TRANSFER OF INSTRUMENT TRAINING AND THE SYNTHETIC FLIGHT TRAINING SYSTEM[1]

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INTRODUCTION

The Army's Synthetic Flight Training System (SFTS), Device 2B24, has been referenced in a number of the papers presented here. It is assumed at this point that the reader is generally familiar with overall SFTS design, and the extent to which it incorporates automated training features as well as manual features which can facilitate the conduct of training administered in a non-automated manner. The device is unique in these aspects in the Army's history of training device development.

Army regulations require that newly acquired equipment of the complexity of the SFTS undergo an extensive service test 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 service testing involves a determination of the operational suitability of the equipment. In the case of the SFTS, the Human Resources Research Organization's Aviation Division was requested to support the service test, to be conducted by the U.S. Army Test and Evaluation Command, by developing and conducting an SFTS Operational Suitability Test. The test is in progress, and its findings are expected to be released later this fiscal year. The present paper addresses one portion of the SFTS suitability test, that portion dealing specifically with transfer of instrument training from the SFTS to the aircraft.

The fact that the SFTS is unique makes its suitability testing difficult. Since it is not a replacement for existing equipment, and since much of the training possible with it previously has not been possible for the Army, even using operational aircraft, previous approaches to training device suitability testing are inappropriate for the SFTS. A test which failed to build upon the unique features of the device probably would produce evidence of its unsuitability to the Army's requirement. A test which asked of the SFTS no more than is provided by existing Army flight training devices undoubtedly would lead to its rejection on a cost-effectiveness basis. On the other hand, a test which exploited the design-for-training features of the SFTS, with the goal of determining its cost-effectiveness in a training situation, could lead to quite different results.

A three-phase operational suitability test was developed. During Phase I, primary emphasis was placed upon a determination of the workability of the various automatic and semi-automatic training features of the device. During Phase II, a training program was developed which was intended to exploit the

[1]The ideas expressed in this paper are based on research conducted at HumRRO Division No. 6 (Aviation), Fort Rucker, Alabama, under Department of the Army contract; the contents of this paper do not necessarily reflect official opinions or policies of the Department of the Army.

potential of the device in such a manner that developmental hardware deficiencies would have minimum adverse effect upon test results. During the final phase, 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 will address only those operational suitability test activities related to a determination of the transfer of instrument training value of the SFTS.

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 it provided with an undergraduate trainee population. 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 is described elsewhere and should be referred to by anyone with an interest in the technology of training applied to flight training per se.[2] The primary features of the training program developed for the SFTS are:

—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 that the SFTS training program had been optimized from the standpoint of efficiency. The overall Service Test schedule required that student training be initiated as soon as practical. Consequently, the program was evolved largely from experience obtained with the

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[2] Caro, Paul W. "An Innovative Instrument Flight Training Program." Paper No. 710480. Society of Automotive Engineers, New York, N.Y., May, 1971.

fixed wing program previously mentioned, with several earlier rotary wing training research programs, the experience of other training organizations, and the general technology of training. The experiences of several commercial airlines were particularly helpful in this regard. As a result, the conduct of student training with the SFTS, Phase III of the Operational Suitability Test, was undertaken with high confidence.

THE TRANSFER OF TRAINING STUDY

EXISTING TRAINING. At the time of the study reported here, 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. Sixty hours instrument training in a similar aircraft, the TH-13T, plus approximately 26 hours training in an existing instrument training device, a modified 1-CA-1, made up the Instrument Phase. The Advanced Contact Phase consisted of 25 hours transition training in the turbine powered UH-1B, D, or H model helicopter. The final phase of training, the Tactics Phase, consisted of 25 hours training in the UH-1 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 training, except that all instrument training was administered to them in the SFTS instead of in the TH-13T and the existing devices. Additionally, the UH-1 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 addressed.

TEST SUBJECTS. Sixteen test subjects participated in this study. They were selected, using a table of random numbers, 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 pilot training in an ROTC private pilot training program prior to entering the Army.

INSTRUCTORS. Nine Army Officers, Warrant Officers, and Department of the Army Civilian Instructor Pilots (IPs) participated in this study. Eight of these were assigned two test subjects each, and the ninth was used as a spare in instances of the necessary absence of one of the other instructors. Initially, each instructor was either an Instrument Phase IP or a Contract 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 varies considerably. It ranged from no prior instrument instructing experience to extensive IP experience and qualification as an Army instrument examiner.

Prior to the beginning of Phase III, each IP underwent training by the research staff in the manner in which the experimental training program was to be administered in the SFTS. Additionally, their performance was closely monitored throughout the training to encourage compliance with the training program design. These steps were necessary due to the fact that 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 non-rated 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 text books. Other training for the test subjects took place with comparable students who were not participating in this study. When the IP determined that his students met all proficiency requirements for award of an Army standard instrument rating, they were scheduled for a checkride.

RESULTS

Table 1 indicates the amount of training received by each trainee in the SFTS. At the end of that training, each trainee was administered an instrument checkride by a qualified Army instrument examiner who was not otherwise participating in this study. The time required for conduct of the checkride and the checkride grade are also indicated in table 1. It should be noted that two subjects did not pass the checkride the first time it was administered. In each case, they returned to their assigned IP for additional training and then were given a second checkride, which each then passed. Table 1 includes all training and checkride time required by these students. Army Aviation School policy dictates that the grade of 70 be assigned when any checkride is passed after having once been failed, regardless of the quality of the student's performance on the recheck.

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

Upon passing the instrument checkride in the SFTS, these experimental trainees were judged qualified, so far as proficiency was concerned, 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. Consequently, the test could not be concluded until these trainees had been examined in the aircraft itself.

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, i.e., it did not include <u>any</u> 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 1. TRAINING AND CHECKRIDE TIME REQUIREMENTS AND CHECKRIDE GRADES OF TEST STUDENTS IN THE SFTS

Student Number	Training Time	Checkride Time	Total Time	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
S. D.	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.

TABLE 2. AIRCRAFT FAMILIARIZATION AND CHECKRIDE TIME REQUIREMENTS AND CHECKRIDE GRADES OF TEST STUDENTS IN THE UH-1

Student Number	Training Time	Checkride Time	Total Time	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
S. D.	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. See the text for comments about this student.

The aircraft time required for this transition training ranged from 2:45 to 6:45. The mean-time was 4:12. 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. In fact, it was found necessary to have three of the aircraft checkrides administered by qualified instrument examiners assigned to the test as IPs instead of using exclusively independent evaluator personnel. In no case, however, did the assigned examiners check their own students.

The aircraft checkride times and grades also are indicated 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. It can be argued that he should not have been allowed to attempt a checkride under those circumstances. 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 programs twelve weeks for the Instrument Phase of Training.

DISCUSSION

The fact that SFTS training transfers to the aircraft should surprise no one. 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 their pilot population is so sophisticated; that these commercial pilots already know all there is to know about flying, and it is just a matter of teaching them to operate a new item of equipment. Since the military undergraduate aviator is not so well qualified, his training must be conducted in the air, or so the reasoning would go.

The study reported here provides evidence that simulators <u>can</u> be used as effectively with undergraduate Army trainees as with highly experienced commercial pilots. In fact, so far as the Instrument Phase of Army undergraduate training is concerned, the training described here was significantly more effective than that conventionally conducted by the Army. The aircraft time was much less, approximately 6:30 hours 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 programed 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 reported here. 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.

It is the opinion of the writer, however, that a large part of the range in times should be attributed to differences in the instructing skills exhibited during the test by the IPs involved. Some of the IPs 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 in this paper, mention was made of principle features of the training program employed in this study. An additional feature should be added: 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 doubt has been resolved by the results obtained. The graduates of the SFTS test training program are indistinguishable from their conventionally trained fellow-students so 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 we will be able to raise that goal 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.