PROOF OF THE PUDDING!
A REPORT ON
THE SCIENTIFIC EVALUATION
OF THE
LINK SNJ OPERATIONAL TRAINER
AS AN AID IN
CONTACT FLIGHT TRAINING
Conducted by
THE UNIVERSITY OF ILLINOIS
Department of Psychology
FOREWORD...

For a long time all those interested in flight training have agreed that the use of "synthetic flight" trainers has a certain qualitative value in teaching students to fly. The only lack of unanimity has been in the quantitative degree to which that value was effective.

Now an evaluation concluded at the University of Illinois in mid-June, 1949, furnishes a definite, tangible figure of measurement and proof. The results forcibly substantiate previous surmise by demonstrating, in flat, cold figures, the effectiveness of a "synthetic flight" trainer in contact flight training.

This effectiveness is highlighted by the superior performance of students trained in the "synthetic flight" trainer, as compared to the performance of students trained in aircraft only, in achieving an identical standard of proficiency.

The trainer students' records showed that they:

- Required 874 fewer trials --- a 62% saving
- Made 1511 less errors --- a 73% saving
- Took 43:36 less air hours --- a 62% saving - than the aircraft group.
This evaluation was conducted at the University of Illinois Institute of Aviation during 1949.

by Dr. A. C. Williams, Jr., University of Illinois, a seasoned civilian pilot, veteran Naval Air Force flight instructor, and transport pilot, now consultant psychologist to USAF, Navy Special Devices Center, and National Research Council, and Ralph E. Flexman, a former AAF flight instructor now with the University of Illinois Institute of Aviation and a graduate student in the Department of Psychology.

University of Illinois.
PURPOSE...

This evaluation was made in order to ascertain if certain aspects of basic contact flight training could be learned successfully in a "synthetic flight" trainer.
EQUIPMENT...

The Link SNJ Operational Trainer

Trainer Instructor's Station

Trainer Cockpit - Front View

The SNJ (T-6) Aircraft
EVALUATION PROCEDURE...

The test groups were chosen in the following manner:

- 12 students, none with previous flight instruction, were chosen from the student population of the University of Illinois.
- Each student was given the Bennett Test of Mechanical Comprehension, Form BB, a test known to correlate with ability in primary flight training.
- The students were divided into two groups of six each, according to their test scores, in an attempt to equate the flying ability of the two groups:
  - Trainer Group - performed maneuvers both in Link SNJ Operational Trainer and in aircraft.
  - Control Group - performed maneuvers in aircraft only.
FLIGHT SYLLABUS...

The syllabus includes cockpit procedure, basic contact air work, traffic pattern flying:

1. 13 exercises — each learned in turn.

2. 370 individual items — students' proficiency checked and scored on each item.

3. 12 hours air time — time required simply to learn exercises the first time.

4. Effect of flight, power, and trim controls — 31 items

5. Visual cockpit check — Time measurement

6. Blindfold cockpit check — Time measurement

7. Starting procedure — 17 items

8. Engine run-up check — 26 items
Return to straight and level flight from normal and abnormal attitudes - 20 items.

Climbing and gliding turns to altitude - 39 items.

Straight, level flight at normal, slow, fast cruise - 26 items.

Level turns-90-360, shallow, medium, steep banks-38 items.

Normal stalls, power on-off, straight ahead, climbing, gliding attitudes-99 items.

Straight climbs and glides - 33 items.

Flying traffic pattern-29 items.

Entry to traffic pattern-12 items.
A TYPICAL EXERCISE...

<table>
<thead>
<tr>
<th>EXERCISE #10 - CLIMBING AND GLIDING TURNS TO ALTITUDES</th>
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<tbody>
<tr>
<td><strong>NAME</strong></td>
</tr>
<tr>
<td><strong>DATE</strong></td>
</tr>
<tr>
<td><strong>TIME EXERCISE STARTED</strong></td>
</tr>
<tr>
<td><strong>TIME EXERCISE ENDED</strong></td>
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<tr>
<td><strong>TOTAL TIME FOR EXERCISE</strong></td>
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</tbody>
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<table>
<thead>
<tr>
<th>ENTRY</th>
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<tbody>
<tr>
<td>STRAIGHT CLIMB ATTITUDE ESTABLISHED</td>
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| INCREASE RPM TO 2100 |
| INCREASE M/P TO 30° |
| TURN - 2 NEEDLE (± ½) |
| RUDDER AND AILERON COORDINATED |

| CARBURATOR HEAT ON |
| ENTRY TO GLIDING TURN |
| GLIDING ATTITUDE ESTABLISHED (100 MPH) |
| TURN ATTITUDE ESTABLISHED - 3 NEEDLE (± ½) |
| RUDDER AND AILERON COORDINATED |

<table>
<thead>
<tr>
<th>ALTIMETER</th>
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<tbody>
<tr>
<td>ALTITUDE - 1500'</td>
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<table>
<thead>
<tr>
<th>SOFT LANDING</th>
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<tbody>
<tr>
<td>WINGS LEVEL</td>
</tr>
<tr>
<td>ELEVATOR, AILERON, AND RUDDER COORDINATED</td>
</tr>
<tr>
<td>DECREASE M/P TO 25°</td>
</tr>
<tr>
<td>DECREASE RPM TO 1850</td>
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<table>
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<tr>
<th>ALTITUDE - 1500'</th>
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<tbody>
<tr>
<td>RUDDER AND AILERON COORDINATED</td>
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<tr>
<td>DECREASE RPM TO 1850</td>
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Scoring Record
TOLERANCES USED...

Reference to calibrated instruments provided an objective check on tolerances.

- **Power Adjustment**: $\pm \frac{1}{2}''$ Hg manifold pressure; $\pm 50$ rpm
- **Directional Control**: $\pm 10^\circ$
- **Aileron-Rudder Coordination**: $\pm \frac{1}{2}$ ball
- **Bank**: $\pm 5^\circ$ (on artificial horizon)
- **Altitude**: $\pm 50'$ (100' in steep turns)
- **Airspeed**: $\pm 10$ mph

STANDARD OF PROFICIENCY REQUIRED...

Students were required to perform three consecutive trials per exercise:

- A trial was the performance of a complete exercise.
- An errorless trial was made when all the items in an exercise were performed within the tolerances established.
CONDUCTING THE EXERCISES...

Each exercise in turn was learned and repeated until the student achieved the established standard of proficiency:

Trainer group learned each exercise first in the trainer, then in aircraft.

Instructor influence was held to a minimum:

- The same instructor handled both groups throughout the syllabus.
- The instructor gave one demonstration at the start of each exercise; infrequent later demonstrations were given as needed — they were counted as trials.
- Upon completion of a trial containing errors, the instructor pointed them out and suggested means of correction.
- If a trial was errorless, the instructor made no comment.
SCORING AND RECORDING STUDENT PERFORMANCE...

Performance on each item was scored with relative objectivity by reference to calibrated instrument readings.

Scoring was done by recording:

- Number of trials
- Number of errors
- Amount of time

required by student to reach established standard of proficiency.
RESULTS...

TRIALS REQUIRED
- Trainer Group: 1318 Total
- Control Group: 1418 (in Aircraft) 1418 Total

ERRORS MADE
- Trainer Group: 1410 Total
- Control Group: 1407 (in Aircraft)

TIME REQUIRED (IN HOURS)
- Trainer Group: 75:17 Total
- Control Group: 70:33 (in Aircraft)

COST OF TRAINING

<table>
<thead>
<tr>
<th>Group</th>
<th>Aircraft Cost</th>
<th>Trainer Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trainer</td>
<td>$1347.50</td>
<td>$995.00</td>
<td>$1572.50</td>
</tr>
<tr>
<td>Control</td>
<td>$3572.50</td>
<td></td>
<td>$3572.50</td>
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Aircraft Cost-$50 per hour
Trainer Cost-$5 per hour
SUMMARY...

TRAINER GROUP

1. REQUIRED 874 FEWER TRIALS - A 62% SAVING
2. MADE 1511 FEWER ERRORS - A 75% SAVING
3. TOOK 43:36 LESS AIR HOURS - A 62% SAVING

THAN CONTROL GROUP!

On a 12-hour Syllabus
ANALYSIS OF RESULTS...

The reliability of the observed difference between the Trainer Group and the Control Group was tested by appropriate methods* (the "χ²" test of significance; the "t" test) and revealed that:

The difference between groups can be attributed to:

THE EFFECT OF THE LINK SNJ OPERATIONAL TRAINER.

*See Technical Report --- Special Devices Center 71-16-3 by the University of Illinois Department of Psychology, July, 1949.
INTERPRETATION OF RESULTS...

While it is safe to expect that similar results would be found with other and larger sample groups, they could be expected only if the following conditions under which they were obtained were similar:

1. The trainer used must accurately simulate, both in cockpit configuration and in flight characteristics, the aircraft to be used.

2. The same instructor should teach the students both in the trainer and in the aircraft.

3. Standards of proficiency which can be measured objectively by reference to calibrated instruments must be agreed upon before instruction starts.

4. A detailed objective method of recording student performance must be maintained.
APPLICATION OF RESULTS TO ROUTINE FLIGHT TRAINING...

This evaluation demonstrates the effectiveness of the Link SNJ Operational Trainer as used in teaching cockpit procedure, basic contact air work, and traffic pattern flying, which are parts of a complete syllabus.

The effectiveness of the Link SNJ Operational Trainer, as shown in this evaluation, suggests the following:

. The trainer can be used profitably throughout the entire contact flight training syllabus.

. The SAVINGS found would be increased in proportion to the increased use of the trainer throughout the syllabus.

. If instrument flying training is included in a basic contact flight syllabus, the SAVINGS already found for contact work would be increased by at least 60% of the time allotted for instrument training.
CONCLUSION...

The findings of this evaluation are of immediate and paramount importance to those concerned with flight training because:

- The practical application of these findings will result in a SAVING of:
  - MONEY
  - TIME
  - LIVES