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THE EFFECTIVENESS OF THE NAVAL AIR BASIC INSTRUMENT TRAINER

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SUMMARY PAGE

THE PROBLEM

This study evaluated the effectiveness of the Naval Basic Instrument Trainer (NavBIT) as it is currently used in the Basic and Radio Instrument Navigation Stages of Basic flight training. Findings are based on a detailed study of individual student reactions and on an intensive search of the pertinent literature.

FINDINGS

The present study indicates that the Naval Basic Instrument Trainer is doing an effective job as an aid to teaching instrument flight, and that the expenditure for a more elaborate simulator would not be justified in terms of increased effectiveness. It also points out that the students themselves feel that the link trainer is adequately fulfilling its basic purpose of teaching procedures, scan, and the reading of instruments.

RECOMMENDATIONS

1). Retain the 1-CA-1 Naval Basic Instrument Trainer in the instrument phase of flight training.

2). Present the link hop syllabus in a single block prior to actual flight rather than in an alternating fashion.

FOREWORD

The following paragraphs were taken from a CNABATRA letter to the U.S. Naval Aerospace Medical Institute:

1. This command conducts a program of instruction involving the use of basic instrument trainers in the Basic and Radio Instrument Navigation Stages of the Basic (Prop) Phase of flight training at NAAS Whiting Field. The assumption behind the use of these basic instrument trainers is that transfer from the simulated training situations to the actual flight situation increases as the two situations become similar.

2. The measurement techniques used in simulated training tend to be subjective, and the testing situations are unstandardized. The results are thus perhaps unreliable from the standpoint of scientific measurement. However, this does not diminish the generally solid feeling among most squadron training administrators that the basic instrument trainers, used as they now are, do a highly satisfactory, if not outstanding job of training.

3. Of great practical importance at the present time are the expenditures of training time and personnel and or money for equipment depreciation and replacement. It is a matter of considerable significance, therefore, that this headquarters obtain more complete and more precise information as to the actual effectiveness of these basic instrument trainers in building the desired skills.

4. The assistance of the Naval Aerospace Medical Institute in gaining the desired information is requested. A conventional experimental design in which ultimate criterion performance for trainees who did and who did not have basic instrument trainer experience would be compared is considered adequate for present purposes.

These paragraphs outline the general problem for investigation. It was this investigation that served as the basis for the following report.

INTRODUCTION and BACKGROUND

The Naval Basic Instrument Trainer (NavBIT), Device 1-CA-1, is designed to provide instruction and practice in all phases of instrument flight, radio range procedures and techniques, and radio navigation (7, p.22). It is currently used in the Basic and Radio Instrument Navigation Stages of the Basic (T-28 Prop) phase of flight training at NAAS Whiting Field. The history of NavBIT usage in instrument training can be traced as far back as 1946, a time when the SNJ was being used as the Navy's basic training aircraft. As the program is now set up, each flight student receives a total of eighteen hops in the instrument trainer, ten during the Basic Instrument (BI) stage and eight during the Radio Instrument (RI) stage. Since the term "link trainer" is used commonly by those in the training command to refer to the NavBIT, henceforth in this report the two terms will be used interchangeably. The specific manner in which the link hops are scheduled in relationship to the actual aircraft hops will be discussed later.

The logical first step in the evaluation of the effectiveness of any training device is a review of previous studies of evaluations of similar devices. The earliest pertinent study was an evaluation of the SNJ contact trainer reported by Williams and Flexman (12) in 1949. Their primary purpose was to determine if certain aspects of basic contact flight training could be learned successfully in a synthetic flight trainer. They used as subjects twelve students from the University of Illinois, none of whom had any previous flight experience. On the basis of Mechanical Comprehension Test scores, they were divided into two matched groups. The "trainer" group performed maneuvers both in the link SNJ operational trainer and in the aircraft, while the "control" group performed maneuvers in the aircraft only. Both groups worked on a 12-hour syllabus which included cockpit procedure, basic contact air work, and traffic pattern flying. To avoid instructor variability, the same

instructor handled both groups throughout the entire syllabus. Each student was expected to achieve an established standard of proficiency for every maneuver. The results of this study showed that the "trainer" group:

1) Required 874 fewer task trials .... 62% saving.
2) Made 1511 fewer errors ..... 75% saving.
3) Used 44 fewer air hours ..... 62% saving.

The estimated cost for training the "control" group was $3,572, while the estimate for the "trainer" group was $1,572. So the effectiveness of the simulator as an aid to contact flying is quite evident in this particular study. Since we are concerned with instrument rather than contact flight, it is interesting to note that the authors of the above study included the following statement among their recommendations: "In an instrument flight training syllabus we anticipate that the relative saving, using the same trainer, will be higher than that found for contact flying, and that the portion of an instrument syllabus which can be taught in the trainer will approach 100%" (12,p.6). This is indeed an optimistic outlook for the use of simulators in instrument training.

In an evaluation study of the P-1 contact simulator for the Air Force (5), a research design quite similar to that of the Williams-Flexman study described above was employed. Results again showed the simulator-trained students to be significantly superior to nonsimulator-trained students in terms of flying proficiency. The aircraft used in this study was the T-6, the same craft the Navy calls the SNJ. Again the opinion was expressed that the value of the simulator would be even greater in the instrument phase of flight training.

The single most valuable reference for purposes of the present study was a report by Wilcoxon, Davy, and Webster describing an evaluation of the SNJ operational flight trainer (OFT) (11). This study included the NavBIT, 1-CA-1, in its

"comparison-type" research design, and was concerned mainly with the value of the SNJ OFT and NavBIT in the instrument stages of flight training. The results of this project provide answers to a number of the questions raised in the request for the present study. The extreme relevance of this report warrants the following verbatim inclusion of the obtained results, which were presented in question-answer form.

RESULTS SECTION: (Taken directly from Wilcoxon, Davy, and Webster)

"The experimental investigations reported herein represent a portion of the Special Devices Center, Office of Naval Research program for the evaluation of training aids and devices, and cover Phases I and II, mentioned above. The present studies are concerned with the relative effectiveness of the SNJ OFT as contrasted with alternate less specialized flight trainers and the comparison of a modified training sequence in basic instrument and radio navigation with the standard procedure.

"Four separate studies were conducted. In each, one or more experimental groups of students were trained with equipment or syllabus differing from that of a control group. The effectiveness of training for each group was determined, using such indices as proficiency in the trainer, proficiency in the plane, written test scores, and time required to complete the unit of training. Conventional statistical methods were used to determine the importance of observed differences (11, pp.1-2).

STUDY I - PROBLEM A

"Do synthetic flight trainers such as NavBIT and SNJ OFT contribute to basic instrument training?

FINDINGS

"Yes. Both the SNJ OFT and the NavBIT are effective aids to Insturment Stage flight training. The students who had no synthetic training required an average of approximately twenty-two hours of flight time to complete training in this stage as opposed to eighteen hours for students who had synthetic training. Still they did not receive as high proficiency as those students who received training in either the SNJ OFT or the NavBIT. Had the students without synthetic training been required to attain the same proficiency as the other students, it is likely that the saving in flights attributable to the training in the NavBIT and SNJ OFT would have been even greater. It seems that the procedures and principles of basic instrument and radio range flying lend themselves well to learning in a ground device and that this learning carries over to subsequent performance in the aircraft" (11, p.2).

These findings are particularly relevant for our purposes. Probably the key question in the minds of those requesting the present evaluation was the same question investigated above: Is the NavBIT contributing to instrument training? Even though the training aircraft has changed (SNJ to T-28), the similarity of the two craft would allow us to accept the above-stated findings. The NavBIT was an effective aid to instrument flying in 1954, and we have every reason to believe that it is still an effective aid in 1965.

STUDY I - PROBLEM B

"Is the specialized SNJ OFT superior for this purpose to the generalized NavBIT?

FINDINGS

"No. The low fidelity NavBIT is equal in effectiveness to the high fidelity SNJ OFT for basic instrument training and is slightly superior for radio range work. The explanation for

failure of the high fidelity device to achieve greater effectiveness probably lies in the intellectual nature of the tasks to be learned. The mechanical aspects of flying, such as adjusting the throttle and controlling the stick, have already been learned to a high degree. Moreover, the experience of flying, the sensations of movement, accelerative pressures, the sounds and visual cues are well known to the student pilot. Thus the advantages of a device which accurately simulates airplane characteristics in these areas are lost. The student's primary task is to learn a number of procedures and the principles behind these procedures. The NavBIT, which contains a simplified cockpit and flight system, which generally resemble that of the SNJ aircraft, is adequate for this training purpose.

"The NavBIT's superiority in radio training is probably attributable to two factors: its effective briefing facilities and its stability. The briefing facilities include a crab which tracks a record of the trainer's flight path on a radio range map and additional headsets which permit other students to listen to the radio signals while watching the flight path recorded. Thus onlookers can gain additional experience and the student in the trainer can review his performance on the radio range map after the hop. The stability of the NavBIT, the ease with which it can be controlled, permits the student to concentrate on the more important tasks of learning the procedures. On the other hand, operation of the SNJ OFT requires considerable attention to the mechanics of controlling the device and limits the student's efforts to learn procedures" (11, pp.2-3).

These findings again are applicable to our present instrument training program. Since it is known that the NavBIT is an effective aid to instrument training, the next logical question might be: Would increased effectiveness justify the changeover to a more elaborate, higher fidelity simulator? Results indi-

cate that such a move would not be justifiable. The NavBIT was found to be at least as effective, and in some aspects (radio instruments) even more effective than a higher fidelity trainer. The implication of these findings is that fidelity of simulation that is not specifically related to what is being taught, or is not absolutely critical to the learning thereof is probably a waste of money.

STUDY II - PROBLEM

"If synthetic trainer time is given in a single block in Basic Instrument or Radio Range training, will it be as effective as when alternated with actual flight?

FINDINGS

"Yes. The blocked syllabus is more efficient than the standard syllabus. Students in the blocked syllabus were able to complete training two and one-half days sooner than students in the standard syllabus, and yet there was no decrease in proficiency. The two and one-half day saving in time resulted from the separation of ground and flight training. Ground training activities no longer were hampered by delays in the flight schedule, since the student was assigned the entire day to ground lecture or trainer hops. Subsequently, when the student advanced to flight status, he became available all day for flight scheduling. The value of the block syllabus is particularly apparent during periods of bad weather, when scheduling must be makeshift to accomplish any flying" (11, p.4).

The results from study II relate to effectiveness from the standpoint of simulator usage. In the present instrument training program, the approach to simulator usage appears to vary as a function of the number of students in a particular stage. If there is a large pool of students coming into the instrument stage, which is usually the case, then the recommended blocked syllabus is used. If there is not an overflow of flight

students, the link hops are alternated with actual flight hops. The written syllabus calls for the alternating method, even though it does not appear to be the most advantageous approach.

STUDY III - PROBLEM

"If students first are given thorough ground training under a blocked sequence and then are allowed to progress through flight training as rapidly as they can pass flight checks, will air time be saved without sacrifice of quality?

FINDINGS

"Yes. A progress-at-own-rate syllabus and a more rigorous ground training combined with a block sequence of instruction resulted in further improvement in utilization of the trainers. Students saved an average of 1.3 hours in flight during the basic instrument phase of their training. Over a period of a year this would result in a saving of more than 3,000 hours. Despite the decrease in number of hours, proficiency actually increased slightly. The effectiveness of this program can be attributed largely to the emphasis which was placed on the student's individual efforts and skill in passing the proficiency checks and advancing rapidly throughout the syllabus. This seemed to increase incentive to study and to lead to a more thorough knowledge of the task" (11. pp.4-5).

Although the results of study III are more concerned with training methodology than with the simulators as such, they do provide valuable insight regarding more effective utilization of simulators. Just how practical a "progress-at-own-rate" program would be in the present syllabus is a question best answered by those in administrative positions.

In summary of the findings from earlier research it would appear that two of the questions raised in the CNABATRA letter have fairly solid answers: First, it has been shown that the NavBIT is a very effective aid in instrument training, and

second, there was no observed gain when a more elaborate, higher fidelity (and more expensive) simulator was used in its place.

In order to get answers to questions as to the effectiveness of trainer utilization, student's motivation relative to link training, instructor effectiveness, possibilities of negative transfer, and similar problems, it was decided to study student reactions to the program.

PROCEDURE

Pre- and Post-Interviews: An initial interview was conducted in which the participating flight students were briefed as to the nature of the study and what their role would be. A post-interview was conducted with each student at the end of the link phase of Basic Instruments. The purpose here was to summarize and clarify information that had been obtained on questionnaire and diary forms.

Link Hop Questionnaire: A semistructured questionnaire form, intended to tap all the informational areas, was developed. The students were directed to fill out one of these forms after each link hop. Stamped envelopes were provided so that the forms could be returned to the Psychology Division immediately following completion. A copy of the link hop questionnaire is included in the Appendix.

Hourly Log: Participating students were asked to maintain an hourly log that would account for the way they allotted their time during a twenty-four hour period. With this form we were able to look at the amount of time devoted to preparing for link hops and flight support examinations. These log sheets were also mailed back to the Psychology Division upon completion. A copy of the Hourly Log is included in the Appendix.

SUBJECTS

The subjects for this study were five flight students from the Basic Training Command who had just completed the "transition-precision-acrobatic" stage in the T-28, and who were about to begin the instrument stage of flight training. The sample included two Ensigns, two NavCads, and a Marine Second Lieutenant. In the hope of obtaining students with reasonably high analytical capacities, one of the criteria for subject selection was an Aviation Qualification Test (AQT) score of at least eighty. As was mentioned earlier, these subjects were brought in for an initial interview, at which time their duties were explained in detail.

RESULTS AND DISCUSSION

The first part of this section presents a summary of the responses obtained for each of the twelve items on the questionnaire. For those items which yielded varying comment throughout most of the syllabus (items 1-7), a chart-type presentation has been included. This chart presents the actual comments for each of the five subjects during the course of the link syllabus. Originally it was intended that a separate questionnaire form be filled out for each of the ten hops. Since in most instances, however, the link hops were given in blocks (single sittings) of two or three, the questionnaire forms were completed for each of these blocks. The chart presentations allow the reader to view the over-all response patterns of the individual subjects on individual items.

ITEM #1

What do you feel you learned in today's hop? In what ways did your performance improve from preceding hops?

The common strand in responses to this item seems to be the revelation that there is most definitely an adjustment period in the links. It takes the student anywhere from two to five hops to get the feel of the trainer. It is quite clear that the main value of the links, from the student's standpoint, is in teaching instrument procedures and improving one's scan. Although there appears to be a general pattern of improvement in link performance, there was one instance noted where a student made a poorer showing on his final link hop. There is reason to believe that this was an instance of negative transfer from the T-28 to the trainer. This "transfer" concept is given more attention in the discussion of item number four.

Questionnaire Item Number One: What do you feel you learned in today's hop? In what ways did your performance improve from preceding hops?

Subjects	Link Hop (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Subject "A" Ensign	The necessity for a good scan.		My procedures and scan improved.		My scan improved, and I made quicker and smoother adjustments.		My performance was not very good because I had little desire to fly links after flying SNJ-2. (This was an actual air hop.)		_____	_____
Subject "B" Ensign	I tried to get the feel of the links. I was introduced to basic attitudes.	Basic attitudes and initial maneuvers. No significant improvement.	Slightly more control over the link My maneuvers were a bit smoother and more coordinated.	As before, better control and ability to trim the links.	Practiced procedures. Performance about the same as yesterday.	Opportunity to practice procedures. Performance slightly improved over previous hop.	Practice of procedures. Performance not as good as preceding link hops.		Nothing new learned. Performance was very poor, and just barely above the minimums.	
Subject "C" NavCad	Today I don't think I learned anything that will help me in SI. About the only thing I learned was how the link operates.		Performance checks. My initial climb to altitude was better in that I did not go off heading during shift.		My turn patterns were a lot better. I am still having trouble with the penetration because of trim.		Straight and level partial panel. I am getting used to flying links, and it is becoming easy.	Today everything went real smooth. This was the third time in a row I had the same link trainer, and it made things easy. My scan improved greatly over the preceding hops.		
Subject "D" NavCad	Just a general orientation on how to operate the link. A little was learned on procedures but not much else.	_____	Average progress. Could have done better if not such a long wait since last link hop. Very little improvement due to not flying links for 4 or 5 days.		Very little, just finished T-28, [illegible], and was pretty tired. I feel they were wasted link hops. My performance dropped off about 70 to 75%.		Very little. I'm mad because I had to fly links Friday night. Sat around all Friday morning. Could have flown then.		Very little. Though I did accomplish the Yankee pattern correctly.	_____
Subject "E" Marine 2/LT	I feel I learned very little other than how to fly the link trainer, which takes special techniques not normally associated with flying the T-28. As I progressed through the 3 hops, my technique did improve as I got the feel of the link.			Introduced penetration pattern. Performance about the same as last hops.		Getting the feel of flying the link, however, performance did not improve noticeably.		Learned nothing new. Familiarity with link probably the main reason for improvement, coupled with the fact that everything had been previously introduced.		

ITEM #2

Based on today's link hop, point out any differences or similarities in flying the link and actually flying the T-28.

The NavBIT is by no means an exact replica of the T-28, but rather a generalized instrument trainer. "Similar but not equal" might be an appropriate description. The reason for including this item, then, is to get some idea about what differences the student perceives between the trainer and the aircraft. The major differences may be stated as follows:

1) Response times in the link are inconsistent. They are sometimes faster and at other times slower than the T-28.
2) It's extremely difficult to trim the link, and hold it in a constant attitude.
3) Power settings in the link are inconsistent.
4) The link cannot be banked over thirty degrees.
5) Extending the speed brake or changing the power setting in the link does not result in yaw or pitch as in the aircraft.
6) The vertical speed indicator in the link is mechanical, and can be used for level flight without cross-checking the instruments.

Questionnaire Item Number Two: Based on today's link hop, point out any differences and similarities in flying the link and actually flying the T-28.

Subjects	Link Hop (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Subject "A" Ensign	The link responds much differently than the T-28. The link responds sometimes slower and other times faster, or not in a smooth manner. I should be able to tell more after another hop, but the link is not like the T-28.		The link had faulty M.A.P. settings. The instructor told me to go ahead and over-boost the engine because I wouldn't be able to rely on the indicated M.A.P.		This link hop was flown on Friday, but I'm filling out this questionnaire on Saturday after my first #2 hop (air hop). In the T-28 I had to be much more gentle with the stick, and move it very little to make corrections. The link seems to have a lag in its response to stick movement. I found no negative transfer from link to T-28.		As I've said before, the scan is about the same, but the link does not handle like the T-28, which I think is of minor importance.		_____	_____
Subject "B" Ensign	Very little feel of flight in the links. Extremely difficult to trim & hold in a constant attitude.	Again, very little feel of control. The control pressures are inconsistent.	Main difference is in control pressures. They are not genuine in the links.	Link cannot move vertically as in the aircraft in air pocket. Actuating speed brake has no effect on link relative to the nose-up pitch of the T-28.	Cannot bank over 30° in the link.	When extending the speed brake or reducing and adding power, the link does not pitch or yaw as the aircraft.	Impossible to trim the link to a hands off position.		No sensation or feel of actual flight. Links give the feeling of pivoting about a fixed point. Links have no control response to extending speed brake or flaps.	
Subject "C" NavCad	(1) The trim lags and makes it almost impossible to trim the link. (2) I had no sensation of flying; it was just like operating a pin-ball machine. (3) Control is instantaneous during turns, but Basic Instrument Flight Procedures state a three second lead is necessary.		I got my down because of my unsatisfactory penetration. I feel the reason for this was my inability to trim the link for my descent. The Vertical Speed Indicator (VSI) is mechanical in the link & could cause some concern when flying the T-28. Control movement causes instant movement in the link; there is no lead necessary.		Trim reacts slowly. On take-off, link was at 230 Kts. before I could raise the nose. No feel in rudders; it causes me to overcontrol and spend too much time on the balance ball.	The VSI in the link is mechanical and can be used for level flight without cross-check instruments. In the T-28 it lags too much to use. Control pressures do not correspond to air speed. Hops in link are easily flown without using rudder trim. It takes a lot of control displacement to get a response.		Lag in trim. Control pressures. The absence of "G" forces makes it easy to correct for large errors in altitude.		
Subject "D" NavCad	Cockpit is entirely different. Link I was in was built in 1941...a bit out of date. Climbs a lot faster than T-28. Doesn't handle at all.	Take-off is too fast. in the link; climbs too fast.	Same as in preceding hops.		The link has no feel & is harder to hold in standard rate turns. The link has a stop watch type clock in it, while the T-28 has a clock one-half the size and is not a stop watch. The clock is the only thing I've noticed so far that is better than the T-28.		_____		On reversing headings, links reverse much quicker, and the nose doesn't rise during reversals.	
Subject "E" Marine 2/LT	The controls require a completely different touch. The trim tabs do not require the same amount of adjustment as in the T-28. In fact, the link may be flown without any trim other than that initially set in.			Some differences today as yesterday. Link I flew today had more feel built in & required a somewhat realistic amount of elevator trim in penetration. Link requires no rudder control except for heading.		The link I flew today simulated the T-28 better than any other thus far. It had sound effects for power increases and reductions, and also was most sensitive to date.		Same ones that I've already mentioned.		

ITEM #3

In today's hop, were you aware of any T-28 instruments or controls that were missing from the link, or that were located in different positions in the link than in the T-28? Describe.

This item could be answered more precisely by a flight engineer than a student, but once again we were primarily concerned with the perceptions or subjective impressions of the students. The most frequently mentioned differences were as follows:

1) The speed brake in the link is not on the throttle as it is in the T-28.

2) The landing gear, flaps, mags, fuel control, and most instruments are in different positions.

3) The clock is in a different position.

Questionnaire Item Number Three: In today's hop, were you aware of any T-28 instruments or controls that were missing from the link, or that were located in different positions in the link than in the T-28? Describe.

Subjects	Link Hop (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Subject "A" Ensign	The link does not simulate the T-28 cockpit. The landing gear flaps, mags, fuel control, and instruments are in different positions.		The speed brake in the link is not on the throttle as in the T-28.		No		No		No	
Subject "B" Ensign	Trim controls are very different, as is the position of the speed brake. Most of the cockpit instruments are located in different positions.	Speed brake located on panel instead of throttle as in the T-28.	No	Speed brake in descents. I'm unaccustomed to taking my hand from the throttle and reaching for the speed brake.	Same as yesterday, with the speed-brake.	Not specifically.	None...other than those previously mentioned (speed brake, trim tabs, etc.)		Very definitely after flying four hops in the T-28, I found it difficult to use the trim tabs as well as some of the instruments. I found myself expecting the movements of the T-28.	
Subject "C" NavCad	The position of the gas, gear, flaps, and speed brake.		I forgot the landing gear on take-off because it was missing from the control panel.		Several times today I got the manifold pressure mixed up with the RPM in level speed changes.	None		No		
Subject "D" NavCad	Gear handles, flap handle, and speed brake all have different locations. Instrument panel is too different to describe.	_____	None		No more than have already been mentioned.		_____		None that haven't already been mentioned.	
Subject "E" Marine 2/LT	The flaps and gear controls were completely out of place, as was the speed brake. The clock is also in an entirely different position			Aware of the same ones as noted yesterday, plus the RMI seemed to be in the wrong place for the first time.		The ones I've mentioned previously.		Same		

ITEM #4

Do you feel that your experience in the T-28 interfered with your performance in today's link hop? For example, did you find yourself looking for some instrument or reaching for some control that wasn't there, etc." Describe such instances.

This item, of course, seeks to isolate instances of negative transfer from the T-28 to the link. The students were also instructed to report any instances of negative transfer in the opposite direction. When the student responses are reviewed, there doesn't appear to be any pronounced problem in this regard. Two of the subjects mentioned that it had been several weeks since they last flew the T-28, which may account in part for the relative ease of transition to the trainer. In the Introduction of this report we discussed the findings of the Psychological Corporation study of 1954. One of the findings of that study showed that synthetic trainer time given in a single block was more efficient than a syllabus which alternates link hops with actual flight (11, p.4). The investigators accounted for this block syllabus advantage wholly in terms of the "flexibility in scheduling which resulted from the separation of ground and flight training."

They may have overlooked the possibility, however, that the blocked syllabus approach tends to minimize the occurrence of reciprocal negative transfer. It stands to reason that the alternation of two "similar-but-unequal" tasks over a period of time will effect an interplay that will prolong the mastery of either task. This would seem to be the case when alternating link hops with actual flight. On the other hand, the "block" approach allows the student to devote a full effort to the completion of a single task. And even though there will be some negative transfer in the initial stages of each task, it will probably fade very quickly. The Wilcoxon, Davy, Webster study

(11, p.26) demonstrated negative transfer in the case of the unusual attitude maneuver. "This lent support to the possibility that other negative training effects result from practice in the OFT and the NavBIT, even though the net effect of such practice was positive. Ideal utilization of the trainers would depend upon minimizing the negative factors and maximizing the positive, so as to achieve the greatest net positive training value" (11, p.26).

The following responses from subjects in the present study affirm the existence of negative interplay in the alternating syllabus:

> "When I started flying the link, I hadn't flown in almost four weeks, and had lost all my touch on the T-28 controls. I soon acquired a fair touch on the link. Mixing of T-28 and link hops really fouls things up."

> "I flew BI hop number one Friday morning, and I think the following comments on my grade sheet were due to link training:
>
> TENDS TO OVERCORRECT. ROUGH ON CONTROL MOVEMENT.
>
> The control sensitivity in the T-28 made it hard to make smooth corrections. In the link it takes a considerable amount of control movement to bring results, while in the T-28 the hop can be flown with two fingers."

With all of the above in mind, it would seem that the use of a block syllabus approach to link training would contribute to the attainment of "the greatest net positive training value."

The question of the "alternating versus the block syllabus" brings to mind a related question. What would happen if the student pilot were exposed to a Primary training syllabus that taught instrument-flight techniques and contact-flight (visual) techniques simultaneously? Both the Army and the Air Force have experimented with this concept of integrated instruction, and

initial results have shown promise of a gain in over-all pilot proficiency and a saving in training time (8, p.21). The research personnel who have supported this integrated training concept have stated the following as their basic points of dissatisfaction with the traditional order of presenting flight instruction (8, p.4):

1) Allows the student pilot to develop habits that make it unnecessarily difficult to learn instrument flying techniques.

2) Produces pilots who, though instrument qualified, often lack confidence in instrument flying techniques. As a result, these less experienced pilots reluctantly engage in actual instrument flight.

3) Does not provide even preliminary emergency instrument training for the 30 to 40 hour pilot.

This concept of integrated instruction appears to be a fertile research area which the Naval Air Training Command might profitably explore.

Questionnaire Item Number Four: Do you feel that your experience in the T-28 interfered with your performance in today's link hop? Did you find yourself looking for some instrument or reaching for some control that wasn't there, etc.? Describe such instances.

Subjects	Link Hop (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Subject "A" Ensign	I didn't find myself reaching for a missing instrument, but I had to think where some of the controls were located.		I'm getting accustomed to the link, and know where the controls are; but still have to think about where they are.		No		No		No	
Subject "B" Ensign	None in particular.	None in particular. Since it has been over two weeks since my last flight, my in-flight procedures are not so much automatic.	No.	I had a tendency to forget the speed brake in descent, possibly because the speed brake is located on the throttle level in the T-28.	Not today.	Not today.	Not today.		Yes, in the links I found myself groping for the trim tabs and misreading the instruments. I anticipated certain control responses, and as a result either lost or gained altitude.	
Subject "C" NavCad	It's too early to tell.		None		Differences in control pressures. I had to stop & think where the speed brake switch was located, thus causing a break in my scan.	No	No	No		
Subject "D" NavCad	Yes, gear handle and speed brake.		No, I'm getting used to the instruments now.		Yes, the T-28 handles much better. When I started flying the links I hadn't flown in almost 4 weeks & had lost all my touch on the T-28 controls. I soon acquired a fair touch on the link. Mixing of T-28 and link hops really fouls things up. It's all due to poor scheduling & organization in the unit.		Yes. There is no "feel" in the link, while there is in the T-28.		No	
Subject "E" Marine 2/LT	It has been approximately three weeks since I last flew the T-28, so there was very little negative association.			Nothing I haven't already mentioned		Experience did not interfere although I was well aware of the many differences.		Not noticeably, as I have now adjusted to the links.		

ITEM #5

Did you use any tricks or gimmicks that helped you perform well on this link hop, and that would not have been possible in the T-28? Where did you learn these tricks?

The most commonly mentioned "gimmicks" were the following:

1) Using the speed brake for air speed control.

2) Use of the vertical speed indicator alone to fly straight and level.

3) Flying straight maneuvers with feet off the rudder pedals.

4) Discarding trim completely, and flying with both hands on the stick.

Gimmicks of this sort have been around since the machine age began. And as long as we use humans as pilots, we'll have to expect them. The main sources for learning these facilitating "tricks" are other students and the link instructors, although the students themselves manage to pick up a number of these through experience and experimentation.

Questionnaire Item Number Five: Did you use any tricks or gimmicks that helped you perform well on this link hop, and that would not have been possible in the T-28? Where did you learn these tricks?

Subjects	Link Hop (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Subject "A" Ensign	No, I haven't heard of any gimmicks that are used in the links. However, I noticed that correction can be made by sharp movements of the stick.		I discovered that even with pressures on the stick, I could take my hand off it, and our attitude remained the same.		No	No	No		No	
Subject "B" Ensign	None	None	None		Kept my feet on the deck when trying to hold course. This prevents the student from inadvertently applying pressure to the rudder, and moving off heading. Instructor recommended this.	None	None		None	
Subject "C" NavCad	Yes, the link will not turn without using the rudder pedals. You can keep a constant rate turn going without worrying about the angle of bank. I learned it by experimenting early in the hop.		Yes, I flew the link with both hands on the stick, and did not trim. The link instructors told me to forget the trim & just fly against the pressures. My performance improved.		I flew the hop without trimming. During level speed changes, I did not touch the rudder or the stick. I learned this from other students.	Yes, straight and level by using the vertical speed indicator alone. I also flew all straight maneuvers with my feet off the rudder pedals. I learned these "tricks" from past experience in links.		I was behind on a climb schedule so I used 60" manifold pressure to catch up. I used a pencil mark on the attitude gyro to do my S-3 pattern. I used the Vertical speed indicator for straight and level without cross-check instruments. I flew most of the hop with both hands on the stick and feet off the rudders. I did not use rudder trim. I learned these things from previous experience in the link.	
Subject "D" NavCad	Whenever I'm fast, I can use the speed brake to slow down. To turn, must hit stick hard to get air pressure, then gently. Instructor showed me these.	I used the speed brake extensively on this hop.		None	None		Mainly, I used just the speed brake.		Used the speed brake extensively to slow down when fast. Also, this link had to use different power settings to accomplish maneuvers.	
Subject "E" Marine 2/LT	To correct for changes in heading, all that is required is manipulation of the rudders. Picked this one up myself. I have also heard that manipulation of speed brake will effectively control air speed without affecting altitude. This came from other students.			Correcting for headings with rudder alone. Speed brake for control of air speed when fast.		Used speed brake for air speed control.		Speed brake to control airspeed again...nothing new.		

ITEM #6

List any malfunctions you spotted in the link trainer used today.

From responses to this item, it is apparent that there is a great deal of variation from one link to another with regard to physical condition. It's possible that aside from the interplay between link and T-28, there may be negative transfer from one link to another. It goes without saying that standardized equipment is essential to the success of any training program.

Questionnaire Item Number Six: List any malfunctions you spotted in the link trainer used today.

Subjects	Link Hop (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Subject "A" Ensign	I was told that the vertical speed indicator was inaccurate. No other problems.		The link had faulty M.A.P. settings.		None	None	The power settings on the link were not correct. This seems to be a common problem with the links.		_____	_____
Subject "B" Ensign	None	Not able to bank over 30°.	None		Clock was inoperative.	Lights were out. I flew with the canopy open.	Trim tabs lag to a degree where they are non-functional. It was just impossible for me to use trim tabs on this link.		Rudders were inoperative, and reversed in a turn. Altimeter would not stop on descent. Control stick very stiff and difficult to move.	
Subject "C" NavCad	None		Excessive control pressures. My link was in the corner by the window, and caused changing light conditions which made it difficult for me to concentrate.		Same one used yesterday.	The link I used today was in exceptionally good operating order.		None		
Subject "D" NavCad	None	_____	Cylinder head temperature gauge not operating, nor oil temperature or the carburetor air temperature. Link would not trim up.		Trim was not working properly, nor was the attitude gyro.		None		None except different power settings.	
Subject "E" Marine 2/LT	The clock isn't working. It was difficult to get the link unlocked initially.			None		None		None		

ITEM #7

Based on today's hop, can you suggest any ways the link might be improved to facilitate actually learning to fly by instruments?

The responses to this item have a deeper meaning than one might initially think. It is no secret that the link trainers in the instrument stage of training are the object of widespread student criticism. How much of this criticism is really valid and how much is "normal student vocal exercise" are good questions. It is one thing to criticize, but quite another to come up with some specific suggestions for improvement. As is evident from the response chart following, the subjects were unable to come up with any revolutionary suggestions for link improvement. The suggested improvements or changes in most instances were very general:

"A more realistic grouping of instruments and controls."

"Cockpit might better resemble that of the aircraft we are presently flying."

"The control response could be improved."

One of the subjects made a suggestion that would solve all the trainer problems: "Forget the links altogether." The other four subjects were not quite so radical in their suggestions, and agreed that the links were a "necessary" part of the instrument syllabus. This thought was brought out more clearly in the post interviews.

Questionnaire Item Number Seven: Based on today's hop, can you suggest any ways the link might be improved to facilitate actually learning to fly by instruments?

Subjects	Link Hop (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Subject "A" Ensign	——— ——— —	———————	No		The instrument panel could be designed like that of the T-28. However, they are very similar now, and the link teaches scan fairly well.		No		No	
Subject "B" Ensign	Not at this stage.	Not at this point.	None specifically. The trainer was relatively accurate.	Cockpit might better resemble that of the aircraft we are presently flying.	None in particular.	No	The control response could be improved.		Better control responses, mainly. Trim tabs should work uniformly.	
Subject "C" NavCad	Instant trim (more feel into the flying).		Trim should be instant. Some control pressure in the rudders would facilitate things.		No	Yes, more control sensitivity. Trim should be instant. There should be a lag in the vertical speed indicator.		No		
Subject "D" NavCad	Get a link that's like a T-28 cockpit.	———————	No. The link can train you to fly by instruments, but time is lost in the transition back to the T-28. You can learn instruments in the T-28 also, just as fast. The link doesn't have any feel in the stick.		Again, the link can teach you to fly by instruments, but not flying instruments in the T-28. Tomorrow I may fly a hop that will have material not yet covered in my link hops. Should be able to find out whether links are necessary at all.		Forget the links altogether.		Have the head phones hooked up for BI hops. Would make it more like the T-28 hops. As is now, instructor opens the door and talks to you.	
Subject "E" Marine 2/LT	Of course the obvious answer would be to make the link an exact replica of the T-28. I feel one of the most important things missing is the lack of similarity in control feel and the effects of power changes on control pressure and trim.			The instruments should be grouped more realistically so you could develop a more effective scan.		Only those previously mentioned.		A more realistic grouping of instruments and controls.		

ITEMS #8 and #9

#8) Evaluate your link instructor for today's hop by placing a check mark at the appropriate position on the scale below.

#9) What specifically could be done to improve the instructor's performance?

With items eight and nine, we were hoping to determine how much variation existed from one link instructor to the next. A quick analysis of the total of twenty-seven ratings by the five students shows that ten of these were in the "average" category, fourteen were "above average," and only two were rated "below average." From the students' standpoint then, it would seem that the link instructors are doing a good job. Most of the responses to item nine, as a matter of fact, were of a complimentary nature. Among the suggestions for improved instructor performance were the following:

"Possibly, the instructor could develop a more positive attitude toward giving instruction."

"Possibly the instructors could be given an instrument hop so they could better understand the problems involved with flying an actual aircraft."

"Could have been a little more enthusiastic about his work."

"Take more interest in what he is doing. Usually the instructor tells you as soon as you're off from the maneuver so you can still salvage it. He just sat there like a bump on a log until I was really off and nothing could be done."

This last response touches upon a most important tenet of instrument flight training. Keeping the pilot informed of position is a key to effective instrument training, and has been emphasized in Williams' study of preliminary information necessary for instrument flight (13, p.13). We must keep in mind that the task of a link instructor over a two or even a three-year

period can be monotonous to say the least. It is easy to understand why there is some mention of a lack of enthusiasm.

ITEM #10

Did the grade you received today accurately reflect your link performance? Did your flight support lecture and syllabus guide enable you to adequately prepare for today's hop? Was anything missing or added?

The comments on item number ten can be succinctly summarized in a single sentence: The students felt that the link grades accurately reflected their performance, and that the flight support lectures and syllabus guides adequately prepared them for their hops.

ITEM #11

Have you heard any complaints among the students lately related to the link trainer?

Among the link complaints commonly heard among the flight students were the following:

"Some students feel that the links do nothing more than teach procedures."

"Several complaints relative to the response of the trim tab mechanisms."

"Poor trim....speed control....and no time between hops."

"Differences between links. Some can be trimmed and some cannot."

"Impossible to trim....stuffy....no feel of flying....like operating a pinball machine."

"The compressed air that works the links is late in making them function. Hence, on timed turns, you get behind."

SUMMARY STATEMENTS BY THE INDIVIDUAL SUBJECTS

The following summary statements were contributed by three of the five subjects on their final questionnaire forms.

Subject "A"

"I haven't filled out this last questionnaire because this hop was the same as the rest. I have been including two hops per questionnaire because we have them two at a time, and they are given by the same instructor. I recommend that these links are kept in use because I don't think any gains received from new trainers would warrant the expenditure. The links are serving the purpose for which they are meant. That is, they teach procedures and scan in a changing environment. No doubt a trainer can be developed (or has been) that can more closely simulate actual instrument flight in the T-28. However, a new trainer would still be a simulation which still leaves a large gap between the trainer and actually flying. Perhaps a degree of simulation can be reached where it would be unnecessary for the student to fly.

"The differences in the two cockpits are immaterial. As long as the links require the student to follow procedure and maintain a scan, he is being prepared for the T-28. There were several cases where I had to locate controls in the links, such as the speed brake, landing gear, and flaps. However, this did not create any noticeable problem for me. I still had to fly the links and scan, which is nothing more than becoming accustomed to a new kind of environment.

"The instructors are satisfactorily doing their job. In the end, it's the student who must know his procedures and practice on the link. At no time was I dissatisfied with an answer I received from an instructor.

"I feel that a greater degree of simulation can be reached, but it is unnecessary. The present link trainers give the student a basis to work from once he is in the air."

Subject "B"

"In general, link trainers seem to be nothing more than a good way to learn and practice procedures. In this sense, they are beneficial to instrument flight. It is possible to develop an initial scan pattern in the link as well as practice in interpreting the instrument readings.

"However, the links are of little value as far as actually flying the T-28 under instrument conditions. In the first place, the cockpit instrumentation in the link is very different from that of a T-28, necessitating a change in scan pattern.

"One of the most frequent complaints seems to be the inconsistency between one link and another. Some trainers can be trimmed to hands-off flight; others cannot be trimmed at all. A few links have trim tab lag, meaning that the tab settings do not take effect until the maneuver has been started, throwing the training out of balance.

"The link does not duplicate the response of the T-28 under certain conditions. For example, extending the speed brake in the T-28 results in considerable nose-up pitch and must be countered with forward stick pressure to maintain altitude. The same is true when extending flaps. I noticed considerable difficulty in this respect when flying my last two link hops after four syllabus hops in the T-28. I found myself anticipating the responses, and this resulted in erratic performance in my last two link hops.

"In general, links proved to be helpful only as a method of learning instrument procedures, interpreting instrument readings, and beginning a scan pattern. Once you have actually flown under instrument conditions in the T-28, the links begin to lose their value."

Subject "E"

"To sum up my own personal views on the link syllabus, I feel that the present link trainer and syllabus adequately serves its purpose; however, the link could be vastly improved with what seems to me to be a simple matter of a realistic grouping of the instruments, realistic power controls, gear, flaps, and speed brake switch. The practice with just the stick though is very helpful to reducing the feelings of apprehension that normally accompany a new situation, and also the practice flying the patterns is beneficial for the same reasons."

HOURLY LOG

Analysis of the hourly logs kept by the students reveals that for every hour in the link trainer, approximately one hour and ten minutes of study preparation are involved. There was not a great deal of variation, with the high student allotting himself one hour and twenty minutes per hop, and the low student one hour and three minutes. It was impossible in most cases to distinguish between study time devoted to flight support lectures and that devoted to the link hops proper. Since they complement one another so closely, however, this was of no great concern. For all five subjects the pattern of link usage was approximately the same. It seems that the first six or seven hops were taken in a fairly compact block, but the remaining hops were alternated with actual BI hops in the T-28. Evidence from the Psychological Corporation's study alluded to earlier (11, p.4) indicates that this alternating pattern is not so efficient as a consistent block syllabus.

POST-INTERVIEW DISCUSSION

The purpose of the post-interview as was mentioned earlier, was to summarize and clarify information that had been obtained on the questionnaire and diary forms. Probably the most important thing we were seeking in these interviews was an

honest over-all evaluation of the effectiveness of the link trainers in the instrument syllabus. The following question was put to each of the subjects: "All right now, if you were running the whole training show, what action would you take regarding the link training syllabus?" Four of the five subjects responded with approximately these thoughts:

> "To be quite honest with you, I don't think I'd make any changes. It would be nice to have a beautiful new trainer that would perfectly simulate the T-28, but I don't think it would improve things enough to justify the tremendous expenditure on a new link system. The links are intended to teach you procedures, scan, and how to read instruments; and despite their shortcomings they accomplish this task."

The remaining subject wasn't quite sold on the link syllabus. He was of the opinion that the link trainers could be done away with completely, and that all instrument instruction should take place in the aircraft. He admitted, however, that it might well have been the irritations surrounding the link usage (maintenance, scheduling, waiting around, etc.) rather than the link trainer itself that prompted him to take this viewpoint. The other four subjects felt that the links were a very necessary part of their instrument training, and thought that performance in the aircraft would be greatly hindered without exposure to the links.

The subjects made reference to link values beyond that of teaching procedures, scan, and instrument reading. One such value was the feeling of vertigo produced by the motion of the link cockpit. One student felt that the link produced more vertigo than the T-28, and in so doing served as an excellent preparation for the actual instrument hops. The necessity of link motion has on occasion been questioned by those intent on developing a more inexpensive trainer, but link evaluations have generally shown that the "sense of motion" is a definite

asset to instrument training. Townsend (10, p.54) stated in his evaluation of the Air Force, ME-1, Instrument Flight Trainer:

> "The one characteristic of the trainer, according to those who flew it, which raised the value of the trainer above all others they had flown was the capability for cockpit motion. The cockpit motion is extremely realistic in this trainer, more so than in any other trainer of a non-revolving type. In fact, the cockpit motion produced for the first time, in many of the pilots, a sensation of vertigo in a trainer. This is, of course, an extremely important factor in teaching instrument flight control."

Aside from the production of vertigo, Townsend (10, p.55) has also stressed the value of the trainer in presenting relationships between bodily and instrument information: "Movement of the trainer will serve as a cue for the student to take corrective action after determining the course of such action by reference to his instruments. Any roughly compatible movement, even one of low fidelity such as the inappropriate kinesthetic clip cues, will serve in this capacity."

Still another value of the link, as the students see it, is that it serves as a forced "dual" study preparation. In other words, the students find it necessary to study for both the link hop and the corresponding T-28 hop. As one student put it: "The links serve as a crutch that exerts immediate pressure for me to study. If I didn't have that crutch, I'd probably just slide along doing as little as I could get away with."

CONCLUSIONS AND RECOMMENDATIONS

Based on a formal link evaluation study conducted by the Psychological Corporation (4), and backed by the present study which deals with student perceptions of and attitudes toward the trainers, we are able to conclude that the 1-CA-1 Naval

Basic Instrument Trainer is doing an effective job as an aid to teaching instrument flight. The present study points out that the students themselves feel that the link trainer is adequately fulfilling its basic purpose of teaching procedures, scan, and the reading of instruments. It serves further to accustom the student to the vertigo he will experience in actual flight, and also as a forced dual study preparation.

Students are well aware of the many differences between the trainer and the T-28, but at the same time they do not feel that the expenditure for a "perfect" simulator would be justified in terms of increased effectiveness. This student attitude supports Wilcoxon's finding (11, p.2) that the NavBIT was as effective, and for some uses more effective, than a more elaborate simulator for purposes of instrument training. In the present study the students were aware of some reciprocal negative transfer between the link and the T-28, but did not feel that it had reached problem status. Regarding link instructors, students felt that the great majority of these people were doing an above-average job.

It should be evident from the discussion up to this point that motivational considerations are essential in any evaluation of synthetic training. "Motivational similarity cannot be built into simulators, for it is a function of the entire instructional program. The motivational problems are many, influenced both by the fidelity of physical representation and by administrative features" (9, p.17). Trainer maintenance, scheduling, and instruction are all areas that should be included in a consideration of motivational similarity. It is not enough to develop the perfect machine.

Based on findings from the present study, and information contained in pertinent research literature, the following recommendations are made:

1) Retain the 1-CA-1 Naval Basic Instrument Trainer in the instrument phase of flight training. Despite its age, it continues to function effectively as an aid to teaching instrument flight.

2) Present the link hop syllabus in a single block prior to actual flight. Alternating the link and T-28 hops is less effective both from the standpoint of scheduling flexibility and of providing more opportunity for negative transfer.

3) Make the flight students realistically aware of the functions of the link trainer from the very start, emphasizing that it is not intended to simulate perfectly the T-28, but rather that it is a "generalized" trainer that can aid them in learning procedures, scan, and instrument reading.

4) Provide each link instructor with at least one instrument hop in the T-28, so that he might better understand his task as an instructor.

5) Implement a tighter program of link maintenance, attempting to maintain a more standardized working condition from one link to another.

6) The Naval Air Training Command might seriously consider the possibility of experimenting with an integrated concept of flight training (8) whereby contact and instrument flight are taught simultaneously in the Primary stage of training.

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APPENDIX

LINK HOP QUESTIONNAIRE

Student's Name _____ Date _____ Link Hop Number _____

BI ___ or RI ___ Grade on this Hop _____ Name of Link Instructor _____

(1) What do you feel you learned in today's hop? In what ways did your performance improve from preceding hops?

(2) Based on today's link hop, point out any differences and similarities in flying the link and actually flying the T-28.

(3) In today's hop, were you aware of any T-28 instruments or controls that were missing from the link, or that were located in different positions in the link than in the T-28? Describe.

(4) Do you feel that your experience in the T-28 interfered with your performance in today's link hop? For example, did you find yourself looking for some instrument or reaching for some control that wasn't there, etc.? Describe such instances.

(5) Did you use any tricks or gimmicks that helped you perform well on this link hop, and that would not have been possible in the T-28? Where did you learn these tricks?

(6) List any malfunctions you spotted in the link trainer used today.

(7) Based on today's hop, can you suggest any ways the link might be improved to facilitate actually learning to fly by instruments?

(8) Evaluate your link instructor for today's hop by placing a check mark at the appropriate position on the scale below:

Very poor _____ Average _____ Outstanding

(9) What specifically could be done to improve the instructor's performance?

(10) Did the grade you received today accurately reflect your link performance? Did your flight support lecture and syllabus guide enable you to adequately prepare for today's hop? Was anything missing or added?

(11) Have you heard any complaints among the students lately related to the links?

(12) On the reverse side of this sheet, feel free to make any comments that you think may be helpful to us.

INSTRUCTIONS FOR HOURLY LOG

The purpose of the hourly log is to provide information relating to how a flight student spends his time in various phases of training. In the present study, we are particularly interested in time allotment during the link phases of "Radio" and "Basic Instruments."

You will notice that the log sheets have been broken down into hourly periods covering an entire twenty-four hour period. We will specify those days for which we would like to have log sheets completed. It is suggested that in order to make these logs as accurate as possible, you designate certain times each day to work on them. For example, you might devote the periods just after lunch or supper, or just before hitting the rack to catching up your log. Please make it a point to account for every hour on the sheet. We don't expect extensive elaboration; just brief but specific descriptions of what you did. Keep in mind the following:

(1) For sleep periods, it will be sufficient to write in the word sleep.
(2) Designate meal periods as breakfast, lunch, or supper.
(3) You can use the term recreation to account for such activities as athletics, television, movies, dates, hobbies, bull sessions, etc.
(4) In listing a flight support lecture or a link hop, be sure to give the number of that particular lecture or hop.
(5) List any time spent just "waiting around."
(6) In listing study time or class preparation, always tell specifically what link hop, test, or class you are preparing for. This is very important.

HOURLY LOG

STUDENT'S NAME _____ _____ DATE _____

0001 - 0100	0100 - 0200	0200 - 0300	0300 - 0400	0400 - 0500	0500 - 0600
0600 - 0700	0700 - 0800	0800 - 0900	0900 - 1000	1000 - 1100	1100 - 1200
1200 - 1300	1300 - 1400	1400 - 1500	1500 - 1600	1600 - 1700	1700 - 1800
1800 - 1900	1900 - 2000	2000 - 2100	2100 - 2200	2200 - 2300	2300 - 2400

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13. ABSTRACT

This study evaluated the effectiveness of the Naval Basic Instrument Trainer (NavBIT) as it is currently used in the Basic and Radio Instrument Navigation Stages of Basic flight training. Findings are based on a detailed study of individual student reactions and on an intensive search of the pertinent literature.

The study indicates that the Naval Basic Instrument Trainer is doing an effective job as an aid to teaching instrument flight, and that the expenditure for a more elaborate simulator would not be justified in terms of increased effectiveness. It also points out that the students themselves feel that the link trainer is adequately fulfilling its basic purpose of teaching procedures, scan, and the reading of instruments.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Flight simulators Instrument flight training Synthetic trainer effectiveness Transfer of training Flight syllabus effectiveness						

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