight training devices undoubtedly would lead to its rejection on a cost basis. On the other hand, a test that utilized the design-for training features of the SFTS, with the goal of determining its cost/effectiveness in a training situation, would lead to quite different conclusions.

A three-phase operational suitability test was developed. During Phase I, primary emphasis was placed upon determining the workability of the various automatic and semiautomatic training features of the device. During Phase II, a training program was developed that was intended to exploit the potential of the device in such a manner that developmental hardware deficiencies would have minimum adverse effect upon test results. During Phase III, a transfer of training study was conducted, and a determination was made of the cost effectiveness of the device in the Army's rotary wing aviator training program. This paper describes only those operational suitability test activities related to a determination of the transfer of instrument training value of the SFTS.

[1] Other papers presented at the Naval Training Device Center and Industry Conference provide additional information concerning the design and characteristics of the equipment. See *Proceedings of the Fifth Naval Training Device Center and Industry Conference*, TR NAVTRADEVCEN IH-206, February 1972, Navy Training Device Center, Orlando, Fla. 32813.

TRAINING PROGRAM DEVELOPMENT

It is generally recognized that the effectiveness of any training program is a joint function of the equipment employed and the manner of its employment. In addition to having a number of unique training features, the SFTS is significantly more comprehensive in its simulation of the training aircraft than is any known equipment used in undergraduate-level flight training. Consequently, a training program had to be developed to take advantage of the capabilities provided for undergraduate trainees. That program was developed during Phase II of the SFTS Operational Suitability Test.

The training program was an advanced adaptation of a program previously developed for use with a fixed wing instrument training device. (The fixed wing program applied the technology of training to flight training per se.[1]) The primary features of the training program developed for the SFTS are listed here:

- Conduct of all training within a functional context
- Conduct of all training on a proficiency basis
- Specification of all training goals in objective, measurable terms
- Conduct of all training in the SFTS, not the aircraft
- Treatment of the SFTS as an aircraft
- Complete individualization of instruction
- Redefinition of the role of the instructor pilot
- Conduct of crew training
- Use of incentive awards
- Use of diagnostic progress rides
- Use of all features of the SFTS found workable during Phase I

Time did not permit a pilot study to verify the efficiency of the SFTS training program. The overall Service Test schedule required that student training be initiated as soon as practical. Consequently, the program was evolved largely from HumRRO experience with the fixed wing program from several earlier rotary wing training research programs, from the experience of other training organizations, and from the general technology of training. The experiences of several commercial airlines were particularly helpful. As a result, the conduct of student training with the SFTS, Phase III of the Operational Suitability Test, was undertaken with a high degree of confidence.

THE TRANSFER OF TRAINING STUDY

Existing Training

At the time the study was conducted, Army undergraduate pilot training consisted of four phases—Primary, Instruments, Advanced Contact, and Tactics. The Primary Phase consisted of 110 hours of dual instruction and solo practice in a light, reciprocating engine helicopter, the TH-55. The Instrument Phase consisted of 60 hours of instrument training in a similar aircraft, the TH-13T, plus approximately 26 hours of training in an existing instrument training device. a modified 1-CA-1. The Advanced Contact Phase consisted of 25 hours of transition training in the turbine powered UH-1B, D, or H model helicopter. The final phase—Tactics—consisted of 25 hours of training in the UH-1

[1] Paul W. Caro. "An Innovative Instrument Flight Training Program," presented at Fourth International Simulation and Training Conference of the Society of Automotive Engineers, Inc. (Paper No. 710480), Atlanta, Ga., May 1971; also issued as HumRRO Professional Paper 16-71, July 1971.

aircraft. The UH-1 is the primary operational aircraft for the newly graduated Army aviator; his initial assignment, typically, is to pilot or co-pilot that aircraft.

Experimental Training

The trainees who participated in the SFTS test received the same undergraduate pilot training, except that all instrument training was administered in the SFTS instead of in the TH-13T and the existing devices. Additionally, the UH-1 Advanced Contact Phase transition training received by this group was modified to take advantage of training received in the SFTS. Only the results related to the Instrument Phase training are described in this paper; the effects of SFTS training upon transition training requirements are not discussed.

Test Subjects

Sixteen test subjects participated in this study. Using a table of random numbers, they were selected from among the 34 active Army members of an Officer Rotary Wing Aviator Course who completed the primary phase of training (110 hours contact training in the TH-55) at the time the SFTS training was scheduled to begin and who volunteered to participate in the study. These trainees had no prior instrument flight training and had relatively little flight experience prior to entering the Army pilot training program. The maximum amount of prior flight experience was approximately 60 hours. The majority of the test subjects had received 35 to 40 hours of pilot training in an ROTC private pilot training program prior to entering the Army.

Instructors

Nine instructors—Army Officers, Warrant Officers, or Department of the Army Civilian Instructor Pilots (IPs)—participated in this study. Eight were assigned two test subjects each; the ninth man was scheduled to substitute in the absence of one of the other instructors. Initially, each instructor was either an Instrument Phase IP or an Advanced Contact Phase IP. Consequently, it was necessary to qualify the former in the UH-1 aircraft and to qualify the latter as instrument instructors. This was done by the U.S. Army Aviation School. The instrument training experience of these IPs thus varied considerably, ranging from no prior instrument instructing experience to extensive IP experience and qualification as an Army instrument examiner.

Prior to the beginning of Phase III of the research, each IP underwent training by the HumRRO research staff in the manner in which the experimental training program was to be administered in the SFTS. Their performance was also closely monitored throughout the training to encourage compliance with the training program design. These steps were necessary because the experimental training program required numerous significant deviations from training practices to which these IPs were accustomed.

In addition to the IPs who conducted the experimental training, the SFTS instructor console was manned by nonrated personnel who assisted the instructors when they were conducting training from inside the cockpits. The chief functions performed by these device operators related to problem set-up and simulated ground-station communication.

Procedure

All instrument training was conducted in the SFTS on a proficiency basis. Necessary instrument flight-related academic instruction was conducted under the supervision of each trainee's IP, using programed textbooks. Other training for the test subjects was conducted with comparable students who were not participating in this study. When the IP determined that his students met all proficiency requirements for an Army standard instrument rating, he scheduled checkrides for them.

Results

Table 1 indicates the amount of training received by each trainee in the SFTS. At the end of that training, each student was given an instrument checkride by a qualified Army instrument examiner who had not participated in the study. The time required for conduct of the checkride and the checkride grade are also given in Table 1. Two students did not pass the checkride the first time it was administered; but both returned to their assigned IP for additional training, were given a second checkride, and passed. Table 1 includes all training and checkride time required by these students. Army Aviation School policy is to assign the grade of 70 when any checkride is passed after having once been failed, regardless of the quality of the recheck performance.

Table 1

Training and Checkride Time Requirements and Grades of Students in the SFTS

Student Number	Training Time (Hours/Minutes)	Checkride Time (Hours/Minutes)	Total Time (Hours/Minutes)	Checkride Grade
1	33/15	2/15	35/30	89
2	35/00	2/00	37/00	82
3	35/00	2/00	37/00	84
4	37/30	2/00	39/30	73
5[a]	39/00	4/15	43/15	70
6	40/00	2/15	42/15	85
7	40/30	2/15	42/45	90
8	40/45	2/00	42/45	91
9	41/00	2/15	43/15	90
10	42/00	2/00	44/00	94
11	42/15	2/45	45/00	89
12	43/00	2/00	45/00	92
13[a]	43/45	3/30	47/15	70
14	44/00	2/15	46/15	80
15	45/00	2/00	47/00	82
16	45/35	2/00	47/35	86
Mean	40/28	2/22	42/50	84.2
Standard Deviation	3/41	/38	3/47	7.6

[a]Students 5 and 13 did not pass the checkride in the SFTS the first time it was administered. Their performance was satisfactory on a subsequent recheck.

The mean time required for these students to pass the required instrument checkride in the SFTS was 42 hours 50 minutes. Of this, 40 hours 28 minutes were devoted to training and 2 hours 22 minutes to evaluating student performance during checkrides. This compares to the total training and evaluation time scheduled for all conventionally trained students of 60 hours in the TH-13T, plus 26 hours of training time in the modified 1-CA-1 device.

After passing the instrument checkride in the SFTS, these experimental trainees were judged qualified, with regard to proficiency, for award of a standard instrument rating. Present Army regulations, however, require that such an award be made only upon the basis of performance during a checkride conducted in an aircraft.

In order to conclude the test, therefore, each IP "transitioned" his assigned trainees from the SFTS to an instrument equipped UH-1H. This transition training was conducted "under the hood" or under actual instrument conditions, that is, it did not include *any* contact flight training. (None of the trainees had prior experience flying the UH-1.) Table 2 indicates the amount of time devoted to this aircraft familiarization activity. Transition training was restricted to familiarization with the aircraft under simulated or actual instrument conditions, since it was presumed that all necessary instrument training had been conducted in the SFTS.

Table 2

Aircraft Familiarization and Checkride Time Requirements and Grades of Students in the UH-1

Student Number	Training Time (Hours/Minutes)	Checkride Time (Hours/Minutes)	Total Time (Hours/Minutes)	Checkride Grade
1	3/00	2/00	5/00	87
2	3/00	2/45	5/45	88
3	6/15	2/00	8/15	88
4	4/45	2/00	6/45	84
5[a]	6/15	3/15	9/30	70
6	5/00	2/00	7/00	85
7	6/45	2/00	8/45	84
8	3/00	1/30	4/30	91
9	3/00	2/00	5/00	83
10	4/00	2/00	6/00	82
11	3/30	2/00	5/30	85
12	3/45	2/00	5/45	80
13	3/30	2/45	6/15	83
14	5/30	3/00	8/30	78
15	3/15	1/45	5/00	74
16	2/45	3/00	5/45	70
Mean	4/12	2/15	6/27	82.0
Standard Deviation	1/21	/30	1/31	6.2

[a]Student 5 did not pass the checkride in the aircraft the first time it was administered; his performance was satisfactory on a subsequent recheck. Possible explanation is contained in the text.

The aircraft time required for this transition training ranged from 2 hours 45 minutes to 6 hours 45 minutes; the mean time was 4 hours 12 minutes. It should be noted that a portion of the range of training times was attributed to the IPs' judgment that some students needed more aircraft familiarization than did others. Some of the range, however, was a function of difficulties experienced in the scheduling of instrument-equipped aircraft and qualified Army instrument examiners. The latter was a particular problem, since the timing of this test conflicted with the scheduling of these personnel for other duties. It was necessary to have three of the aircraft checkrides administered by qualified instrument examiners assigned to the test as IPs instead of using independent evaluator personnel exclusively. In no case, however, did the assigned examiners check their own students.

The aircraft checkride times and grades also are shown in Table 2. It should be noted that one trainee failed to pass the inflight checkride on his first attempt. Unknown to test personnel at the time, this trainee had learned of the death of his mother the evening before the checkride and was awaiting a flight home when he took the checkride. Upon returning from emergency leave, he was given one additional familiarization flight and then successfully completed the required checkride. This additional time is included in Table 2.

The total calendar time required for the conduct of the experimental training in the SFTS and the familiarization flights and instrument checkrides in the aircraft for the experimental trainees was seven to eight weeks, excluding the one individual whose recheck was delayed by emergency leave. The conventional schedule allows 12 weeks for the Instrument Phase of Training.

DISCUSSION

The fact that SFTS training transfers to the aircraft is not surprising since it is a high fidelity simulator of the training aircraft. Airline experience transitioning pilots to the 747 and other aircraft has shown that such equipment can provide effective training.

It has been said, however, that the airlines have been able to use simulators effectively because of their sophisticated pilots already knowing all there is to know about flying, and that it is just a matter of teaching them to operate a new item of equipment. According to this reasoning, since the military undergraduate aviator is not so well qualified, his training must be conducted in the air.

The study reported here provides evidence that simulators *can* be used as effectively with undergraduate Army trainees as with highly experienced commercial pilot. In fact, as far as the Instrument Phase is concerned, the Army undergraduate training we have described was significantly more effective than the conventional training conducted by the Army. The aircraft time was much less, approximately 6 hours 30 minutes altogether for the test group, versus 60 hours for the conventional trainees, and the total aircraft and simulator or training device time also was less, approximately 49 hours for the test group (including two checkrides), versus 86 programmed hours for the conventional trainees. Also, calendar time was only 8 weeks, versus 12 weeks for the conventional program.

Certainly, the unique design-for-training features of the SFTS contributed to the transfer of training. It should be obvious, however, that the manner in which the device was used contributed to these results perhaps as much as the equipment itself. Undoubtedly, had any existing synthetic training program been used, much of the potential effectiveness of the SFTS would have been lost. An appropriately designed training device can make transfer of training possible, but device design alone does not assure effective training.

The training was conducted on a proficiency basis. Thus, the amount of time required by each trainee to reach criterion performance varied considerably in both the SFTS and the aircraft. It might be assumed that the range of times reported in Tables 1 and 2 reflect the times required to bring all students to essentially the same skill level. To an extent, such an assumption is supported by the evidence that more training time did not result in higher checkride grades. The product moment correlation coefficient between training time in the SFTS and SFTS checkride grade is .04, and the corresponding correlation between familiarization time in the aircraft and aircraft checkride grade is —.09.

In the writer's opinion, however, a large part of the range in times should be attributed to differences in the instructing skills exhibited during the test by the IPs. Some of them were more proficient in their administration of the training program developed for this test than were others. It is believed that more efficiency can be obtained in subsequent administration of SFTS training with a resulting reduction in the amount of training time required by the less proficient IPs and in the range of training time required.

Earlier, mention was made of principal features of the training program employed in this study. Several of these features deserve further comment. Throughout training, emphasis was placed upon training to stated behavioral objectives, and checks were made almost constantly to minimize inefficiencies resulting from extensive and unnecessary training beyond those behavioral objectives. The entire training program was criterion-performance oriented. Conventional training activities, such as "attitude instrument flying," were included in the program only if they were found necessary to the attainment of the required behavioral objectives. In fact, the program is so unconventional that considerable doubt was expressed by experienced aviators concerning its workability. Their doubts have been resolved by the results obtained. The graduates of the SFTS test training program are indistinguishable from their conventionally trained fellow-students as far as measurable instrument flight proficiency is concerned--only their log books show the difference.

It is clear that military pilot training organizations can make much more extensive use of aircraft simulators in their undergraduate pilot training programs. In fact, with properly designed equipment and training programs, much of the training now conducted in aircraft could be conducted more efficiently on the ground. With existing simulation and training technology, the conduct of 50% of present Army, Navy, and Air Force undergraduate pilot training on the ground might be a modest goal. Within a few years, I believe that goal could be raised to somewhere in excess of 75%—but not if we sit back and say that the only way to learn to fly is to fly.

RELATED PUBLICATIONS

Other HumRRO publications related to the design and testing of flight training devices and the development of training programs for use with them include:

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