AD-769 696

THE EFFECT OF PROLONGED NON-FLYING PERIODS ON PILOT SKILL IN PERFORMANCE OF A SIMULATED CARRIER LANDING TASK

Wayne Bruce Wilson

Naval Postgraduate School
Monterey, California

September 1973

AD 769 696

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE — READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER / 2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) The Effect of Prolonged Non-Flying Periods on Pilot Skill in Performance of a Simulated Carrier Landing Task	5. TYPE OF REPORT & PERIOD COVERED Master's Thesis September 1973 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Wayne Bruce Wilson	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940	12. REPORT DATE September 1973 13. NUMBER OF PAGES 41
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

proficiency flying
basic flight skills
degradation of basic flight skills
skill retention

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An experiment was undertaken to determine if a significant loss of basic pilot skill occurs during prolonged non-flying periods. "Current", "one-year stagnant" and "two-year stagnant" groups of jet qualified Naval Aviators were tested on a computer simulation of a carrier approach and landing. Performance by "currency" groupings was then analyzed.

Test subjects were subsequently re-assigned to "experience" groups, according to total actual flight hours accrued by each pilot. "Least experienced", "intermediate" and "most experienced" group performance was then compared.

Significant variables and important parameters in retention of pilot skills are discussed. In light of the experimental results, some possible "real-world" implications and suggestions are made by the author

19. Key Words (continued)

current vs. non-current Aviators
experience factor
carrier landing simulator
pilot proficiency
Replacement Air Group syllabus

AD 769696

NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

THE EFFECT OF PROLONGED NON-FLYING PERIODS
ON PILOT SKILL IN PERFORMANCE OF A
SIMULATED CARRIER LANDING TASK

by

Wayne Bruce Wilson

Thesis Advisor: D. E. Neil

September 1973

Approved for public release; distribution unlimited.

The Effect of Prolonged Non-Flying Periods on Pilot Skill in Performance of a Simulated Carrier Landing Task

by

Wayne Bruce Wilson
Lieutenant, United States Navy
B.S., United States Naval Academy, 1967

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

NAVAL POSTGRADUATE SCHOOL
September 1973

Author ______________________

Approved by: ______________________ Thesis Advisor

______________________ Second Reader

______________________ Chairman, Department of Operations Research and Administrative Sciences

______________________ Academic Dean

ABSTRACT

An experiment was undertaken to determine if a significant loss of basic pilot skill occurs during prolonged non-flying periods. "Current", "one-year stagnant" and "two-year stagnant" groups of jet qualified Naval Aviators were tested on a computer simulation of a carrier approach and landing. Performance by "currency" groupings was then analyzed.

Test subjects were subsequently re-assigned to "experience" groups, according to total actual flight hours accrued by each pilot. "Least experienced", "intermediate" and "most experienced" group performance was then compared.

Significant variables and important parameters in retention of pilot skills are discussed. In light of the experimental results, some possible "real-world" implications and suggestions are made by the author.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. BACKGROUND AND PURPOSE

Since the cessation of "proficiency flying" for military pilots undergoing lengthy courses of instruction, much concern has been voiced over the loss or degradation of basic flying skills. Prior to December, 1971, each designated pilot was required to log a minimum of four hours flight time per month in the interest of maintaining at least a reasonable degree of flight proficiency. More often than not, this "proficiency flying" was done in an aircraft that was not operational in the fleet and the missions flown in no way resembled a "standard" mission for an attack or fighter aircraft. In a survey conducted by Schrady and Hanley (Ref. 1) at the Naval Postgraduate School in 1971, almost 60% of the students flying the T-1A aircraft stated that "proficiency flying" (4 hours per month) did not maintain basic flight skills.

Many Naval Aviators undertake courses of instruction of two years or more. Considering the fact that "proficiency flying", be it good or bad, is now a thing of the past, it might prove fruitful to try to determine the amount of degradation in pilot skills over specified non-flying periods. Probably the most exact and demanding skill required of a Naval Aviator is that of landing aboard an aircraft carrier. By examining carrier landing proficiency of both current and non-current Naval Aviators, some measure of flight proficiency loss can be determined over various non-flying periods.

Although much research has been done in the field of skill retention, few studies have actually dealt with pilot proficiency. Naylor and Briggs (Ref. 2) divided skill retention variables into four sets; task variables, learning variables, retention interval variables and recall variables. Task variables are either discrete (procedural) or continuous (tracking), with a superior skill retention for continuous tasks. Learning variables investigate the relationship between the amount of original learning versus the amount of skill retention. In this vein, it has been proven that retention performance on a given task is enhanced by specific rather than general training. Thirdly, retention interval variables follow two basic premises; large decrements occur over extended periods of time and the largest decrement appears at the first retention trial. Finally, recall variables are variables having potential importance during recall of a learned skill. These include such factors as environmental conditions and warmup activity. The more accurately the retention test environment reflects the actual task performance environment, the greater will be the positive transfer of learned skills. Greater retention performance is also greatly enhanced by controlled warmup activity.

In the majority of the literature dealing with skill retention, the two most significant variables are 1.) the amount of original training, and 2.) the length of the retention interval. While the development of a clear-cut retention decrement function is all but impossible because of inconsistent initial conditions, some general trends can be observed. Ammons et al. (Ref. 2) found the absolute loss in performance to be the same, irrespective of initial competency, but proportional losses were greater for lesser trained groups. Mengelkoch et al. (Ref. 3) examined the forgetting of instrument flight skills using a flight simulator, and reached somewhat the same conclusion regarding absolute retention loss. He also found that better trained individuals quickly reached a higher level of competence than those with less training. A much greater decrement was noted in procedural tasks, as compared to tracking tasks. Fleischman's (Ref. 4) experiments also confirm that good retention of tracking tasks was evidenced up to two years, with initial proficiency being the determining factor in skill retention.

In attempting to measure such an abstract quantity as the decrement in pilot skills, without the use of an actual aircraft, simulation appears to be the logical choice. Some problems are inherent in the use of any simulation, however. The task must be unique enough to be modeled with some fidelity and enough subjects must be tested to achieve meaningful results. The latter is usually constrained by time and/or money factors.

A carrier approach landing simulation, such as the one developed by Kahrs and Redlin (Ref. 5) at the Naval Postgraduate School, combines elements of both procedural and continuous tasks. It tests overall recall of pilot skills in two dimensions: 1.) spatial accuracy and 2.) timeliness of response. The task is unique and is familiar to all jet carrier pilots. It requires recollection of the proper scan sequence and a recognition of the continuously changing parameters, which are inherent in any flying evolution. If a pilot is able to maintain a high degree of proficiency in carrier landing technique, which is one of the most demanding flying skills, it is a logical assumption that his overall retention of pilot skills is closely correlated.

Three complete carrier approaches and landings were "flown" by each pilot subject, with a subsequent grade computed for each "pass". Three basic groups of aviators were tested; "current" Fleet aviators, one-year "stagnant" pilots and two-year "stagnant" pilots. The purpose of this experiment was twofold:

1. To determine if there exists a significant decrement in basic pilot skills over one and two-year non-flying periods.

2. To determine the significance of the various skill retention variables in the loss of pilot proficiency.

If these two objectives are achieved, then certain conclusions can be drawn concerning pilot refresher training after prolonged non-flying periods. Areas for specific emphasis can be delineated and questions concerning the real value of proficiency flying can be addressed. One very germane application is the length of re-familiarization training in the Replacement Air Group (R.A.G.) for second tour pilots going back to the Fleet. A reduction in this typical five or six month evolution could result in tremendous savings in both dollars and manpower, as well as increased efficiency in the training of first-tour Aviators.

II. EXPERIMENTAL PROCEDURES

A. APPARATUS

The Carrier Approach Landing Simulator (Ref. 5) which was utilized is a hybrid computer simulation, incorporating a CI-5000 analog computer, an XDS-9300 digital computer and an ADAGE AGT-10 Graphics Processor. Aircraft motion equations are processed in the analog computer, while storage, control and display functions are handled by the digital system.

Control of the simulator is accomplished through a control stick and a throttle quadrant, mounted on a desk in front of the graphic display (Appendix F). Control inputs go directly to the CI-5000 analog computer for processing; the control loop is diagrammed in Figure 1. The stick is a Gemini Control Stick providing yaw, pitch and roll control and is mounted on the right arm of the chair, with an armrest provided. The control button on top of the stick is used to start, stop and/or abort a "run". The throttle plate and throttle are mounted on the left arm of the chair, along with another control button. Complete operating instructions can be found in Appendix H of reference 5.

The display on the graphics terminal is a computer-drawn picture, as illustrated in Figure 2. The presentation is an inside-out display depicting a runway/carrier deck, a landing mirror and a set of indexer lights, which are the three

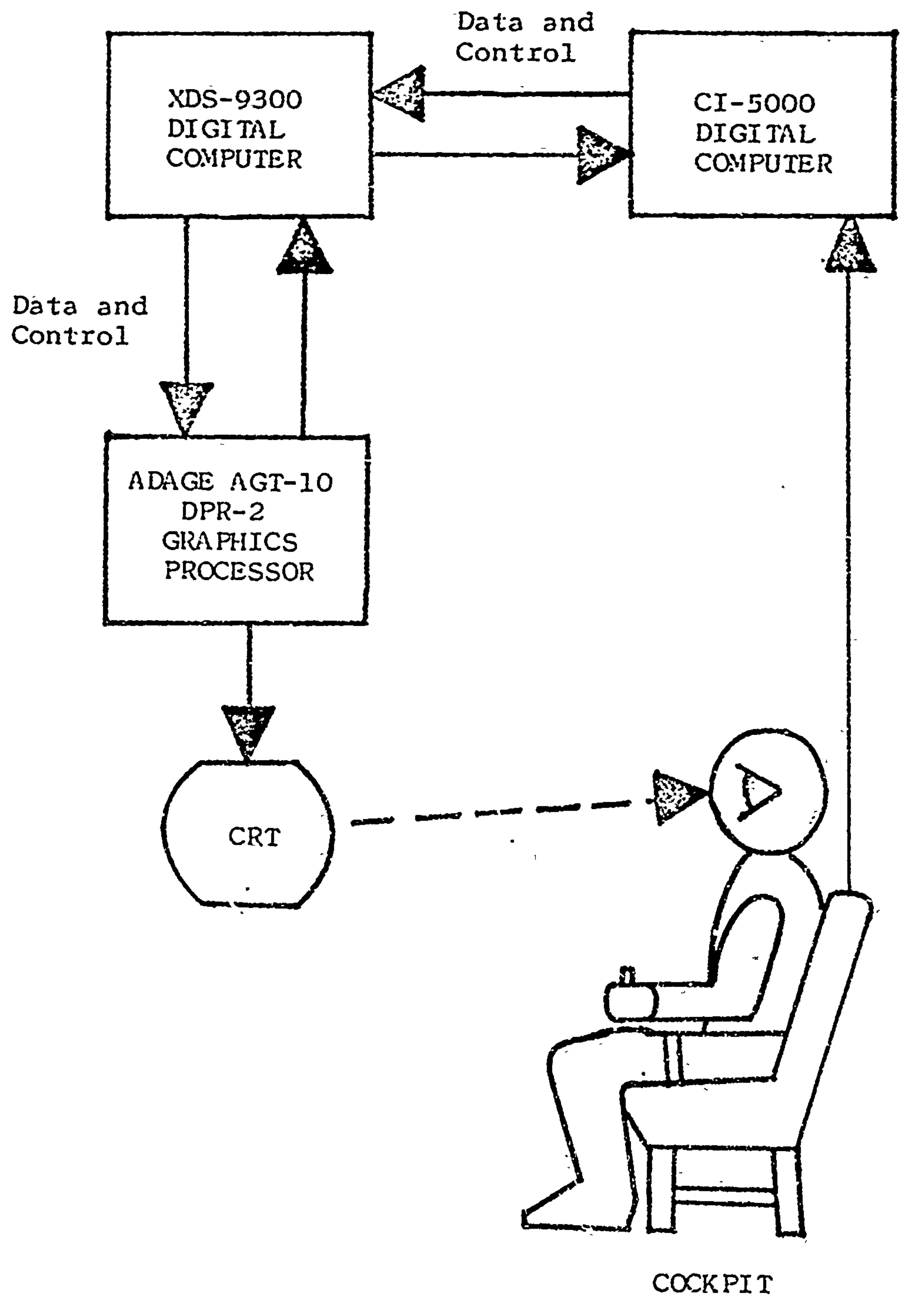


Figure 1. The Control Loop

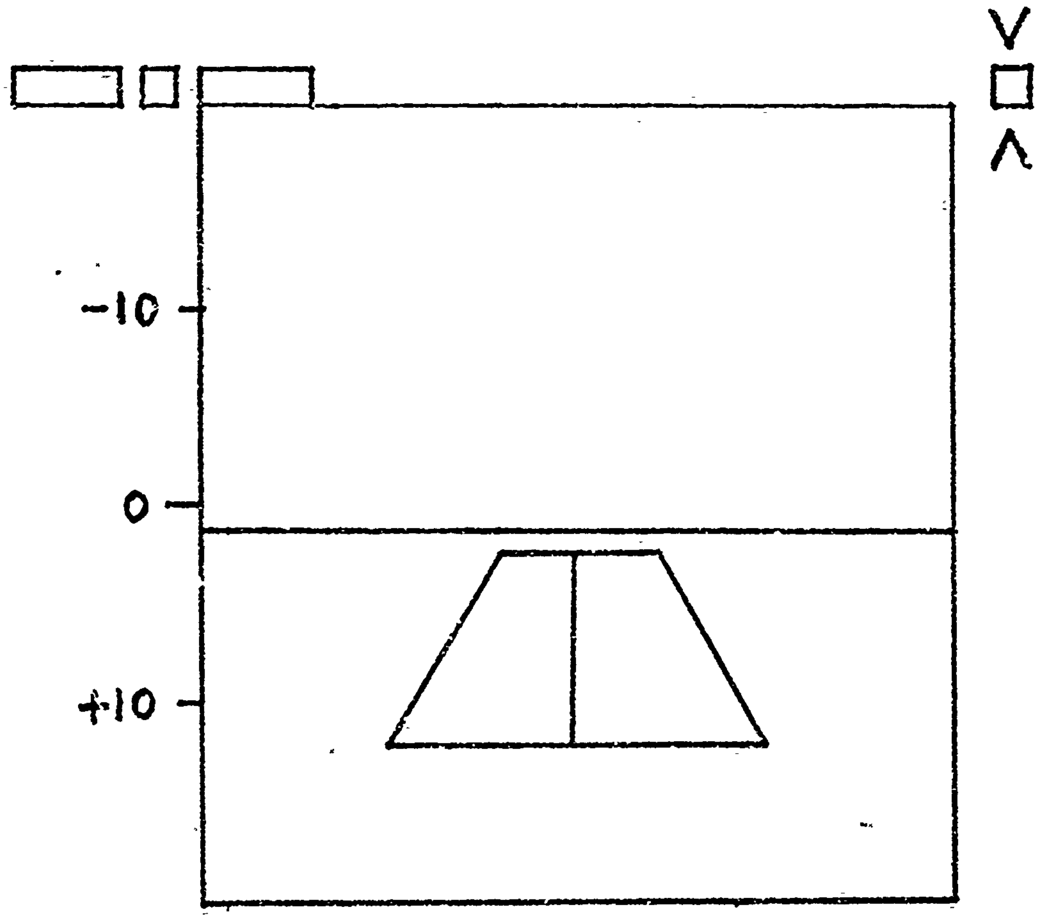


Figure 2. The Graphics Display

primary references used by the pilot in landing aboard a carrier. Pressing the button on top of the control stick starts the simulation. Initial conditions used in the test runs were as follows:

altitude - 1200 ft.

range - 2.9 miles to touchdown

speed - 250 kts.

glide slope - 3.25 degrees

wind velocity - 10 kts.

Various aircraft constants were also utilized to simulate the performance characteristics of an A-7 Corsair II aircraft. These parameters can be easily changed to suit the needs of the experimenter and a complete list of program options is provided in Ref. 5.

As the "run" progresses, the landing field/carrier deck grows progressively larger and visual cues give a definite closure effect, as well as a realistic optical perspective of the runway from right, left or on-centerline. The graphics display is updated by the analog computer at the rate of 18 frames per second, resulting in virtually no flicker.

At the completion of each landing/arrestment, the simulator analyzes and presents results on the graphics processor. Included are:

1. Sink rate at touchdown (ft./sec.)
2. Line-up (ft. right or left of centerline)

3. Airspeed (fast, little-fast, on-speed, little-slow, slow)

4. Landing result (crash, bolter or arrestment wire number)

The simulator can then be flown again with the same parameters, or inputs can be changed to alter the initial conditions or the flying characteristics of the simulated aircraft. A complete listing of the digital and analog programs, as written by Kahrs and Redlin can be found in Appendices A and B of Reference 5.

B. SUBJECTS

All subjects tested on the Carrier Approach Landing Simulator were designated Naval Aviators with backgrounds in attack or fighter-type jet aircraft. Each individual was carrier qualified as part of his original flight training and re-qualified on all subsequent squadron tours. All were either students at the Naval Postgraduate School (NPS) or the Naval Aviation Safety School in Monterey, California.

The fifteen subjects ranged in age from twenty-five to thirty-six and in rank from LTjg to Commander. The median age was 28.5 years and the "typical" subject was a Lieutenant with one squadron tour (2 to 3 years) and two carrier deployments (6 to 10 months each). Total flight time ranged from 300 to 3300 hours, with a median of 1600 hours. A breakdown, by type of aircraft last flown operationally,* is as follows:

---

*Two subjects have flown only in the Training Command.

AIRCRAFT	NO. OF SUBJECTS
A-7 CORSAIR II	6
A-6 INTRUDER	2
F-4 PHANTOM II	4
A-4 SKYRAIDER	2
TF-9 COUGAR	1

In order to determine the effects of prolonged non-flying periods on pilot skills in general, and carrier landing technique in particular, the subjects were divided into three distinct groups. Group I was classified as "current" Aviators; all had flown operationally within sixty days. Group II was labeled the "1-year" group; they had ceased operational flying 10 to 17 months previously. Group III was designated the "2-year" group; they had not flown operationally for 25 to 30 months. It was hypothesized that there would exist a significant difference in carrier landing ability between the three groups, with the largest decrement existing between Group I and Group II.

Additionally, the fifteen Aviators were broken into three categories, according to total flight hours. The five subjects with 1900 or more hours were classified as the most experienced group, while those five with less than 1100 total flight hours comprised the least experienced group. The remaining five Aviators were designated the intermediate group. If learning variables are indeed significant and if the amount of original training is the most significant variable in skill retention (Ref. 2), a higher degree of proficiency should be evidenced in the most experienced group. A complete breakdown of subjects is listed in Table 1.

C. METHOD

Prior to testing, each subject was given a brief explanation of the computer set-up and informed of the basic purpose and goals of the experiment. He was then required to fill out a short biography questionnaire and read the instruction sheet (Appendix C). One demonstration "run" was then flown by the experimenter to familiarize each subject with the equipment and display. Subsequently, three practice runs were flown by each Aviator, followed by three graded runs. A score was calculated for the landing at the completion of each run. A wave-off or aborted run was counted as one of the three graded runs, but no score was assigned.

D. GRADING PROCEDURE

At the completion of each run, the following information was displayed on the graphics processor: landing result, rate-of-descent, line-up and airspeed. A breakdown of scoring values is listed in Table 2.

Point totals were based on a perfect score of 100. As in the "real world", the target wire is number three and the object is to land as close to on-centerline as possible, while maintaining the correct landing airspeed. The pilot

TABLE I

BACKGROUND OF SUBJECTS

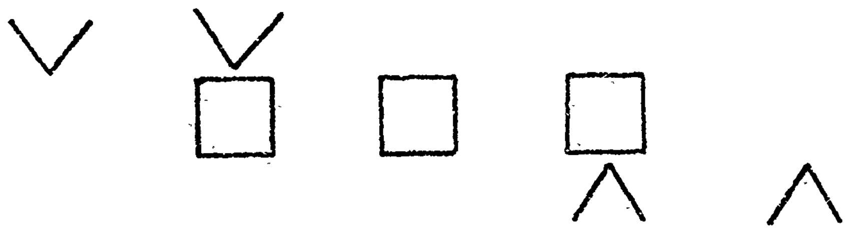
SUBJECT	TOTAL HOURS	RANK	AGE	TIME SINCE LAST OPERATIONAL FLIGHT	LAST OPERATIONAL AIRCRAFT
1	300	LT	25	16 months	TF-9
2	300	LTjg	26	25 months	TA-4
3	950	LT	27	27 months	A-6
4	970	LT	27	17 months	A-6
5	1050	LT	27	1 month	F-4J
6	1150	LT	28	30 months	A-7A
7	1200	LT	28	25 months	F-4B
8	1400	LT	27	2 months	A-7B
9	1500	LT	30	29 months	A-7E
10	1750	LT	28	1 month	F-4J
11	1900	LT	29	1 month	F-4J
12	2300	LT	28	2 months	A-7E
13	2900	LCDR	30	15 months	A-7E
14	3000	CDR	36	16 months	TA-4
15	3300	LCDR	31	10 months	A-7E

TABLE 2

SCORING PARAMETERS

SCORING PARAMETER	POSSIBLE OUTCOMES	POINTS ASSIGNED
LANDING RESULT	crash	0
	bolter	10
	1-wire	15
	2-wire	25
	3-wire	35
	4-wire	25
RATE-OF-DESCENT (at touchdown)	0 to 6.9 ft./sec.	5
	7.0 to 13.9 ft./sec.	10
	14.0 to 20.0 ft./sec.	5
LINE-UP (ft. from centerline)	0 to 9.9 ft.	25
	10.0 to 24.9 ft.	20
	25.0 to 49.9 ft.	15
	50.0 to 74.9 ft.	10
	greater than 75.0 ft.	0
AIRSPEED	slow	10
	slightly slow	20
	on-speed	30
	slightly fast	25
	fast	15

maintains landing airspeed by utilizing the angle-of-attack (AOA) indexer in the upper right hand corner of the display. The five possible states are slow, slightly slow, on-speed, slightly-fast and fast. These states correspond to the visual presentation in Figure 3, considering 0° as perfect.



STATES	SLOW	SLIGHTLY SLOW	ON-SPEED	SLIGHTLY FAST	FAST
RANGE OF AOA	greater than 2.0°	1.0° to 2.0°	1.0° to -1.0°	-1.0° to -2.0°	less than -2.0°

FIGURE 3. ANGLE OF ATTACK INDEXER STATES

Hitting the target (number three) wire is accomplished by keeping the "meatball" lined up with the datum lights (the two fixed rectangular boxes) all the way to touchdown. A centered-ball is illustrated in the upper left corner of Figure 2. Allowing the ball to go low will result in a two-wire, a one-wire, or a ramp strike, depending upon the degree. Similarly, as the ball rises above the centered position, the result is a four-wire or a bolter.

An optimum rate of descent for the simulation is between 10 and 11 ft./sec. Some deviation is allowed in this parameter to adjust for last minute corrections and lag in aircraft response to stick and throttle movements. A full ten points can be scored between 7.0 and 13.9 ft./sec. A rate of descent greater than 20.0 ft./sec. results in an extremely hard landing and automatically registers a crash on the simulator.

Because of the lack of adequate visual cues, a great deal of lee-way is permitted in the scoring of line-up. Maximum points can be obtained up to 10 feet either side of centerline, while some points are scored out to 75 feet. In actuality, line-up tolerances are much more stringent aboard a carrier.

III. DISCUSSION OF RESULTS

Table 3 summarizes the total scores obtained by pilot subjects on each of the three graded runs. A mean score per subject and per group was also calculated. In comparing the group means, a small decrement was evidenced between the current and the "1-year" group, while the "1-year" and "2-year" stagnant groups performed almost identically. An analysis of variance (Table 4) showed no significant difference between the three "currency" groups. Within subjects, the trials were not significant (no learning effect) and the trials by "currency" interaction was significant only at the 0.1 level.

TABLE 4

ANALYSIS OF VARIANCE COMPARING OVERALL TASK PERFORMANCE BETWEEN "CURRENT", "1-YEAR STAGNANT" AND "2-YEAR STAGNANT" GROUPS

SOURCE	SS	df	ms	F	p
TOTAL	8538.75	44	-	-	-
BETWEEN SUBJECTS	2831.46	14	-	-	-
CURRENCY	154.36	2	77.18	.34	n.s.
ERROR	2677.10	12	223.09	-	-
WITHIN SUBJECTS	5707.29	30	-	-	-
TRIALS	552.69	2	246.34	1.75	n.s.
TRIALS X CURRENCY	1385.45	4	346.36	2.20	$< .10$
ERROR	3769.15	24	157.04	-	-

TABLE 3

TEST RESULTS BY TRIALS, MEAN SCORE BY SUBJECT, GROUP MEAN: CURRENT VS. 1-YEAR STAGNANT VS. 2-YEAR STAGNANT GROUPS

GROUP	SUBJECT	TRIALS			MEAN	GROUP MEAN
		1	2	3		
	1	85	75	55	71.7	
	2	65	-	80	72.5	
CURRENT	3	80	70	75	75.0	70.2
	4	60	70	65	65.0	
	5	60	75	65	66.7	
	1	60	0	-	30.0	
	2	65	60	65	63.3	
1-YEAR STAGNANT	3	75	-	-	75.0	65.3
	4	85	75	90	83.3	
	5	60	70	-	65.0	
	1	55	60	60	58.3	
	2	55	60	90	68.3	
2-YEAR STAGNANT	3	75	65	60	66.7	66.7
	4	65	75	-	70.0	
	5	70	70	-	70.0	

While this result was surprising, it was not wholly unexpected. In an attitude-gyro recognition experiment performed by Smittle (Ref. 6), the same results were obtained. No significant degradation of pilot skills appears to have occurred for "stagnant" pilots in either test. Two possible explanations can be forwarded:

1. Overall pilot performance is not adversely affected to any great degree in non-flying periods up to 30 months.

2. Overall pilot performance is degraded by non-flying periods; degradation is restricted primarily to loss in discrete (procedural) tasks, with little or no decrement in continuous (tracking) tasks for non-flying periods up to 30 months.

The second explanation appeared more palatable and served to explain certain other observations made during the testing phase of the experiment. "Current" pilots performed significantly better on the first trial run, than did "non-current" pilots, although no scores were recorded and tabulated. By the end of the third trial run, however, the "stagnant" Aviators had refreshed their procedural skills adequately to compete on a par with "current" Aviators. A satisfactory scan pattern was re-established and procedural knowledge relating to sequence and degree of proper control stick and throttle adjustments was re-acquired. The actual graded runs for the three groups did not differ significantly, as a result.

Since procedural type skills are lost quickly in non-flying periods, this serves to explain much of the dissatisfaction with the old "proficiency flying" program. Pilots felt unsafe primarily because they doubted their ability to retain all of the multitudinous emergency, safety and standard operating procedures; they did not doubt their actual flying ability, per se. Skills acquired over the years in aircraft handling techniques are not easily forgotten; flying once or twice a month does lead to lapses in procedural tasks, however. A quick scan through the aviation accident reports bears out the fact that the majority of accidents attributed to pilot-error are related to a procedural or judgemental error, and not to actual flying technique.

Since no significant difference was noted in group performance for the various non-flying periods, another grouping was made according to total flight experience. Three groups were formulated as follows:

0 - 1100 total flight hours = LEAST EXPERIENCED

1100 - 1900 total flight hours = INTERMEDIATE

1900 - 3300 total flight hours = MOST EXPERIENCED

Since the amount of initial training is the most important variable associated with skill retention (Ref. 2), an increase in overall proficiency by "experience" groups should be evident. Table 5 is a breakdown of scores, subject means and group means, for the "experience" grouping. A large improvement in group means was noted between the "least experienced" and the other two groups.

An analysis of variance (Table 6) confirmed that the difference between group means was significant ($p < .150$) and that pilots having greater than 1100 total flight hours

TABLE 5

TEST RESULTS BY TRIALS, MEAN SCORE BY SUBJECT, GROUP MEAN: LEAST EXPERIENCED VS. INTERMEDIATE VS. MOST EXPERIENCED GROUPS

GROUP	SUBJECT	TRIALS 1	TRIALS 2	TRIALS 3	MEAN	GROUP MEAN
LEAST EXPERIENCED	1	60	0	-	30.0	58.3
	2	55	60	60	58.3	
	3	55	60	90	68.3	
	4	65	60	65	63.3	
	5	85	75	55	71.7	
INTERMEDIATE	1	75	65	60	66.7	70.8
	2	65	75	-	70.0	
	3	65	-	80	72.5	
	4	70	70	-	70.0	
	5	80	70	75	75.0	
MOST EXPERIENCED	1	60	70	65	65.0	71.0
	2	60	75	65	66.7	
	3	75	-	-	75.0	
	4	85	75	90	83.3	
	5	60	70	-	65.0	

performed better than the less experienced pilots. The lack of greater significance between groups was attributed to the fact that even in the least experienced group, the pilots had flown literally hundreds of practice carrier landings with an average of over 100 actual carrier landings per man. The effect of the learning variable becomes asymtotic after a great number of practice runs. A much more pronounced difference should be evidenced if a group of newly designated or student pilots could be tested. This is a potentially productive area for further study.

TABLE 6

ANALYSIS OF VARIANCE COMPARING OVERALL TASK PERFORMANCE BETWEEN "LEAST EXPERIENCED", "INTERMEDIATE" AND "MOST EXPERIENCED" GROUPS

SOURCE	SS	df	ms	F	p
TOTAL	1931.10	14	-	-	-
BETWEEN GROUPS	529.26	2	264.63	2.26	$<.150$
WITHIN GROUPS	1401.84	12	116.82	-	-

One further attempt was made to validate the previous conclusions. Pilots were divided into "current" or "non-current" categories, using sixty days (since the last operational flight) as the cutoff. These two groups were then segregated according to the "experience groups" defined previously; i.e., least experienced, intermediate and most experienced. An analysis of variance using the two-factor factorial design was then performed, utilizing the test scores of each individual subject (TABLE 7).

TABLE 7

ANALYSIS OF VARIANCE COMPARING "CURRENT" AND "STAGNANT" AVIATORS BY EXPERIENCE GROUPS

SOURCE	SS	df	ms	F	p
TOTAL	7926.97	37	-	-	-
BY EXPERIENCE	970.42	2	485.21	2.55	$<.10$
BY "CURRENCY"	203.01	1	203.01	1.07	n.s.
EXP. X CURR.	673.30	2	335.65	1.77	$<.20$
ERROR	6082.24	32	190.07	-	-

As in the previous analyses, "experience" was found to be a significant factor ($p < .10$), while "currency" of the individual pilots was not. An experience by currency interaction was significant only at the .20 level. The lack of a more significant interaction can be explained partially by the strong learning effect (procedural tasks) during the three trial runs.

The results of the three analyses suggest that total flight experience is a much more important parameter than currency, in predicting task performance on the carrier landing simulator. Since the simulator has been generally credited with high task fidelity by the test subjects, some real-world implications should be addressed.

Present re-training programs for "experienced" Aviators are based (approximately) on a five month cycle. This is not significantly less than the training cycle of a newly designated Aviator. Since "experience" has proven to be the dominant variable in pilot skill retention and because the only significant degradation noted in overall pilot skill was in the realm of procedures, perhaps the Replacement Air Group (RAG) syllabus for "experienced" (second and third tour) pilots should be re-examined. A greater concentration on ground training (classroom, Link trainers, emergency procedure trainers, etc.) might alleviate the requirement for a great number of training flights, and result in the same end product. Decreasing the required flight syllabus by even a small number of "hops" could result in substantial savings in both operating and support costs, as well as increased efficiency in processing Aviators through the RAG and on to their Fleet squadrons. Keeping flight safety considerations foremost, a re-evaluation of present syllabus requirements in the various Replacement Air Groups appears warranted.

IV. SUMMARY

An experiment was undertaken to determine if a significant loss of basic pilot skill occurs during prolonged non-flying periods. "Current", "1-year stagnant" and "2-year stagnant" groups of jet Naval Aviators were tested on a Carrier Approach Landing Simulator. No significant difference in overall performance was noted among the three "currency" groups. Lack of significant degradation in pilot skill was attributed to refreshment of procedural skills during practice runs by "non-current" pilots. No loss of continuous (tracking) skills was evidenced for non-flying periods of up to 30 months.

Subjects were subsequently reassigned to a "least experienced", "intermediate", or "most experienced" group, according to total flight hours. The "experience" factor was found to be significant in group performance, with more experienced pilots performing better.

The results of the experiment suggest that the "experience" factor outweighs "currency" in task performance on the Carrier Approach Landing Simulator. Additionally, while tracking skills (pilot technique) are essentially retained during prolonged non-flying periods, procedural tasks may be susceptable to significant degradation.

In light of these results, the author believes that a re-evaluation of the current Replacement Air Group syllabus for "experienced" pilots is warranted. A greater emphasis on procedural training and a possible reduction in syllabus flights might result in the same end product, with substantial savings in dollars and manpower.

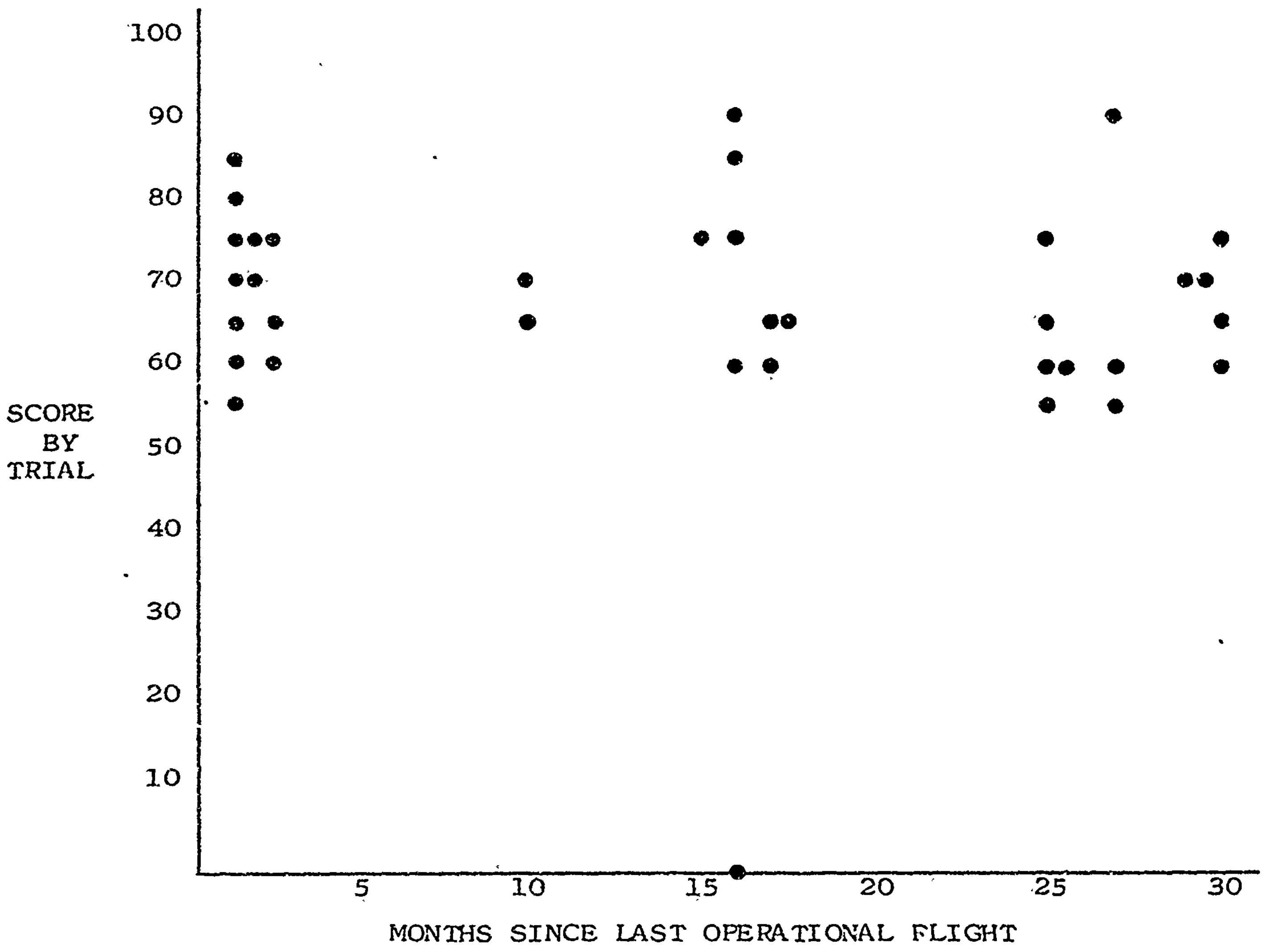
APPENDIX A

BACKGROUND AND PERFORMANCE OF SUBJECTS

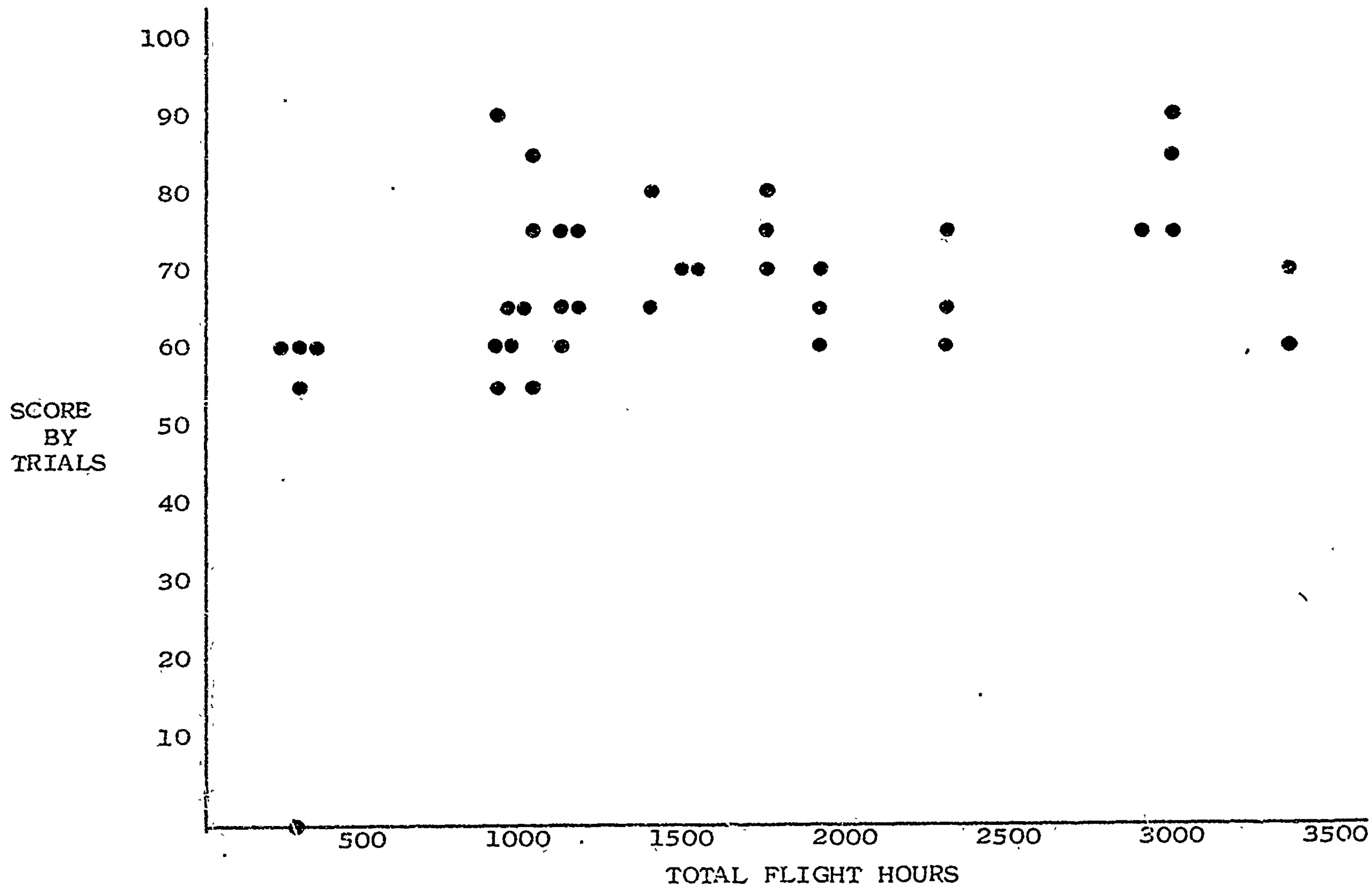
SUBJECT	TOTAL FLIGHT HOURS	TIME SINCE LAST OPERATIONAL FLIGHT (MONTHS)	MEAN SCORE FOR THREE TRIALS
1	300	16	30.0
2	300	25	58.3
3	950	27	68.3
4	970	17	63.3
5	1050	1	71.7
6	1150	30	66.7
7	1200	25	70.0
8	1400	2	72.5
9	1500	29	70.0
10	1750	1	75.0
11	1900	1	65.0
12	2300	2	66.7
13	2900	15	75.0
14	3000	16	83.3
15	3300	10	65.0

APPENDIX B

OVERALL TASK PERFORMANCE BY "CURRENCY"



OVERALL TASK PERFORMANCE BY "EXPERIENCE"



APPENDIX C

INSTRUCTIONS TO TEST SUBJECTS

You are about to participate in an experiment designed to test your current or retained skill in landing a jet aircraft aboard an aircraft carrier. The simulator you will fly is designed to exhibit the aerodynamic characteristics of an A-7 aircraft. You will use the control stick and throttle mounted on the desk as your inputs to the simulator. The graphics display you will see in front of you is an inside-out display, comparable to what you would see from an actual aircraft. You will fly a straight-in approach to a landing, using the simulated mirror landing system and "meatball" at the upper left of the display. The standard angle-of-attack indexer is located at the top right of the screen. Attempt to fly an on-speed approach and centered ball to touchdown, using the runway centerline for your line-up. As in the "real world", your scan should be "meatball", line-up, angle-of-attack.....

You will be given three practice runs followed by three graded runs for your score. Your score for each run will be determined from a weighted multiple of the following: 1) airspeed at touchdown 2) line-up (feet from centerline) 3) landing result (crash, bolter, 1, 2, 3, or 4 wire) and 4) rate of descent at touchdown. A rate of descent greater than 20 ft./sec. will automatically register a crash.

Because of the slight negative stability of the simulator, you will find it to your advantage to make small control movements. Additionally, you should concentrate your efforts on maintaining correct airspeed and a centered ball in-close, as line-up counts only 25% of your total score.

Do you have any questions? If not, press the button on the throttle quadrant to receive the display.

APPENDIX D

SUBJECT IN POSITION
TO BEGIN A RUN

THE "COCKPIT" SIMULATOR

BIBLIOGRAPHY

1. Hanley, M.J., Investigation of the Effects of Increased Flying Hours on Naval Postgraduate School Aviator Skill, Knowledge and Satisfaction; A Comparative Analysis, Masters Thesis, Naval Postgraduate School, Monterey, 1971.

2. National Aeronautics and Space Administration D180-15080-1, Degradation of Learned Skills; A Review and Annotated Bibliography, by G.F. Gardlin and T.E. Sitterly, June 1972.

3. Mengelkoch, R.F., Adams, J.A., and Gainer, C.A., "The Forgetting of Instrument Flight Skills," Human Factors, v. 13(5), p. 397-405, May 1971.

4. Fleischman, E.A., and Parker, J.F., "Factors in the Retention and Relearning of Perceptual-Motor Skills," Journal of Experimental Psychology, v. 64(3), p. 215-226, March 1962.

5. Kahrs, J.H., A Fixed-Base Variable-Stability Carrier Approach Landing Simulator, Masters Thesis, Naval Postgraduate School, Monterey, 1972.

6. Smittle, J.H., "Current" vs "Stagnant" Jet Pilots' Response Times: A Comparison, Masters Thesis, Naval Postgraduate School, Monterey, 1973.

7. Bruning, J.L. and Kintz, B.L., Computational Handbook of Statistics, Scott, Foresman and Company, 1968.

8. Dixon, W.J. and Massey, F.J., Introduction to Statistical Analysis, 3rd ed., McGraw-Hill, 1969.