COMPARISON OF STUDENT PILOT PERFORMANCE IN SUCCESSIVE CHECK FLIGHTS AS MEASURED BY PHOTOGRAPHIC RECORDS

by

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A statistical analysis conducted at the University of Rochester, Rochester, New York, on photographic records from the University of Pennsylvania Project as part of the Midwest-Navy Training Project, by means of a grant-in-aid from the National Research Council Committee on Selection and Training of Aircraft Pilots from funds provided by the Civil Aeronautics Administration.

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Committee on Selection and Training of Aircraft Pilots

Executive Subcommittee

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NATIONAL RESEARCH COUNCIL

2101 Constitution Avenue, Washington, D. C.
Division of Anthropology and Psychology
Committee on Selection and Training of Aircraft Pilots

March 27, 1946

Dr. Dean R. Brimhall
Director of Research
Civil Aeronautics Administration
Room 3895, Commerce Building
Washington 25, D. C.

Dear Dr. Brimhall:

Attached is a report entitled Comparison of Student Pilot Performance in Successive Check Flights as Measured by Photographic Records, by Seymour Wapner, Leon Festinger, and Henry S. Odbert. This report is submitted by the Committee on Selection and Training of Aircraft Pilots with the recommendation that it be included in the series of technical reports issued by the Division of Research, Civil Aeronautics Administration.

The photographic records were collected in connection with the Midwest-Navy Training Project. These records were analyzed to assess the consistency of student pilot performance in successive check flights, and the degree to which improvement or lack of improvement occurred from first to second flights.

The findings, although not definitive because of the small samples used, indicate the need for extreme caution in accepting a single flight test as representative of a pilot's proficiency. The study has furnished evidence that measures of some aspects of performance at the end of primary training are much more consistent than others. Further research is needed to identify those aspects which can be measured with highest reliability and for combining such measures into an over-all measure of flight proficiency.

Cordially yours,

Morris S. Viteles, Chairman
Committee on Selection and
Training of Aircraft Pilots
National Research Council

MSV:rm

EDITORIAL FOREWORD

This report presents an analysis of research data collected as part of an extensive study known as the Midwest-Navy Training Project. Many persons have participated in designing the project, obtaining the records, and analyzing the results. The 1943-44 Midwest-Navy Training Project was designed by M. S. Viteles, R. Y. Walker, and R. C. Rogers, with the assistance of A. S. Thompson, E. S. Ewart, and H. S. Odbert, and with the guidance and assistance of the Executive Subcommittee and of the CAA Division of Research, D. R. Brimhall, Director. Data were collected by R. Y. Walker, S. V. Bennett, Edward Girden, and E. S. Ewart. Opportunity to collect data from schools participating in the War Training Service, as well as the services of a number of CAA flight inspectors who served as check pilots, was provided by the Civil Aeronautics Administration through the efforts of D. R. Brimhall. Subjects for the study were made available through the courtesy of the U. S. Navy.

The procedures for obtaining the photographic records of flight performance, with which the present report is specifically concerned, were developed as a part of the University of Pennsylvania Project. The procedures for tabulating and analyzing the specific data pertinent to the reliability study were planned by M. S. Viteles, A. S. Thompson, and E. S. Ewart. Photographic records were read by a staff of eight workers at the Institute of Aviation Psychology, University of Tennessee, under the supervision of E. S. Ewart. The analysis of the reliability data was planned by the staffs of the Statistical Unit, University of Rochester, and of the University of Pennsylvania Project. The analysis was carried out by the Statistical Unit at the University of Rochester.

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SUMMARY

Photographic records of a special instrument panel were obtained while student pilots with approximately 35 hours of training executed two successive check flights. Records of 16 maneuvers in each flight were analyzed during slow-motion projection, and readings of specific aspects of performance were recorded on check sheets. Readings were obtained on Average Airspeed, Revolutions per Minute (RPM), Airspeed Variation, Average Bank, Altitude Gain or Loss, Altitude Variation, Maximum Rate of Climb, and Ball Bank Deviations.

These records made it possible to compare performance on successive flights without depending upon observer judgments, which are frequently of low reliability. The data were analyzed to obtain information on two basic questions:

1. The consistency of student pilot performance from flight to flight in terms of correlations between the two flights.

2. Differences between the two flights, particularly with respect to possible improvement from first to second flight.

Preliminary analyses of the data revealed significant differences in records obtained from the two planes used in the study (both were Piper Cubs, one powered by a Franklin motor and one by a Continental motor). There were also indications that records obtained at different times of the year were not comparable. The data were therefore fractionated into six sub-groups.

The results of the investigation were as follows:

1. Of the nine aspects of performance studied, only three (Average Airspeed, Average Bank, and RPM) yielded correlations of any appreciable size when a single measure in the first flight was correlated with the corresponding single measure in the second flight. These appear to represent less complex aspects of performance which may become relatively fixed early in training and are not as predominantly associated with "skill" as are other items in the analysis.

2. When corresponding measures on several maneuvers were summated for each flight, correlations tended to be somewhat higher than the median correlations on single maneuvers. In most cases the degree of consistency was so slight that many measures would have to be taken to obtain a score of adequate reliability.

3 Items related to smoothness of performance (Variation in Airspeed, Bank, Altitude, etc.) exhibited generally low levels of consistency.

4. Comparison of the two flights in terms of mean scores on each of the items revealed little evidence of significant change in the direction of either improvement or decline in performance from first to second flights.

These results, although not definitive because of the small samples used, indicate the need for extreme caution in accepting a single flight test as representative of a pilot's proficiency. The study has furnished evidence that some aspects of performance are much more consistent than others at the end of primary training. Further efforts should be made to identify those aspects which can be measured with highest reliability, and methods should be developed for combining such measures into an over-all measure of flight proficiency.

COMPARISON OF STUDENT PILOT PERFORMANCE IN SUCCESSIVE CHECK FLIGHTS AS MEASURED BY PHOTOGRAPHIC RECORDS

INTRODUCTION

One troublesome problem in the evaluation of flight performance is the extent to which performance during a single flight test is representative of the actual proficiency of the pilot. Clearly, aspects of performance which exhibit marked variability from flight to flight cannot be reliably evaluated on the basis of a single flight by a given pilot. It has been extremely difficult to obtain evidence as to the reliability of pilot performance from check pilots or observers, even under conditions in which the administration of the test flights is carefully controlled. (If a single check pilot administers successive test flights, his subjective evaluation of a student pilot's performance on the first flight may influence his evaluation of performance on succeeding flights.) On the other hand, if different check pilots are employed on successive flights it is difficult to determine whether differences in their evaluation of the respective test flights are due to differences in the evaluative standards of the observers[1] or to differences in the performances of the subjects.

The 1943-44 Midwest-Navy Training Project of the Committee on Selection and Training of Aircraft Pilots provided a unique opportunity to determine the consistency of student pilot performance in two successive check flights, since the two flights can be analyzed from objective photographic records, thereby eliminating the check pilot variable. This report describes an analysis of the photographic records of the two flights, which was undertaken to answer the following questions:

1. How consistently does a student pilot near the end of primary training perform during two successive check flights with no intervening flying?

2. Were there significant changes in performance from first to second flights?

SOURCE OF DATA

Design of the Midwest-Navy Training Project. The Midwest-Navy Training Project was concerned not only with the consistency of student performance on successive check flights, but also with other problems, including the effectiveness of two training aids (the Ohio State Flight

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[1]For early research in this area, see: Johnson, H. M., and Boots, M. L. Analysis of ratings in the preliminary phase of the CAA training program. Washington, D. C.: CAA Division of Research, Report No. 21, October 1943.

Inventory[2] and Form ACA 342A),[3] and the accuracy of inspectors' ratings as obtained on wire recordings and on Form ACA 342Z.[4] Although the present report is not concerned with these other problems, the general design of the study must be reviewed briefly, since aspects of the design which were concerned primarily with these other problems have influenced the treatment of the present data.

Subjects were War Training Service Program students in five training schools.[5] Two successive classes in four schools were trained in accordance with traditional procedures. The following two classes were given experimental instruction involving the use of one or the other of the training aids. An additional class in a fifth school was trained according to traditional methods at the conclusion of the study to provide a partial check on the influence of weather conditions. The study extended from October, 1943, to February, 1944.

Criterion data were obtained by having each student make two check flights near the completion of primary training. A pair of inspectors went from school to school to make these check flights. (The trip to the various schools to check a given class is referred to as a "swing." Thus, there were five swings in the course of the study.) Each student flew the same standard flight twice in the same plane with different inspectors.

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[2]The development of the various versions of this inventory is described in: Edgerton, H. A., and Walker, R. Y. History and development of the Ohio State Flight Inventory. Part I: Early versions and basic research. Washington, D. C.: CAA Division of Research, Report No. 47, July 1945. Also, NRC Committee on Selection and Training of Aircraft Pilots. History and development of the Ohio State Flight Inventory. Part II: Recent versions and current applications. Washington, D. C.: CAA Division of Research, Report No. 51, November 1945.

[3]Form ACA 342A is a form on which the maneuver grades and over-all grades of the flight instructors, flight examiners, and CAA inspectors can be recorded. It also provides for ratings on several aspects of coordination and control, judgment, aptitude, flying habits, and accuracy.

[4]Form ACA 342Z provides space for an over-all grade, grades on specific maneuvers, and ratings on specific aspects of flight performance. An analysis of ratings on this form made by flight inspectors is described in: Festinger, Leon, Kogan, L. S., Odbert, H. S., and Wapner, Seymour. An analysis of inspectors' ratings on check flights as recorded on Form ACA 342Z. Washington, D. C.: CAA Division of Research, Report No. 58, March 1946.

[5]The five training schools were located at Bowling Green, Ohio; Muncie, Indiana; Kalamazoo, Michigan; Oxford, Ohio; and Milwaukee, Wisconsin.

Two criterion planes were used. One plane was a Continental-powered Cub; the other was a Franklin-powered Cub. Each plane was equipped with a photographic installation[6] which furnished camera records on the following instruments:

Airspeed Indicator
Turn Indicator
Ball Bank
Control Indicator
Tachometer
Altimeter
Artificial Horizon
Rate-of-Climb Indicator

The Standard Flight used in this project included 27 maneuvers. Camera records were obtained only on the following 16 maneuvers, numbered in the order of their occurrence in the complete Standard Flight:

2. Take-off
3. Straight and Level
7. Straight Climb and Recovery
10. 90° Climbing Turn Right, 45° Bank
11. 90° Climbing Turn Left, 45° Bank
12. 90° Turn Left, 15° Bank
13. 90° Turn Right, 15° Bank
14. 180° Turn Left, 45° Bank
15. 180° Turn Right, 45° Bank
16. 360° Steep Turn Left, 60° Bank
17. 360° Steep Turn Right, 60° Bank
18. Normal Power-off Stall
21. Straight Glide and Recovery
22. 90° Gliding Turn Right, 15° Bank
23. 90° Gliding Turn Left, 15° Bank
27. Landing

Data Used in the Analysis. The photographic records of the above maneuvers were analyzed by trained film readers who observed the records during slow-motion projection and recorded their observations on check sheets. These Film Analysis Check Sheets required instrument readings at specified points in the maneuver or estimates of performance through-

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[6] The photographic installation included a special instrument panel, located in the baggage compartment, which was photographed at 8 frames per second by a Bell and Howell Model 70 camera controlled by the observer. This installation was prepared by Mr. R. Y. Walker in collaboration with the University of Pennsylvania Project staff and was an adaptation of the installation described in: Viteles, M. S. and Thompson, A. S. An analysis of photographic records of aircraft pilot performance. Washington, D. C.: CAA Division of Research, Report No. 31, June 1944.

out portions of the maneuver, in objective terms whenever possible.[7] The data available from this analysis were thus in the form of check sheet entries based on readings of the flight instruments described above.

A careful check on the accuracy of the readings was made by periodically having selected records re-read by the same or another "crew" of film readers. Information on the reliability of the readings, derived from these periodic checks, is presented in Appendix 2, in terms of per cent of instances in which the two readings disagreed beyond arbitrarily established tolerance limits.

In general, the reliability of the readings was satisfactory, except for those items in which a considerable amount of judgment was involved, for example, aileron-rudder coordination. Items found to be of low reliability were discarded and, for the items on which this report is based, the amount of disagreement was usually less than 5%, as shown in the tables in Appendix 2.

TREATMENT OF DATA

Preliminary Survey of Data. Frequency distributions were made of all readings to determine whether plane differences were sufficiently marked to require separate treatment and further to determine the most suitable procedures for analyzing the data. Tallies were made separately for first and second flights for each plane.

Major Analysis. The preliminary frequency tabulations revealed such marked differences between planes in certain items such as Revolutions per Minute (RPM), Airspeed, Rate of Climb, and Ball Bank, that it was decided to keep the records of the two planes separate throughout the analysis.[8] This decision was reinforced by inspector reports that the Continental-powered plane was easier to handle.

Preliminary tallies also revealed that certain instrument readings were not sufficiently distributed to warrant further analysis. Many additional items were eliminated because observations in the field and in the reading of the photographs suggested that the results would be ambiguous. In turns, for example, readings had been recorded for the entry into the turn and recovery from the turn as well as for the turn itself. It was observed, however, that the camera frequently was not turned on until the entry was started or was turned off before the recovery was

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[7] Sample check sheets and a detailed description of the types of observations required are found in Appendix 1, which presents: Ewart, E. S., Thompson, A. S., and Viteles, M. S. Manual for use of check sheets in recording data from photographic records of flight performance.

[8] A detailed comparison of the data from the two planes is given in Appendix 3.

completed. Furthermore, the records frequently suggested that there was an instrument lag from the previous maneuver. Therefore, no analysis has been made of the readings taken during entry and recovery. With these conditions in mind, the following items were selected for analysis in each maneuver to which they are applicable:

1. Average Airspeed
2. RPM
3. Airspeed Variation
4. Average Bank
5. Bank Variation
6. Altitude Gain or Loss
7. Altitude Variation
8. Maximum Rate of Climb
9. Ball Bank Deviations

In comparing student performance from Flight I to Flight II, it was necessary to treat data from students trained under experimental conditions (Swings 3 and 4) separately from data from the control students (Swings 1 and 2). It also seemed desirable to treat results from the final control group (Swing 5) separately because the weather conditions during this swing were quite different from those for the earlier control groups. The denser air in cold weather, for example, gives the plane more lift.[9] Thus, treating all control subjects as a homogeneous group might spuriously increase the size of the correlations. It has already been pointed out that data from the two planes were also treated separately. The analysis was, therefore, made separately for the six samples as follows:

Continental-powered plane:	Swings 1 and 2
	Swings 3 and 4
	Swing 5
Franklin-powered plane:	Swings 1 and 2
	Swings 3 and 4
	Swing 5

The number of cases used in the analysis varies from maneuver to maneuver and from item to item because of incomplete data. Any case in which a reading was missing on either Flight I or Flight II had to be omitted. The highest number of cases in any sample was only 27. It is, therefore, necessary to observe the general trend of results rather than to place any great reliance on single or pairs of relationships.

Product-Moment Correlations. Consistency of performance from Flight I to Flight II was evaluated by means of Pearson product-moment correlations wherever continuously measured variables were involved, i.e., Air-

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[9] For example, the data for the rate-of-climb indicator presented in Appendix 4, Table 20, showed that the rate of climb in various maneuvers was, in general, greater during Swings 3 and 4 conducted in the winter months, than during Swings 1 and 2 conducted in the fall. Detailed comparison of the data obtained during Swings 1 and 2 and Swings 3 and 4 is presented in Appendix 4.

speed, RPM, Bank, Altitude, and Rate of Climb. No correlations were computed if the number of cases fell below 8.

An exact evaluation of the significance of these correlations is rendered somewhat difficult by the marked deviations from normality observed in the bivariate distributions. It is obvious that large sampling fluctuations in correlations may be anticipated with such small N's. The general trend of the results is indicated by the median correlation for each sample, a comparison of the number of positive and negative correlations, and the number of correlations significant at the 5% level.

4 x 4 Tables. For Ball Bank readings, where the measurements were for all practical purposes categorizations, tabulations were made in 4 x 4 tables. These tables are presented for each item in which the N was 16 or greater. Because of the small number of cases, no analysis was undertaken beyond a simple count of a number of instances in which performance was more consistent or less consistent than chance expectation. Tests of significance of departure from chance expectation were not made.

Summed Measures. In addition to consistency of performance on single items in specific maneuvers, a further aspect of consistency was studied, namely: consistency in scores obtained by summating measures on a specific item for comparable maneuvers. It was recognized that mere summation is a crude method of combination, especially since the standard deviations frequently differ from maneuver to maneuver. The number of cases in any one sample, however, did not justify more refined treatment.

Flight Differences. Tendencies for the group as a whole to exhibit better (or worse) performance during the second flight were studied by computing t tests between the means of Flight I and Flight II. These comparisons were of interest in determining the possible existence of "learning" from first to second flight, particularly since in this study the students had never flown the criterion planes before and might have been expected to have some trouble adapting to the greater weight of these planes.[10]

RESULTS AND DISCUSSION

The treatment of the data, as described above, was made to provide information on consistency in performance of student pilots from flight to flight and on characteristic differences between the two flights.

Consistency of Performance. Results of the analysis bearing on the question, "How consistently does a student pilot near the end of pri-

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[10]Although the criterion planes were Piper Cubs, the same as those on which the students were trained, they were heavier due to the research apparatus carried in the baggage compartment. The center of gravity in these planes was not changed, however.

mary training perform during two successive check flights?", were as follows:

1. Average Airspeed. The Average Airspeed was recorded for each maneuver in units of one mile per hour MPH). In Table 1, correlations for Average Airspeed are presented for the six samples for each of 16 maneuvers. The median correlation for each sample is shown at the bottom of the table.

It can be seen that the correlations range from -.26 to .97, and the N's for which correlations were computed range from 8 to 27. The median correlations for the six samples range from .29 to .64. Five correlations are negative; 82 are positive; one is zero. Forty-two of the 88 correlations are significant at or beyond the 5% level.[11]

Later comparisons will show that these Average Airspeed correlations are among the highest obtained for any of the measures.

Average Airspeed was summed for Maneuvers 3, 7, 10, 11, 16, 17, 21, 22, and 23. Only those cases having complete data on all the maneuvers involved were used for this summation. Other maneuvers had to be eliminated from the summation in order to retain an adequate number of cases. Each individual thus received two scores, one for Flight I and one for Flight II. Pearson product-moment correlations between Flight I and Flight II were computed separately for each sample. These correlations are presented as Item 1 in Table 9, which summarizes similar information for other measures. Means, standard deviations, and the number of cases involved are also shown. Beside each correlation is presented, for the corresponding sample, the median of the correlations for the maneuvers involved in the summation. These medians furnish only a very rough basis for comparison, since the individual correlations generally involve a larger number of cases than the correlations between summed scores. The correlations for the summed scores range from .41 to .85, whereas the median correlations range from .23 to .51. In each case the summation correlation represents an increase over the median correlation.

2. RPM. The RPM setting was recorded in units of 50 RPM. In Table 2 the correlations for RPM are presented for 15 maneuvers. Maneuver 8, Normal Power-off Stall, was omitted because of inadequacies in the recording. This table duplicates the form of Table 1.

The correlations range from -.40 to .96, and the N's for which correlations were computed range from 8 to 27. The median correlations for the six samples range from .34 to .58. Nine correlations are negative and 78 are positive. Of the 87 correlations, 39 are significant at or beyond the 5% level.

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[11] In this and subsequent tables, correlation coefficients significant at the 5% level are identified by asterisks. The means and sigmas of the distributions may be found in the tables in Appendix 5.

TABLE 1

AVERAGE AIRSPEED: FLIGHT I - FLIGHT II CORRELATION

Maneuver		CONTINENTAL Swings 1&2	CONTINENTAL Swings 3&4	CONTINENTAL Swings 5	FRANKLIN Swings 1&2	FRANKLIN Swings 3&4	FRANKLIN Swings 5
2. Take-off	N	14	16	13	15	19	7
	r	.26	.30	.97*	.79*	.48*	-
3. Str. & Level	N	17	24	11	19	24	10
	r	.56*	.05	.01	.23	.15	.71*
7. Str. Climb	N	20	23	13	21	23	10
	r	.39	.28	.60*	.05	.53*	.73*
10. 90° Cl. Turn R 45° Bank	N	22	26	13	20	24	9
	r	.23	.25	.14	-.01	.01	.20
11. 90° Cl. Turn L 45° Bank	N	20	26	12	17	21	9
	r	.46*	.28	-.10	.16	.26	.04
12. 90° Turn L 15° Bank (in Turn)	N	20	26	11	20	23	8
	r	.62*	.00	.88*	.23	.31	.75*
13. 90° Turn R 15° Bank (in Turn)	N	22	27	11	20	21	9
	r	.63*	.35	.62*	.68*	.31	.45
14. 180° Turn L 45° Bank (in Turn)	N	20	26	13	21	23	10
	r	.67*	.51*	.52	.34	.66*	.64*
15. 180° Turn R 45° Bank (in Turn)	N	23	26	12	22	24	8
	r	.67*	.39*	.37	.34	.68*	.79*
16. 360° Steep Turn L 60° Bank (in Turn)	N	23	26	12	21	23	10
	r	.59*	.78*	.65*	.64*	.80*	.47
17. 360° Steep Turn R 60° Bank (in Turn)	N	19	26	13	20	22	10
	r	.67*	.75*	.62*	.07	.69*	.83*
18. Normal Power-off Stall (at Break)	N	17	20	3	11	14	7
	r	.07	-.07	-	.60*	-.26	-
21. Str. Glide & Recovery (in Glide)	N	20	23	13	19	19	9
	r	.72*	.28	.25	.56*	.71*	.58
22. 90° Gl. Turn R 15° Bank (in Turn)	N	22	21	10	18	15	3
	r	.40	.49*	.53	.55*	.41	-
23. 90° Gl. Turn L 15° Bank (in Turn)	N	21	17	10	18	16	3
	r	.51*	.51*	.24	.48*	.46	-
27. Landing (Moment of Landing)	N	14	9	1	13	7	5
	r	-.10	.15	-	.43	-	-
Median	r	.54	.29	.53	.39	.46	.64

TABLE 2

RPM (TACHOMETER): FLIGHT I - FLIGHT II CORRELATION

Maneuver		CONTINENTAL Swings 1&2	CONTINENTAL Swings 3&4	CONTINENTAL Swings 5	FRANKLIN Swings 1&2	FRANKLIN Swings 3&4	FRANKLIN Swings 5
2. Take-off (moment of)	N	14	17	12	15	18	8
	r	.50	.33	.81*	.89*	.68*	.57
3. Str. & Level	N	18	24	12	19	24	10
	r	.54*	.36	.95*	.52*	.40*	.71*
7. Str. Climb & Recovery (in Climb)	N	20	23	13	21	23	10
	r	.15	.29	.40	.23	.44*	.08
10. 90° Cl. Turn R 45° Bank (in Turn)	N	22	26	13	19	24	10
	r	.43*	-.28	.58*	.39	.43*	.24
11. 90° Cl. Turn L 45° Bank (in Turn)	N	20	26	12	17	21	9
	r	.38	-.05	.72*	-.36	.28	-.40
12. 90° Turn L 15° Bank (in Turn)	N	20	25	11	21	23	8
	r	.32	.34	.74*	.35	-.02	-.09
13. 90° Turn R 15° Bank (in Turn)	N	22	27	11	21	21	9
	r	.04	.13	.80*	.59*	.35	.40
14. 180° Turn L 45° Bank (in Turn)	N	20	26	13	21	23	10
	r	.35	.27	.52	.42	.53*	.80*
15. 180° Turn R 45° Bank (in Turn)	N	23	26	12	22	24	8
	r	.19	.12	.55	.20	.59*	.50
16. 360° Steep Turn L 60° Bank (in Turn)	N	23	26	12	21	23	10
	r	.55*	.36	.77*	.57*	.65*	.47
17. 360° Steep Turn R 60° Bank (in Turn)	N	19	26	13	20	23	10
	r	.50*	.52*	.78*	.71*	.65*	.51
21. Str. Glide & Recovery (in Entry)	N	18	22	11	17	19	9
	r	.67*	.57*	-.25	.96*	.23	.79*
22. 90° Gl. Turn R 15° Bank (in Turn)	N	19	20	10	18	16	3
	r	.22	.94*	-.03	.67*	.30	-
23. 90° Gl. Turn L 15° Bank (in Turn)	N	19	16	10	18	16	3
	r	.38	.70*	.39	.88*	.32	-
27. Landing (during level off)	N	17	13	10	14	10	7
	r	.56*	.83*	-.27	.91*	.28	-
	Median r	.38	.34	.58	.57	.40	.49

These correlations are not markedly different from those reported for Average Airspeed.

Readings were summed for Maneuvers 3, 7, 10, 11, 12, 13, 14, 15, 16, and 17. Correlations on four samples are presented as Item 2 in Table 9. They range from .35 to .74, whereas the median correlations range from .28 to .44. Correlations for summations are appreciably higher than the median correlations for Swings 1 and 2 but not for Swings 3 and 4.

3. Airspeed Variation. The photographic check sheets showed the highest and lowest airspeed readings in the course of a maneuver. Difference scores were computed representing Airspeed Variation. The correlations for these Airspeed Variation scores are presented in Table 3. Airspeed Variation was not recorded for three maneuvers: 2, Take-off; 18, Normal Power-off Stall; and 27, Landings.

The range of correlations is from -.71 to .67. The median correlations distribute themselves between .08 and .22. Twenty-four correlations are negative; 52 are positive. Eleven of the 76 correlations are significant. Two of these significant correlations are negative: -.71 (11 cases) and -.44 (23 cases).

On the whole, the correlations do not depart markedly from zero. There was apparently little or no consistency in performance from Flight I to Flight II with respect to Airspeed Variation.

Airspeed Variation was summed for Maneuvers 7, 10, 11, 16, 17, 21, 22, and 23. Maneuvers 1, 2, 3, 13, 14, and 15 were omitted since their inclusion would have reduced the number of cases available for summation to a negligible amount. The maneuvers retained were those in which variation in airspeed appeared to be most important, namely, the climbs, glides, and steep turns. Pearson product-moment correlations between Flight I and Flight II are presented as Item 3 in Table 9. Median correlations for each sample, computed with reference only to the correlations for maneuvers involved in the summation, appear alongside each correlation for purposes of comparison.

The correlations for the summations range from .06 to .30. The corresponding median correlations range from .08 to .22. For the Continental plane the summation correlations are not appreciably different from the median correlations. For the Franklin plane the summation correlations represent slight increases over the median correlations.

4. Average Bank. The artificial horizon in the photographic installation furnished a measure of degree of bank during turns; Average Bank was recorded for each turn in units of 5°. The correlations for Average Bank are presented in Table 4 for the 10 turn maneuvers. The correlations range from -.14 to .86, and the N's for which correlations were computed range from 8 to 22. The median correlations range from .42 to .51. Median correlations are not presented for either of the Swing 5 samples because data were too meager.

TABLE 3

AIRSPEED VARIATION: FLIGHT I - FLIGHT II CORRELATION

Maneuver		CONTINENTAL Swings 1&2	CONTINENTAL Swings 3&4	CONTINENTAL Swings 5	FRANKLIN Swings 1&2	FRANKLIN Swings 3&4	FRANKLIN Swings 5
3. Str. & Level	N	17	24	11	19	23	10
	r	.27	-.11	-.04	.41	-.20	-.49
7. Str. Climb & Recovery (in Climb)	N	20	23	13	21	23	10
	r	.08	.04	.35	-.25	.11	.53
10. 90° Cl. Turn R 45° Bank (in Turn)	N	22	26	13	20	24	10
	r	.07	.27	.01	-.39	-.02	.10
11. 90° Cl. Turn L 45° Bank (in Turn)	N	20	26	12	17	21	9
	r	.13	-.08	.09	.58*	.45*	-.17
12. 90° Turn L 15° Bank (in Turn)	N	20	25	11	20	23	8
	r	-.10	.39	-.71*	-.01	.36	.57
13. 90° Turn R. 15° Bank (in Turn)	N	22	27	10	19	22	9
	r	.06	.14	.05	.11	.43*	-.23
14. 180° Turn L 45° Bank (in Turn)	N	20	26	13	21	23	10
	r	-.04	.50*	.10	.43*	-.22	-.14
15. 180° Turn R 45° Bank (in Turn)	N	23	26	12	22	24	8
	r	.30	-.16	.51	.42*	-.01	.13
16. 360° Steep Turn L 60° Bank (in Turn)	N	23	26	12	21	23	10
	r	.12	.47	-.10	.10	-.41*	.38
17. 360° Steep Turn R 60° Bank (in Turn)	N	.19	26	13	20	23	10
	r	.34	.24	.67*	.30	.45*	.56
21. Str. Glide & Recovery (in Glide)	N	20	23	13	19	19	9
	r	.39	-.02	.08	-.40	.12	-.14
22. 90° Gl. Turn R 15° Bank (in Turn)	N	22	23	10	18	15	3
	r	.07	.23	.24	.05	.40	-
23. 90° Gl. Turn L 15° Bank (in Turn)	N	21	17	10	18	17	3
	r	.03	.42	.18	.19	.01	-
Median r		.08	.22	.09	.11	.11	.10

TABLE 4

AVERAGE BANK: FLIGHT I - FLIGHT II CORRELATION

Maneuver		CONTINENTAL Swings 1&2	CONTINENTAL Swings 3&4	CONTINENTAL Swings 5	FRANKLIN Swings 1&2	FRANKLIN Swings 3&4	FRANKLIN Swings 5
10. 90° Cl. Turn R	N	21	21	3	16	13	9
45° Bank (in Turn)	r	.41	.48*	-	.14	.63*	.19
11. 90° Cl. Turn L	N	19	20	3	13	12	7
45° Bank (in Turn)	r	.64*	.50*	-	.72*	.58*	-
12. 90° Turn L	N	19	21	3	16	14	6
15° Bank (in Turn)	r	.21	.39	-	.28	.14	-
13. 90° Turn R	N	21	22	3	16	14	8
15° Bank (in Turn)	r	.57*	.62*	-	.38	.44	.82*
14. 180° Turn L	N	20	21	3	16	15	9
45° Bank (in Turn)	r	.78*	.48*	-	.63*	.05	.45
15. 180° Turn R	N	19	22	3	16	16	7
45° Bank (in Turn)	r	.63*	.69*	-	.86*	.54*	-
16. 360° Steep Turn L	N	18	22	3	14	13	6
60° Bank (in Turn)	r	.63*	.34	-	.72*	.53	-
17. 360° Steep Turn R	N	13	21	3	10	13	6
60° Bank (in Turn)	r	.40	.67*	-	.76*	.40	-
22. 90° Cl. Turn R	N	20	18	3	10	8	3
15° Bank (in Turn)	r	.10	.47*	-	-.14	.23	-
23. 90° Cl. Turn L	N	19	14	3	10	8	3
15° Bank (in Turn)	r	.34	.45	-	.32	.28	-
Median	r	.49	.48	-	.51	.42	-

Only one correlation is negative and the other 42 are positive. Twenty-one of the 43 correlations are significant.

The correlations in this table closely resemble in magnitude those for Average Airspeed and RPM.

5. Bank Variation. The difference between maximum and minimum bank during a turn provided a measure of Bank Variation. In Table 5 the correlations for Bank Variation are presented for the 10 turn maneuvers. The correlations range from -.53 to .68. The number of cases for which correlations were computed range from 8 to 22. The median correlations range from -.15 to .20. (No median correlations are presented for Swing 5 because the data were not adequate.) Sixteen correlations are negative; one is zero; and 26 are positive.

Of the 43 correlations, only one is significant, indicating little consistency from Flight I to Flight II for Bank Variation.

Bank Variation was summed for the six level turn maneuvers (12 to 17). The correlations from Flight I to Flight II for these summations are presented as Item 4 in Table 9. The summation correlations range from .24 to .47, whereas the corresponding median correlations range from -.18 to .16. In each case the summation correlation is greater than the corresponding median correlation.

6. Altitude Gain or Loss. Gain or loss in altitude was computed by subtracting the reading at the end of the entry from the reading at the beginning of the recovery from the maneuver. Data on this item for 11 maneuvers are presented in Table 6. The correlations range from -.67 to .94. The number of cases for which correlations were computed range from 8 to 26. The median correlations for the six samples range from .09 to .46. Forty-six of the correlations are positive; 18 are negative.

Seventeen of the 64 correlations are significant at the 5% level. One of these is negative (-.67, N = 13). The correlations indicate a degree of consistency so slight as to be of little importance.

Scores were summed for the seven level maneuvers. The summation correlations presented as Item 5 in Table 9 range from .05 to .71. The corresponding median correlations range from .09 to .28. It will be seen that the correlations of Continental, Swings 3 and 4, and Franklin, Swings 1 and 2, are appreciably higher than the median correlations of the maneuvers used in the summation. There is no appreciable change in the correlations for Continental, Swings 1 and 2, and Franklin, Swings 3 and 4.

7. Altitude Variation. The maximum variation in altitude during a maneuver was recorded without regard to direction. Data on Altitude Variation for the seven level maneuvers appear in Table 7. The correlations range from -.54 to .90; and the N's from 8 to 27. The median correlations for the six samples range from -.18 to .26. Twenty-four of the correlations are positive; 17 are negative; one is zero. Seven of the 42 correlations

TABLE 5

BANK VARIATION: FLIGHT I - FLIGHT II CORRELATION

Maneuver		CONTINENTAL Swings 1&2	CONTINENTAL Swings 3&4	CONTINENTAL Swings 5	FRANKLIN Swings 1&2	FRANKLIN Swings 3&4	FRANKLIN Swings 5
10. 90° Cl. Turn R	N	20	21	3	15	13	9
45° Bank (in Turn)	r	-.38	.35	-	.02	.58*	.66
11. 90° Cl. Turn L	N	17	20	3	13	12	7
45° Bank (in Turn)	r	-.23	.17	-	.14	-.20	-
12. 90° Turn L	N	19	21	3	16	14	6
15° Bank (in Turn)	r	.00	.18	-	-.17	-.10	-
13. 90° Turn R	N	21	22	3	16	13	8
15° Bank (in Turn)	r	.29	.11	-	.02	-.32	.68
14. 180° Turn L	N	20	21	3	16	15	9
45° Bank (in Turn)	r	.39	-.06	-	.17	.04	-.15
15. 180° Turn R	N	20	22	3	16	16	7
45° Bank (in Turn)	r	-.19	-.14	-	.34	.03	-
16. 360° Steep Turn L	N	18	22	3	14	13	6
60° Bank (in Turn)	r	.44	.24	-	-.24	-.31	-
17. 360° Steep Turn R	N	13	21	3	10	13	6
60° Bank (in Turn)	r	.02	.31	-	-.26	-.25	-
22. 90° Gl. Turn R	N	20	18	3	10	8	3
15° Bank (in Turn)	r	.15	.22	-	.36	-.53	-
23. 90° Gl. Turn L	N	19	14	3	10	7	3
15° Bank (in Turn)	r	.09	.27	-	-.33	.22	-
Median	r	.06	.20	-	.02	-.15	-

TABLE 6

ALTITUDE GAIN OR LOSS: FLIGHT I - FLIGHT II CORRELATION

Maneuver		CONTINENTAL Swings 1&2	CONTINENTAL Swings 3&4	CONTINENTAL Swings 5	FRANKLIN Swings 1&2	FRANKLIN Swings 3&4	FRANKLIN Swings 5
3. Str. & Level	N	17	24	12	19	23	10
	r	-.06	-.13	.21	-.10	.14	-.38
10. 90° Cl. Turn R 45° Bank	N	22	25	13	20	24	10
	r	.11	.33	-.20	.15	.22	.69*
11. 90° Cl. Turn L 45° Bank	N	20	26	12	17	22	9
	r	.08	.21	.83*	.66*	.42*	-.16
12. 90° Turn L 15° Bank	N	20	23	11	21	23	8
	r	-.14	.12	-.58	.07	.05	-.10
13. 90° Turn R 15° Bank	N	22	24	9	21	18	9
	r	.03	-.16	.19	-.14	-.13	-.39
14. 180° Turn L 45° Bank	N	20	25	13	21	23	10
	r	.09	.28	-.67*	.10	.43*	.94*
15. 180° Turn R 45° Bank	N	22	26	12	22	23	8
	r	.16	.45*	.14	.20	-.01	.64
16. 360° Steep Turn L 60° Bank	N	23	26	12	21	23	10
	r	.28	.65*	.85*	.80*	.59*	.46
17. 360° Steep Turn R 60° Bank	N	19	26	13	20	22	10
	r	.13	.57*	.66*	.60*	.15	.69*
22. 90° Gl. Turn R 15° Bank	N	22	21	10	17	15	4
	r	-.14	.27	.37	.10	-.08	-
23. 90° Gl. Turn L 15° Bank	N	21	15	8	18	16	3
	r	.36	.30	-.60	.30	.66*	-
Median r		.09	.28	.19	.15	.15	.46

TABLE 7

ALTITUDE VARIATION: FLIGHT I - FLIGHT II CORRELATION

Maneuver		CONTINENTAL Swings 1&2	CONTINENTAL Swings 3&4	CONTINENTAL Swings 5	FRANKLIN Swings 1&2	FRANKLIN Swings 3&4	FRANKLIN Swings 5
3. Str. & Level	N	16	23	12	19	23	10
	r	-.18	.19	.44	.26	-.11	.35
12. 90° Turn L 15° Bank (in Turn)	N	20	26	11	20	23	8
	r	-.18	.03	-.44	-.17	-.05	.21
13. 90° Turn R 15° Bank (in Turn)	N	22	27	10	21	22	9
	r	-.25	.38*	.29	-.11	-.03	-.54
14. 180° Turn L 45° Bank (in Turn)	N	19	26	13	21	23	10
	r	-.39	.28	.00	.01	-.04	.90*
15. 180° Turn R 45° Bank (in Turn)	N	22	25	12	22	23	8
	r	-.14	.03	.03	.61*	.29	.17
16. 360° Steep Turn L 60° Bank (in Turn)	N	22	26	12	21	23	10
	r	.26	.53*	.64*	.56*	.14	-.16
17. 360° Steep Turn R 60° Bank (in Turn)	N	19	26	13	20	23	10
	r	-.17	.26	.17	.52*	-.23	-.49
Median	r	-.18	.26	.17	.26	-.04	.17

are significant at the 5% level.[12] The lack of consistency for this item is suggested by the number of negative correlations.

Scores on these seven items were summed. It will be seen in Table 9, Item 6, that the correlations for these summed items are higher than the corresponding median correlations, ranging from .27 to .59.

8. Maximum Rate of Climb. Maximum Rate of Climb was recorded for the three climbing maneuvers and the three gliding maneuvers. Data for all six maneuvers are presented in Table 8. The range of correlations for

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[12]These correlations are affected by the skewness of the distributions of Altitude Variation. As shown in Table 32, Appendix 5, the sigmas are frequently larger than the means for this item.

the climbing maneuvers is from -.17 to .70. The number of cases for which correlations were computed range from 9 to 26. The median correlations for the samples range from -.06 to .59. Four of the 18 correlations are significant. Six correlations are negative; 12 are positive.

As shown in Item 7, Table 9, the summed scores for these three items exhibit correlations which are generally higher than the median correlations, although one remains slightly negative. The three positive correlations range from .35 to .43.

Correlations for the three gliding maneuvers range from -.27 to .56; the N's range from 9 to 22. The median correlations for the samples range from -.23 to .36. Eight correlations are positive; 7 are negative; and one is zero. None of the correlations is significant.

The correlations for the summed scores for gliding maneuvers (Item 8, Table 9) range from -.05 to .26. The increase of the summed correlations over the median correlations is not appreciable.

In general, correlations for single items show little evidence of consistency in either climbing or gliding maneuvers. Correlations of summed items tend to be somewhat higher.

9. Ball Bank. Data were derived from the Ball Bank Indicator in terms of direction, degree, and duration of the deviation of the ball from the center position. Degree 1 was defined as any excursion of the ball from the center position less than the radius of the ball; Degree 2 was an excursion in which one-half the ball, but less than the entire ball, was outside the lubber line; Degree 3 was an excursion of the ball outside the lubber line but in a position less than the extreme position; Degree 4 was the maximum possible excursion of the ball. Duration 1 was a temporary excursion in which the ball did not come to rest; Duration 2 was an excursion in which the ball remained within the limits of a given degree for less than 50% of the specified part of the maneuver; Duration 3 was an excursion within the limits of a given degree position for more than 50% of the total duration, but less than the total duration; and Duration 4 applied only if the ball was in a given position continuously throughout the specified part of a maneuver.

Preliminary tallies indicated marked differences between readings from the two planes and further showed so few extreme deviations that some special treatment of the data was required. In the present analysis it was decided to use the following groupings:

Category A: steady or a deviation of Degree 1 or Duration 1 in either direction.

Category B: right deviations greater than Duration 1 and Degree 1.

Category C: left deviations greater than Duration 1 and Degree 1.

TABLE 8

MAXIMUM RATE OF CLIMB: FLIGHT I - FLIGHT II CORRELATION

Maneuver		CONTINENTAL Swings 1&2	CONTINENTAL Swings 3&4	CONTINENTAL Swings 5	FRANKLIN Swings 1&2	FRANKLIN Swings 3&4	FRANKLIN Swings 5
7. Str. Cl. & Recovery (in Climb)	N	20	22	13	21	23	9
	r	-.01	-.17	.59*	.14	-.05	.42
10. 90° Cl. Turn R 45° Bank (in Turn)	N	22	26	13	20	24	10
	r	.59*	.35	.21	-.02	.20	.16
11. 90° Cl. Turn L 45° Bank (in Turn)	N	20	26	12	18	21	9
	r	.27	-.06	.66*	.03	-.13	.70*
21. Str. Glide & Recovery (in Glide)	N	21	22	13	19	19	9
	r	-.09	.20	-.13	-.11	-.27	.56
22. 90° Gl. Turn R 15° Bank (in Turn)	N	22	20	10	18	16	3
	r	.36	-.03	.11	.00	-.23	-
23. 90° Gl. Turn L 15° Bank (in Turn)	N	21	17	10	18	17	2
	r	.36	-.03	.55	.28	.33	-
Median r (Climbs)		.27	-.06	.59	.03	-.05	.42
Median r (Glides)		.36	-.03	.11	.00	-.23	-

Category D: deviations in both directions in a single maneuver which were greater than Duration 1 and Degree 1.

Deviations of Degree 1 or Duration 1 or both were classified with "steady" partly because such deviations of one degree were felt to be negligible and partly because it had been observed that the modal reading for the Franklin powered plane was Degree 1.

The number of cases in any one maneuver proved to be too small to justify extensive statistical treatment of the results. The results are, therefore, presented in 4 X 4 tables. These appear in Table 10 for all instances in which the N is 16 or greater. Several of the 4 X 4 tables show a large preponderance of cases in Category A in both flights, suggesting that performance in these maneuvers was uniformly good or that the grouping decided upon was too coarse to reveal differences in performance. The number of cases showing a deviation in one direction was too small to allow for any comparison of tendencies

TABLE 9

CONSISTENCY OF PERFORMANCE ON SUMMED ITEMS: FLIGHT I - FLIGHT II CORRELATION

Maneuver		CONTINENTAL Swings 1&2	CONTINENTAL Swings 3&4	FRANKLIN Swings 1&2	FRANKLIN Swings 3&4
1. Airspeed (9 maneuvers)	N	11	12	12	8
	r	.85(.51)*	.45(.28)	.41(.23)	.78(.46)
2. RPM (10 maneuvers)	N	13	19	14	15
	r	.67(.37)	.35(.28)	.74(.41)	.43(.44)
3. Airspeed Variation (8 maneuvers)	N	12	13	12	10
	r	.06(.16)	.24(.22)	.30(.08)	.22(.12)
4. Bank Variation (6 maneuvers)	N	12	17	9	9
	r	.26(.16)	.47(.15)	.24(-.08)	.39(-.18)
5. Alt. Gain or Loss (7 level maneuvers)	N	12	15	16	15
	r	.05(.09)	.58(.28)	.71(.10)	.13(.14)
6. Alt. Variation (7 level maneuvers)	N	11	19	15	18
	r	.59(-.18)	.30(.26)	.55(.26)	.27(-.04)
7. Max. Rate of Climb (3 climbing maneuvers)	N	19	22	18	19
	r	.43(.27)	-.12(-.06)	.36(.03)	.35(-.05)
8. Max. Rate of Climb (3 gliding maneuvers)	N	19	13	16	12
	r	.25(.36)	.26(-.03)	.00(.00)	-.05(-.23)

*The coefficient in parentheses is the median of the coefficients for the maneuvers included in the summation. It should be noted that the median is not based on the same N as the correlation of summed items.

TABLE 10

BALL BANK*

(Consistency of performance on successive flights)

CONTINENTAL

Maneuver 2. Take-off (moment of)

(N = 14)

Flight I \ Flight II	Swings 1 & 2 A	B	C	D	Tot.	Swings 3 & 4 A	B	C	D	Tot.
A						16	-	-	-	16
B						-	-	-	-	0
C						-	-	-	-	0
D						-	-	-	-	0
Tot.						16	0	0	0	16

3. Str. & Level

Flight I \ Flight II	Swings 1 & 2 A	B	C	D	Tot.	Swings 3 & 4 A	B	C	D	Tot.
A	8	3	-	-	11	21	-	-	-	21
B	3	1	-	-	4	1	-	-	-	1
C	-	-	-	-	0	-	-	-	-	0
D	2	-	-	-	2	-	-	-	-	0
Tot.	13	4	0	0	17	22	0	0	0	22

7. Str. Climb & Recovery (in Climb)

Flight I \ Flight II	Swings 1 & 2 A	B	C	D	Tot.	Swings 3 & 4 A	B	C	D	Tot.
A	8	3	-	-	11	16	2	-	-	18
B	3	4	-	-	7	3	-	-	-	3
C	-	-	-	-	0	-	-	-	-	0
D	1	-	-	-	1	-	-	-	-	0
Tot.	12	7	0	0	19	19	2	0	0	21

FRANKLIN

Maneuver 2. Take-off (moment of)

(N = 15)

Flight I \ Flight II	Swings 1 & 2 A	B	C	D	Tot.	Swings 3 & 4 A	B	C	D	Tot.
A						6	5	-	-	11
B						3	4	-	-	7
C						-	-	-	-	0
D						-	-	-	-	0
Tot.						9	9	0	0	18

3. Str. & Level

Flight I \ Flight II	Swings 1 & 2 A	B	C	D	Tot.	Swings 3 & 4 A	B	C	D	Tot.
A	4	1	-	-	5	5	4	-	1	10
B	4	5	-	1	10	4	6	-	-	10
C	-	-	-	-	0	-	-	-	-	0
D	-	1	-	-	1	1	-	-	-	1
Tot.	8	7	0	1	16	10	10	0	1	21

7. Str. Climb & Recovery (in Climb)

Flight I \ Flight II	Swings 1 & 2 A	B	C	D	Tot.	Swings 3 & 4 A	B	C	D	Tot.
A	2	4	-	1	7	3	4	-	-	7
B	4	6	-	1	11	5	9	-	-	14
C	-	-	-	-	0	-	-	-	-	0
D	-	-	-	-	0	-	-	-	-	0
Tot.	6	10	0	2	18	8	13	0	0	21

*A = steady or a deviation of Degree 1 or Duration 1 in either direction
B = right deviation greater than Duration 1 and Degree 1
C = left deviation greater than Duration 1 and Degree 1
D = deviations in both directions greater than Duration 1 and Degree 1

TABLE 10

BALL BANK (Continued)

Maneuver		CONTINENTAL										FRANKLIN									
			Swings 1 & 2 Flight II					Swings 3 & 4 Flight II					Swings 1 & 2 Flight II					Swings 3 & 4 Flight II				
			A	B	C	D	Tot.		A	B	C	D	Tot.		A	B	C	D	Tot.		A	B	C	D	Tot.
10. 90° Cl. Turn R 45° Bank (in Turn)	Flight I	A	6	2	-	-	8	A	12	3	-	-	15	A	4	4	-	-	8	A	1	1	-	-	2
		B	6	7	-	-	13	B	3	7	-	-	10	B	2	10	-	-	12	B	1	21	-	-	22
		C	-	-	-	-	0	C	-	-	-	-	0	C	-	-	-	-	0	C	-	-	-	-	0
		D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0
	Tot.		12	9	0	0	21		15	10	0	0	25		6	14	0	0	20		2	22	0	0	24
11. 90° Cl. Turn L 45° Bank (in Turn)			A	B	C	D			A	B	C	D			A	B	C	D			A	B	C	D	
	Flight I	A	14	-	-	-	14	A	21	4	-	-	25	A	8	4	-	-	12	A	8	4	-	-	12
		B	4	1	-	-	5	B	1	-	-	-	1	B	4	2	-	-	6	B	3	6	-	-	9
		C	-	-	-	-	0	C	-	-	-	-	0	C	-	-	-	-	0	C	-	-	-	-	0
		D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0
	Tot.		18	1	0	0	19		22	4	0	0	26		12	6	0	0	18		11	10	0	0	21
12. 90° Turn L 15° Bank (in Turn)			A	B	C	D			A	B	C	D			A	B	C	D			A	B	C	D	
	Flight I	A	7	5	-	-	12	A	24	-	-	-	24	A	11	2	-	-	13	A	6	4	-	-	10
		B	3	4	-	-	7	B	1	1	-	-	2	B	3	4	-	-	7	B	8	5	-	-	13
		C	-	-	-	-	0	C	-	-	-	-	0	C	-	-	-	-	0	C	-	-	-	-	0
		D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0
	Tot.		10	9	0	0	19		25	1	0	0	26		14	6	0	0	20		14	9	0	0	23
13. 90° Turn R 15° Bank (in Turn)			A	B	C	D			A	B	C	D			A	B	C	D			A	B	C	D	
	Flight I	A	9	5	1	-	15	A	25	-	-	-	25	A	13	1	-	-	14	A	4	7	-	-	11
		B	4	2	-	-	6	B	-	2	-	-	2	B	1	7	-	-	8	B	2	8	-	-	10
		C	-	-	-	-	0	C	-	-	-	-	0	C	-	-	-	-	0	C	-	-	-	-	0
		D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0
	Tot.		13	7	1	0	21		25	2	0	0	27		14	8	0	0	22		6	15	0	0	21

TABLE 10

BALL BANK (Continued)

Maneuver		CONTINENTAL										FRANKLIN									
		Swings 1 & 2 Flight II					Swings 3 & 4 Flight II					Swings 1 & 2 Flight II					Swings 3 & 4 Flight II				
			A	B	C	D	Tot.		A	B	C	D	Tot.		A	B	C	D	Tot.		A	B	C	D	Tot.
14. 180° Turn L 45° Bank (in Turn)	Flight I	A	12	3	-	-	15	A	23	-	1	-	24	A	13	-	-	-	13	A	11	1	-	-	12
		B	2	-	-	-	2	B	1	-	-	-	1	B	3	5	-	-	8	B	6	5	-	-	11
		C	1	-	1	-	2	C	-	-	1	-	1	C	-	-	-	-	0	C	-	-	-	-	0
		D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0
		Tot.	15	3	1	0	19		24	0	2	0	26		16	5	0	0	21		17	6	0	0	23
15. 180° Turn R 45° Bank (in Turn)			A	B	C	D			A	B	C	D			A	B	C	D			A	B	C	D	
	Flight I	A	7	4	-	-	11	A	15	2	-	-	17	A	7	3	-	-	10	A	1	4	-	-	5
		B	3	8	-	-	11	B	3	5	-	-	8	B	3	9	-	-	12	B	4	15	-	-	19
		C	-	-	-	-	0	C	-	-	-	-	0	C	-	-	-	-	0	C	-	-	-	-	0
		D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0
		Tot.	10	12	0	0	22		18	7	0	0	25		10	12	0	0	22		5	19	0	0	24
16. 360° Steep Turn L 60° Bank (in Turn)			A	B	C	D			A	B	C	D			A	B	C	D			A	B	C	D	
	Flight I	A	13	-	1	-	14	A	20	-	1	1	22	A	13	4	-	-	17	A	13	2	-	1	16
		B	4	1	-	-	5	B	-	1	-	-	1	B	3	1	-	-	4	B	5	2	-	-	7
		C	2	1	-	-	3	C	1	-	2	-	3	C	-	-	-	-	0	C	-	-	-	-	0
		D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0	D	-	-	-	-	0
		Tot.	19	2	1	0	22		21	1	3	1	26		16	5	0	0	21		18	4	0	1	23

TABLE 10

BALL BANK (Concluded)

CONTINENTAL

Maneuver		Swings 1 & 2 Flight II A	B	C	D	Tot.	Swings 3 & 4 Flight II A	B	C	D	Tot.
17. 360° Steep Turn R 60° Bank (in Turn)	Flight I A	3	-	-	-	3	4	4	-	-	8
	Flight I B	2	13	-	-	15	7	11	-	-	18
	Flight I C	-	-	-	-	0	-	-	-	-	0
	Flight I D	-	-	-	-	0	-	-	-	-	0
	Tot.	5	13	0	0	18	11	15	0	0	26
21. Str. Glide & Recovery (in Glide)		A	B	C	D		A	B	C	D	
	Flight I A	14	2	1	-	17	19	1	-	1	21
	Flight I B	1	1	-	-	2	-	-	-	-	0
	Flight I C	-	-	-	-	0	2	-	-	-	2
	Flight I D	1	-	-	-	1	-	-	-	-	0
	Tot.	16	3	1	0	20	21	1	0	1	23
22. 90° Gl. Turn R 15° Bank (in Turn)		A	B	C	D		A	B	C	D	
	Flight I A	17	2	-	-	19	14	1	1	-	16
	Flight I B	1	-	-	-	1	1	-	-	-	1
	Flight I C	1	-	-	-	1	1	-	2	-	3
	Flight I D	-	-	-	-	0	-	-	-	1	1
	Tot.	19	2	0	0	21	16	1	3	1	21
23. 90° Gl. Turn L 15° Bank (in Turn)		A	B	C	D		A	B	C	D	
	Flight I A	16	3	-	-	19	16	1	-	-	17
	Flight I B	1	-	-	-	1	-	-	-	-	0
	Flight I C	-	-	-	-	0	-	-	-	-	0
	Flight I D	-	-	-	-	0	-	-	-	-	0
	Tot.	17	3	0	0	20	16	1	0	0	17

FRANKLIN

Maneuver		Swings 1 & 2 Flight II A	B	C	D	Tot.	Swings 3 & 4 Flight II A	B	C	D	Tot.
17. 360° Steep Turn R 60° Bank (in Turn)	Flight I A	1	3	-	-	4	-	-	-	-	0
	Flight I B	2	13	1	-	16	-	23	-	-	23
	Flight I C	-	-	-	-	0	-	-	-	-	0
	Flight I D	-	-	-	-	0	-	-	-	-	0
	Tot.	3	16	1	0	20	0	23	0	0	23
21. Str. Glide & Recovery (in Glide)		A	B	C	D		A	B	C	D	
	Flight I A	12	3	-	-	15					
	Flight I B	1	-	-	-	1					
	Flight I C	-	-	-	-	0	(N = 15)				
	Flight I D	1	-	-	1	2					
	Tot.	14	3	0	1	18					
22. 90° Gl. Turn R 15° Bank (in Turn)		A	B	C	D		A	B	C	D	
	Flight I A	13	-	-	-	13	13	1	-	-	14
	Flight I B	4	1	-	-	5	2	1	-	-	3
	Flight I C	-	-	-	-	0	-	-	-	-	0
	Flight I D	-	-	-	-	0	-	-	-	-	0
	Tot.	17	1	0	0	18	15	2	0	0	17
23. 90° Gl. Turn L 15° Bank (in Turn)		A	B	C	D		A	B	C	D	
	Flight I A	11	3	-	-	14	12	2	-	-	14
	Flight I B	2	1	-	-	3	1	2	-	-	3
	Flight I C	-	-	-	-	0	-	-	-	-	0
	Flight I D	1	-	-	-	1	-	-	-	-	0
	Tot.	14	4	0	0	18	13	4	0	0	17

toward slipping or skidding.[13]

An effort was made to determine by inspection any trend towards consistency by calculating the frequency which would be expected in Category A on both flights if the relationship were chance. In 38 of the contingency tables the observed frequency is greater than the calculated expectation; in 10, it is less than that expected; and in 5 it is the same as expected. Many of the departures from chance expectation are very slight. The relative proportion of positive and negative relationships is approximately the same as has been observed in some of the preceding tables.

Certain incidental observations may be made from the contingency tables. In straight maneuvers the ball moved to the right more frequently on the Franklin-powered plane than on the Continental-powered plane. As instruments were carefully checked throughout the study, this difference seems to reflect, at least in part, a difference in the flight characteristics of the two planes. Examination of data from Maneuvers 14-17 appears to indicate that both planes showed a greater tendency to slip on medium and steep right turns than on medium or steep left turns.

10. Comparison of Maneuvers. An indication of relative consistency of performance in different maneuvers is offered in Table 11. This table shows the median of the sample correlations for each aspect of performance studied on each maneuver. The table is necessarily restricted to those aspects of performance studied by correlational techniques. The median is ordinarily based on six samples and is specifically the midpoint between the third and fourth largest correlations.[14]

Table 11 emphasizes the uniformly greater consistency of performance for Average Airspeed, RPM, and Average Bank. Correlations on other items are predominantly positive, but in most instances, very low. The most striking exceptions are for Altitude Gain or Loss in the case of the 360° turns with 60° bank. These median correlations are .62 and .58. These steep turns appear to offer the most consistent measures of performance, possibly because of the difficulty of the maneuver and possibly also, in part, because the maneuvers represent longer samples of performance than most of the others. Certain other maneuvers show relatively little consistency. The only aspect consistently performed in straight and level flight, for instance, is the RPM setting. The gliding turns show quite low correlations, except in Average Airspeed.

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[13]Two-by-two tables might be constructed comparing "steady" performance with "other" performance, grouping all other types of errors together. The N's in these tables again would be too small to merit computation of chi-squared tests or coefficients of relationship.

[14]More refined methods of obtaining a measure of central tendency did not appear to be justified, especially since it cannot be assumed that these six samples are drawn at random from a homogeneous parent population.

TABLE 11

THE MEDIAN OF THE SAMPLE CORRELATIONS FOR EACH ASPECT OF PERFORMANCE STUDIED ON EACH MANEUVER

Maneuver	Average Airspeed	RPM	Airspeed Variation	Average Bank	Bank Variation	Altitude Gain or Loss	Altitude Variation	Max. Rate of Climb
2. Take-off	.48	.62	-	-	-	-	-	-
3. Str. & Level	.19	.53	-.08	-	-	-.08	.22	-
7. Str. Cl. & Recovery	.46	.26	.10	-	-	-	-	.06
10. 90° Cl. Turn R 45° Bank	.17	.41	.04	.41	.35	.18	-	.20
11. 90° Cl. Turn L 45° Bank	.21	.12	.11	.61	-.03	.32	-	.15
12. 90° Turn L 15° Bank	.46	.33	.18	.24	-.05	-.02	-.11	-
13. 90° Turn R 15° Bank	.54	.38	.08	.57	.11	-.14	-.07	-
14. 180° Turn L 45° Bank	.58	.47	.03	.48	.04	.19	.00	-
15. 180° Turn R 45° Bank	.53	.39	.22	.66	-.06	.18	.10	-
16. 360° Stp. Turn L 60° Bank	.64	.56	.13	.58	.00	.62	.40	-
17. 360° Stp. Turn R 60° Bank	.68	.58	.40	.54	-.12	.58	.00	-
18. Normal Power-off Stall	.00	-	-	-	-	-	-	-
21. Str. Glide & Recovery	.57	.62	.03	-	-	-	-	-.10
22. 90° Gl. Turn R 15° Bank	.49	.30	.22	.16	.18	.10	-	.00
23. 90° Gl. Turn L 15° Bank	.48	.39	.18	.33	.16	.30	-	.33
27. Landing	.15	.56	-	-	-	-	-	-

11. Discussion of Results of Consistency Analysis. For only three items -- Average Airspeed, Average Bank, and RPM -- do the correlations for single maneuvers give a uniform indication of any degree of consistency of student pilot performance from Flight I to Flight II. Other items show moderate correlations on certain specific maneuvers, or on a summation of maneuvers, but the correlations are, in general, quite low.

The three items on which there is greatest consistency represent less complex aspects of performance which may become relatively fixed early in training. It may be noteworthy that these three items can be considered predominantly perceptual in nature, or as representing habits of performance rather than being clearly "skill" items. Instructors commonly specify the desired RPM and Airspeed, and the student can check his performance by the instrument readings. If all instructors specified the same optimal RPM and Airspeed settings, low correlations might be anticipated because of the homogeneity of the settings. If instructors did not specify the same optimal settings, however, or if the students were trained in planes with differing optimal settings, high correlations could be achieved to the extent that habits become well fixed.

The consistency observed in the readings of Average Bank cannot be similarly related to a reliance on instruments, since a degree-of-bank indicator was not observable by the students in the experimental planes. The presence of consistency from flight to flight does not mean that the pilot actually attained the correct or specified bank.[15] Consistency in Average Bank merely means that the student pilot tends to develop a fixed habit of attaining the same degree of bank for a given maneuver.

It is to be noted that the above three items refer to average performance during a maneuver. The remaining items, on which the correlational analysis revealed little consistency -- Airspeed Variation, Bank Variation, Altitude Gain or Loss, Altitude Variation, and Maximum Rate of Climb -- are more closely related to smoothness of performance than the other items. Performance on these items would be more seriously affected by air conditions. Moreover, maintenance of bank, airspeed, and altitude requires a coordination of skills not demanded by items such as Average Airspeed, Average Bank, and RPM.

An examination of the data suggests the possibility that at the completion of approximately 35 hours of training, individual student pilots have not yet established specific habits of performance making for consistent differentiation from other student pilots. However, there are various other possibilities that must be considered in explaining the low correlations from flight to flight. One factor may be the tendency of the individual to compensate on errors from one flight to another. For example, if the individual was conscious of too much altitude variation at one time, he might very well make a deliberate effort to reduce his variation in altitude at another time. This compensation might be accomplished at the

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[15] As shown in Table 21, Appendix 4, the mean bank in Medium and Steep Turns was uniformly below the requirements of 45° and 60°, respectively.

expense of other aspects of his performance, and in that way decrease the general consistency of his performance.

Even if there were isolated instances of compensation, however, the summation of items throughout a series of maneuvers usually revealed some degree of consistency of performance. In most cases the correlations between the summation scores of Flight I and Flight II represented increases over the median correlations of the separate maneuvers. Summation of the measures showing a moderate degree of correlation between isolated items resulted in scores sometimes approaching a reliability adequate for criterion purposes. A more refined method of combining measures would probably increase the reliability still more.

Data from the Ball Bank Indicator are not conclusive. There is perhaps a hint of consistency in the avoidance of slips and skids. A more refined classification of the ball bank readings might furnish additional information. On this and the other above items, however, the treatment of the data was limited by the incompleteness of the records.

Comparison of First and Second Flights. The second basic question stated earlier in the report was: "Were there significant changes in performance from first to second flights?" Information on this question can be presented briefly.

The significance of differences between means was determined for the Flight I and Flight II distributions on each item of performance measured, using the t test for matched groups. No comparisons were made when the number of cases was less than eight, and data from Swing 5 were omitted altogether because of the generally small number of cases. Detailed information on these comparisons appears in Appendix 5.[16] A summary of the comparisons appears in Table 12, which indicates the number of comparisons made and the number of differences significant at or below the 5% level.

The summary table reveals little evidence of significant change in performance from the first to the second flight. The total of 20 significant differences out of 351 comparisons is about as many as might occur in random sampling, and not all these differences represent improved performance.

The only single items which may deserve special examination are Average Bank and Altitude Gain or Loss. Reference to Table 29 in Appendix 5 shows that 4 of the 5 significant differences in Average Bank represent improved performance, while 26 of the total of 40 differences are in the direction of improvement. (Negative differences represent improvement on this item, since the average banks in Flight I were considerably below those required for each maneuver.) On the other hand, Table 31 shows

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[16] These tables, which are more detailed than those in Appendices 3 and 4, present the N's, means, standard deviations, differences between means, t values, and p values for each comparison.

that of the 24 comparisons involving gain or loss of altitude during level turns, improvement in performance (in terms of smaller gain or loss in altitude) was exhibited in only 14 instances. Two of the four significant differences represent poorer performance on the second flight.

TABLE 12

SUMMARY TABLE OF FLIGHT I - FLIGHT II DIFFERENCES

Item	No. of Maneuvers	Total No. of t tests	Number significant at or below 5% level
1. Average Airspeed	16	63	2
2. RPM	15	60	3
3. Airspeed Variation	13	52	4
4. Average Bank	10	40	5
5. Variation in Bank	10	40	0
6. Altitude Gain or Loss	11	44	5
7. Variation in Altitude	7	28	1
8. Maximum Rate of Climb	6	24	0
TOTAL		351	20

CONCLUSIONS

The findings of the investigation may be summarized as follows:

1. Of the nine aspects of performance studied, only three (Average Airspeed, Average Bank, and RPM) yielded correlations of any appreciable size when a single measure in the first flight was correlated with the corresponding single measure in the second flight.

2. When corresponding measures in several maneuvers were summated for each flight, correlations tended to be somewhat higher than the median correlations on single maneuvers. In most cases the degree of consistency was so slight that many measures would have to be taken to obtain a score of adequate reliability.

3. Items related to smoothness of performance (Variation in Airspeed, Bank, Altitude, etc.) exhibited generally low levels of consistency.

4. Comparison of the two flights in terms of mean scores on each of the items revealed little evidence of significant change in the direction of either improvement or decline in performance from first to second flights.

These results, although not definitive because of the small samples used, indicate the need for extreme caution in accepting a single flight test as representative of a pilot's proficiency. The study has furnished evidence that measures of some aspects of performance at the end of primary training are much more consistent than others. Further research is needed to identify those aspects which can be measured with highest reliability and for combining such measures into an over-all measure of flight proficiency.

APPENDIX 1

MANUAL FOR USE OF CHECK SHEETS IN RECORDING DATA FROM PHOTOGRAPHIC RECORDS OF FLIGHT PERFORMANCE

Prepared

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MANUAL FOR USE OF CHECK SHEETS IN RECORDING DATA FROM PHOTOGRAPHIC RECORDS OF FLIGHT PERFORMANCE

In connection with the photographic analysis of flight performance, Film Analysis Check Sheets have been designed to provide controlled and accurate observation of the photographic records, and to facilitate the recording of critical information from these records. Samples of the check sheets are attached to this manual. The entries called for in these check sheets fall under three general headings:

1. "Degree" entries, expressed in quantitatively defined terms, based on observations of the instruments in the photographic records.

2. "Duration" entries, expressed in defined terms, indicative of the "duration" of given readings.

3. "Judgment" entries. These entries, of which there are relatively few, are to be made in terms of non-quantitative judgments of plane performance as indicated by the photographic records, e.g., bank entered "smoothly" or "irregularly."

The purpose of this manual is to outline the procedure for reading the records, to define the "Degree" and "Duration" entries in quantitative terms, and to insure that the "Judgment" entries are as clearly defined as possible.

DEFINITIONS OF TERMS

A. Quantitative definition of "degree" entries made on the basis of instrument observations.

1. Ball bank: Observations of this instrument are made in terms of whether the ball moves to the right, or to the left.

The degrees descriptive of excursions of the ball in this instrument are outlined below:

Degree	Lower Limit	Upper Limit
1	Any movement of ball from center position.	Less than one-half of ball outside "lubber" line, i.e., excursion less than radius of ball.
2	One-half, or more, of ball outside "lubber" line.	Less than entire ball outside "lubber" line, i.e., excursion less than diameter of ball.
3	Entire ball outside "lubber" line.	Ball in position less than extreme position, i.e., less than maximum excursion.
4	Ball in extreme position, i.e., maximum excursion.	

2. Artificial Horizon:

a. Wings: Except in those cases where degree of bank is required to to be written in, the amount to which one wing is low, or the wings are rolled, is expressed in terms of coded "degrees," as outlined below. It should be noted that variations of less than 5 degrees are disregarded.

Degree	Lower Limit	Upper Limit
1	5° variation	Less than 10° variation
2	10° variation	Less than 15° variation
3	Greater than 15° variation	

3 Rate of Turn Indicator: Observations of this instrument are to be made in terms of the maximum swing of the pointer in each direction, and in terms of the degree to which the pointer is in the position of degree 2 or greater on either or both sides of the center position.

Degree	Lower Limit	Upper Limit
1	Pointer more than one-half of its width beyond the center mark.	"Leading edge" of pointer touches near edge of triangular marker.
2	"Leading edge" of pointer in position greater than near edge of triangular marker.	"Leading edge" of pointer touches far side of triangular marker, i.e., pointer hand flush with base of triangular marker.
3	"Leading edge" of pointer in position greater than far edge of triangular marker.	Maximum excursion.

4. Airspeed Indicator: Readings of this instrument are in absolute terms, i.e., airspeed is required to be recorded:

   a. In terms of miles per hour at specified points during the maneuver.

   b. In terms of an estimate of the average airspeed during a maneuver or part thereof.

   c. In terms of the limits of the variation in airspeed during the maneuver or part thereof.

5. Rate of Climb: Readings of this instrument are to be in absolute terms, i.e., Rate of Climb is required to be recorded in terms of feet per minute in units of 50 f.p.m.:

   a. At specified points during certain maneuvers.

   b. In terms of the maximum reading during the maneuver or part thereof.

6. Tachometer: Readings of this instrument are to be made in absolute terms, in units of 50 r.p.m. at specified points during certain maneuvers.

7. Altimeter: Readings of this instrument are to be made in absolute terms, in units of 10 feet:

   a. At specified points during certain maneuvers.

   b. In terms of the limits of the variation in altitude during the maneuver or part thereof.

8. Control Indicator: This instrument shows the positions of the Throttle, Aileron, Elevator, and Rudder. The scale on which these

positions are indicated is not linear. A given amount of movement of the controls around the center position results in greater excursions of the pointers than do similar amounts of control movements when such movements are not around the center position. In no case are the movements of the controls to be recorded in absolute terms. In most cases, entries are made in terms of whether the controls were moved, and in terms of the movements of given controls in temporal relation to other controls. Explanation regarding recording of such control movements will be given below in connection with the discussion of entries for specific maneuvers.

B. Definition of duration entries.

In all cases, duration entries fall under four categories descriptive of the interval of time, in a given maneuver, that specific readings continue. These categories of "duration" are defined as follows:

Category	Definition
1	Excursion of instrument from zero or other reference point "temporary," i.e., hand or pointer moves to given position and returns to zero or other reference point without coming to rest during excursion.
2	Hand or pointer within limits of given "degree" position less than fifty per cent of the total duration of given maneuver or specified part of maneuver.
3	Hand or pointer within limits of given "degree" position more than fifty per cent of the duration of given maneuver or specified part of maneuver, but not in given position throughout maneuver, or specified part thereof.
4	Hand or pointer in given position continuously throughout maneuver, or specified part thereof.

C. Recording of "degree-duration" relationships.

During a maneuver, or part of a maneuver, which covers a considerable interval of time, a given instrument may yield various readings, and the "duration" of different readings may not be the same. That is, in terms of plane performance indicated by the instrument readings, a given characteristic of plane performance (e.g., slip) may be evident to varying degrees during the execution of a maneuver or part of a maneuver.

To facilitate the recording of data yielded by this situation, a "checkerboard" scheme is to be used (see Figure 1), with "degree" variables being indicated along the horizontal axis, and duration variables being indicated along the vertical axis. Thus, a given degree reading and its duration can be indicated by a single check mark.

In using the checkerboard scheme, the "degree" readings should be considered as "cumulative," i.e., a check in the square "degree 2, duration 4" indicates that an instrument reading of at least degree 2 (i.e., degree 2 or greater) was observed throughout the maneuver (or specified part). If an instrument reading greater than degree 2 was observed, its degree and duration would be recorded in other columns and rows.

For example, suppose that during a 360° turn the plane (as indicated by the ball bank instrument) slipped to at least degree 2 throughout the maneuver. Suppose further that for less than 50% of the time the ball was in the position denoted by degree 3, and that once during this time the ball swung to the extreme position, but then swung back immediately without coming to rest. Under these conditions, since the ball was in position 2 or greater throughout the maneuver, a check would be placed denoting "degree 2, duration 4." Since in addition the ball swung to position 3 or greater but remained there less than 50% of the time a check would also be placed denoting "degree 3, duration 2." Finally, since the ball swung to the extreme position but returned without coming to rest, a check would be placed denoting "degree 4, duration 1." (See marking of checkerboard in Figure 1.)

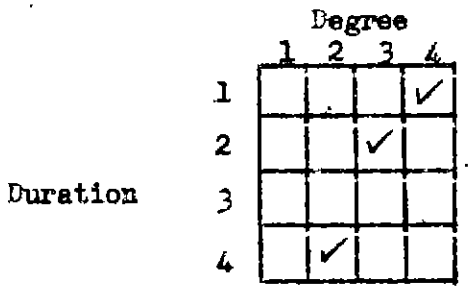


Figure 1

D. Definition of general terms.

Certain terms appear in the check sheets for nearly all maneuvers, and may require explanation. The following terms should be noted:

1. Varies, fluctuates, or rolls: "Varies" or "fluctuates" refer to pointer hands. "Rolls" refers to the wings of the plane, as observed from the artificial horizon. In all cases these terms refer to oscillations of the instrument pointers from the zero point, or from some other stated reference point, and are to be checked whenever the instrument pointers swing on both sides of the zero or reference point. Under these circumstances:

   a. Degree is to be determined in terms of the maximum swing on either side of the zero or reference point.

   b. Duration is to be determined in terms of the interval during which such oscillation occurs.

2. Walks Rudder: This is defined as oscillatory movement of the rudder indicator on both sides of the center position, the pointer not coming to a definite rest position during the swings.

3. Smooth, Irregular: These refer, in general, to changes in the plane position as inferred from the artificial horizon and rate of turn instruments, or to movements of the controls. These items are essentially judgment items.

   a. Irregular denotes the condition in which during the change in position of the plane, or of the controls, reversals in direction of change occur.

   b. Smooth: Changes in plane position or control position which are not "irregular" are defined as "smooth."

4. Control Coordination: It should be noted that in general, indications of the adequacy of degree of control movement are not evident directly from the control indicator, and that the majority of the items are concerned with temporal relationships.

   a. Leads rudder or aileron: These entries, which occur only in check sheets for 180° and 360° turns, should be checked in those situations in which:

      (1) Movements of the rudder and aileron in executing the entry or recovery from a bank are not simultaneous.

      (2) Movements of the rudder and aileron in returning to a streamlined position after the bank has been established or recovered from, are not simultaneous.

5. Maximum Rate of Climb: In recording Maximum Rate of Climb, disregard temporary, sudden, and abrupt fluctuations of the needle, since they are probably due to rough air.

6. Over-recovers: This item refers to the lateral control of the plane in recovering from a bank and is checked when the wings go 5° or more beyond the level position.

7. Cruising Speed: Cruising airspeed should be regarded as between 68 and 75 miles per hour, unless definite evidence exists that the airspeed indicator is not functioning properly.

8. Observer Assisted: The fact that the observer or check pilot assisted is indicated by a prolonged flash of the signal light. The check pilots were instructed to depress a button, lighting the signal light, during the interval in which they were assisting the pilot in flying the plane.

E. Definition of terms peculiar to specific maneuvers.

1. Take-off:

a. Point of take-off: The check pilot was instructed to flash the signal light, momentarily, at the instant the plane left the ground. In case the light does not flash during this maneuver, judgment as to moment of take-off should be made in terms of:

(1) Cessation of vibration of the instruments.

(2) Observation of the elevator indicator. Usually a slight backward movement of the elevator pointer (corresponding to an increase in back pressure on the stick) is made just before, or as, the plane leaves the ground.

b. Plane flown off or stalled off: Stalled off is indicated when there is a definite backward movement of the stick of greater than one scale unit on the control indicator, just before, or as, the plane leaves the ground on take-off, and when the airspeed, immediately after take-off, is unduly low, i.e., 45 miles per hour or under.

2. Turns:

a. Determination of "entry," "turn," and "recovery." The determination of the duration of these parts of the maneuver is to be made primarily in terms of control movements, and secondarily in terms of the plane's position as indicated by the artificial horizon.

(1) The entry should be considered to begin with the first application of the controls in the direction of the bank, and should be considered to end when the aileron control has been returned to the neutral position.

(2) The turn is that portion of the maneuver between the end of the entry and the beginning of the recovery.

(3) The recovery should be considered to begin with the first positive application of the controls in the direction opposite to the bank, which is accompanied by a positive decrease in the angle of bank -- i.e., the first positive application of the controls other than the holding of opposite aileron to maintain the bank. The recovery should be considered to end when the plane returns to a stable level position, i.e., over-recovery should be considered as a part of the recovery.

b. Slip or skid in recovery: In recording observations on slip or skid during recovery in cases where there has been a continuous slip or skid during the turn, mark neither if the ball returns to the zero during the recovery unless:

(1) The return to zero is not smooth, i.e., the ball comes to rest at some point before reaching the zero position.

(2) The slip or skid increases during the recovery, i.e., the excursion of the ball increases during recovery.

c. Readings on airspeed, altitude, and rate of climb should be made at four positions in the maneuver: at the beginning of the maneuver, at the end of the entry, at the beginning of the recovery, and at the completion of the maneuver. In addition, variations in airspeed and altitude, and the Maximum Rate of Climb should be noted during the "turn" portion of the maneuver.

d. Determination of "nose position," from the artificial horizon should be made in terms of the reference circle. The "nose-on-horizon" position of the artificial horizon should be estimated from straight and level flight, and the projector adjusted so that when the plane is in level flight the horizon bar will bisect the reference circle. (If the artificial horizon installation is one in which the horizon is represented by two parallel bars, the projector should be adjusted so that each bar is equidistant from the line which bisects the circle.)

"Nose high" or "nose low" is indicated whenever the horizon bar becomes tangent to the upper or lower halves, respectively, of the periphery of the reference circle. (If the artificial horizon installation is one in which the horizon is represented by two parallel bars, nose high or nose low is indicated when more than half of the space between the parallel bars is outside of the periphery of the circle.) "Nose wanders" is checked when the nose reaches both high and low positions.

e. It should be noted that nose position observations, in terms of the artificial horizon, are to be made only in level turns, and not in the climbing and gliding turns.

3. Stall:

a. The pull-up is defined as beginning when the nose begins to rise -- i.e., if the stall is entered from a definite glide, the glide should be disregarded in making entries on the check sheets.

b. The "break" is that part of the maneuver just before the plane "falls off" and enters the dive -- i.e., the portion of the maneuver where the plane is fully stalled.

c. The recovery from the dive begins when the nose begins to rise at the end of the dive, and ends when it returns to a stable position.

(1) It is almost inevitable that there will be some variation in direction, and in the position of the wings, during the dive. Thus, this part of the maneuver is disregarded. In making observations as to instrument readings during recovery, disregard variations at the beginning of the recovery which are obviously due to variations in direction and wing position during the dive, i.e., if the direction pointer swings to one side during the dive, and then during the first part of the recovery swings back to the "straight" position and stays there, enter the direction as straight.

d. The readings at the "break" should be taken in the following manner:

(1) The camera should be stopped at the beginning of the dive, i.e., just as the nose begins to drop.

(2) The camera should then be run back a few frames, to a point where it is evident that the back pressure is still being increased.

e. The camera should also be stopped at the beginning of the recovery, to insure that this part of the maneuver is observed as a unit.

f. "Evidence of a secondary stall" is indicated when during the recovery from this maneuver, the nose is raised clearly to a nose-high position, the airspeed at the same time dropping to below 50 m.p.h.

g. The "stick full back" position is indicated when the elevator indicator is within one-half unit of its extreme left position.

4. Landing:

a. The "level off" should be considered to begin when the nose begins to rise from the position it maintains during the approach. Confirmatory evidence may be had from the control indicator. At the beginning of the level off, back pressure is usually increased, or the rate of increase of the back pressure is noticeably speeded up.

(1) In checking the direction during level-off, a slight but abrupt movement of the turn indicator just before the wheels touch should be disregarded. Due to the prevalence of slightly cross-wind landings, such movements in the control indicator are probably due to the fact that the plane is turned slightly just before landing.

b. The moment of landing can be determined by the sudden vibration of the instruments, and by the fact that usually (but not always) the stick is pulled full back just before the wheels touch. The observations at "moment of landing" should be made just one or two frames before the record indicates that the wheels touch.

c. If there is no correction made (as for a bad landing), the stick will be held back (although not necessarily full back) and the throttle-r.p.m. will remain at idling. Correction for a bad bounce can be made with either stick alone, or with stick and throttle.

A bounce landing is usually evident from the fact that there is a sudden vibration of the instruments, followed by a brief period of no vibration. Correction with the stick is evident if there is a relaxation of back pressure followed by an increase in back pressure, or when the record indicates that the wheels hit while the stick is not full back, and a subsequent relaxation and increase in pressure occur.

When the throttle is also advanced, throttle correction is indicated.

d. The "stick full back" position is indicated when the elevator indicator is within one-half unit of its extreme left position.

TAKE-OFF (Man. No. 2) Flight No._____

	TAKE-OFF RUN	AT TAKE-OFF	FOLLOWING TAKE-OFF
AIRSPEED		Airspeed at take-off:_____mph	
TURN INDICATOR			Straight___ Right___ Turns:Left___Dgr:1__2__3__ Varies___
BALL BANK		Ball / Bank: Steady___ R___ Swings:L___ Dgr:1__2__3__4__	
CONTROL INDICATOR	Walks rudder: No___ Yes___ Stick back: Smoothly___ Irregul.___	Plane apparently: flown off___ stalled off___	Walks rudder: No___ Yes___
TACHOMETER		RPM at moment of take-off:___RPM	
	Camera turned on too late___		Observer assisted_____ Camera turned off too soon_____

STRAIGHT AND LEVEL (Man. No. 3) Flight No. _____

Altitude: at entry_____ft. at recov_____ft. diff_____ft. Max. variation_____ft. Varies one direction only_____fluctuates

Average:_____MPH Varies_____to_____MPH

Wings: Level_____ R_____ Low: L_____ Rolled_____ Nose: On hor_____ high_____ low_____ Varies_____

Maximum Swing: Straight_____ Right_____ Degree: 1__2__3__ Left_____ Degree: 1__2__3__ Degree 2 or greater--Duration:

Ball Bank: Steady at zero_____ Moves: Rt_____ Lt_____ Fluctuates_____

	1	2	3	4
1				
2				
3				
4				

Uses aileron only in correcting for wing variation: No_____ Yes_____

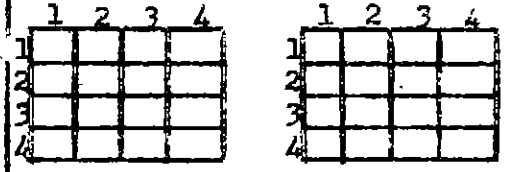
RPM-Throttle at: _____rpm

STRAIGHT CLIMB (Man. No.7) Flight No. 452

	ENTRY	CLIMB	RECOVERY
ALTITUDE	Entry_____ Recovery_____ Diff_____		
AIRSPEED		Airspeed: Ave_____mph Varies:_____to_____	
RATE OF CLIMB		Max. Rate of Climb _____fpm	
ARTIFICIAL HORIZON		Wings: Level_____ R_____ Low: L_____ Rolled_____	
TURN INDICATOR		Maximum Swing No_____ Right____ 1 2 3 Left____ 1 2 3 Degree 2 or greater-- Duration: 1 2 3 4	
BALL BANK		Ball: Steady_____ R_____ Moves: L_____ fluctuates_____ 1 2 3 4 1 2 3 4	
MIXTURE CONTROL	Bk. Pr. Incrsd: before____ after____ throttle as____ advanced	Rudder: walked: No____ Yes____ Uses aileron only in correcting for wing variation: No____ Yes____	Bk. Pr. Decrsd: before____ after____ throttle as____ advanced
TACHOMETER		RPM setting: _____rpm	RPM: returned to_____rpm remains at_____rpm
	Camera turned on too late____		Camera turned off too soon____

TURN MANEUVER NO.
12 13 14 15 16 (17)

Flight No. 452

	ENTRY	TURN	RECOVERY
ALTITUDE	Beginning of Entry____ft. End of Entry____ft.	Altitude varies____to____	Beginning of Recovery____ft. End of Recovery____ft.
AIRSPEED	A.S. at Beg:____ft. A.S. at Entry____ft.	A.S. Average_____mph Varies:____mph to___mph	A.S. at Beg:____ft. A.S. at End____ft.
RATE OF CLIMB	Beginning of Entry____fpm End of Entry____fpm	Rate of Climb: Max_____fpm	Beginning of Recovery 450 fpm End of Recovery 200 fpm
ARTIFICIAL HORIZON	Bank Entered: smthly__irreg__ Nose: Correct____ High____ Low____	Average Bank___° Varies__to__ Nose: Correct____ High____ Low____ Wanders____	Recov (bank): smth____irreg____ Over-recovers: Yes____ No____ Nose: Correct____ High____ Low____
BALL BANK	Moves: Neither____ Right____ Left____ Degree: 1__2__3__4__ Degree: 1__2__3__4__	Left Neither Right 	Moves: Neither____ Right____ Left____ Degree: 1__2__3__4__ Degree: 1__2__3__4__
CONTROL INDICATOR	*Rudder and Aileron Coordinated_____ In Entry Leads R____ A____ Neutralizing: Leads R____ A____	Walks Rudder: Yes____ No____	*Rudder and Aileron Coordinated___ In Entry Leads R____ A____ Neutralizing: R____ A____
TACHOMETER	RPM: Adv_____ or cut	Setting_____RPM	Ret. to_____
	Camera turned on too late____		Camera turned off too soon____

*Mark only in maneuvers 14, 15, 16, 17.

TURN MANEUVER NO. 10 11 22 23

Flight No._____

	ENTRY	TURN	RECOVERY
ALTIMETER	Beginning of Entry_____ft. End of Entry_____ft.	Altitude varies_____to_____	Beginning of Recovery_____ft. End of Recovery_____ft.
AIRSPEED	A.S. at Beg:_____mph End of Entry_____mph	A.S. Average_____mph Varies:_____mph to_____mph	A.S. at Beg:_____mph A.S. at End_____mph
RATE OF CLIMB	Beginning of Entry_____fpm End of Entry_____fpm	Rate of Climb: Max_____fpm	Beginning of Recovery_____fpm End of Recovery_____fpm
BANK	Smoothly_____ Bank entered: Irregul._____	Average Bank_____° Varies_____to_____	Recov(Bank): Smth_____irreg_____ Over-recovers: Yes_____No_____
TURN	Moves: Neither_____ Right_____ Left_____ Degree: 1__2__3__4__ Degree: 1__2__3__4__	Left / Neither / Right 1 2 3 4 1 2 3 4	Moves: Neither_____ Right_____ Left_____ Degree: 1__2__3__4__ Degree: 1__2__3__4__
CONTROL POSITION		Walks rudder: No_____ Yes_____	
TACHOMETER	RPM: Adv_____ or cut	Setting:_____RPM	Ret. to_____
	Camera turned on too late___		Camera turned off too soon_____

NORMAL STALL (Man. No. 18)

Flight No._____

	PULL UP	BREAK	RECOVERY FROM DIVE
[illegible]	Altitude at entry_____ft.	Altitude at break_____mph	Altitude at recovery_____ft.
[illegible]		Airspeed at break_____mph	Higher than cruising during dive:_____ Levels off to:_____mph
[illegible]	Wings: level____ low R____ Dgr. 1 2 3 4 L____ rolled____	Wings: level__ dropped R____ o L____ o	Wings: level____ low R____ L____ rolled____
			Evidence of secondary stall: No____ Yes____
[illegible]	Maximum Swing: No Right 1 2 3 Left 1 2 3		Maximum Swing: No Right 1 2 3 Left 1 2 3
CONTROL INDICATOR	Elev. pressure increased: smoothly____ irregul.____	Stick full back: Yes____ No____ In stalled condition: Low wing raised by: R__dgr. A__ Neither__ Walks rudder: No____ Yes____	Bk. Pr. Released: During dive____ During recov____ For'd pressure Used: Yes____ No____
TACHOMETER	Throttle cut to: idling____ _____rpm		Returned to: cruising_____ _____rpm During dive_____ During recovery_____
	Camera on too late_____		Camera off too soon_____

STRAIGHT GLIDE (Man. No. 21) Flight No._____

	ENTRY	GLIDE	RECOVERY
ALTIMETER	At entry_____ft. At recov_____ft. diff_____ft.		
AIRSPEED	A.S. increases No_____ above cruising: MPH_____	Ave. A.S. _____mph Varies:_____to____mph	A.S. increases No_____ above cruising: MPH_____
RATE OF CLIMB		Max. rate of climb _____fpm	
ARTIFICIAL HORIZON		Wings: level_____ / low R_____ L_____ / rolled_____	
TURN INDICATOR		Maximum swing: No____ / Right____ 1 2 3 / Left____ 1 2 3 Degree 2 or greater-- Duration: 1 2 3 4	
BALL BANK		Ball: Steady____ / Rolls R____ L____ / Varies____ 1 2 3 4 1 2 3 4	
CONTROL INDICATOR		Rudder: walked: No____ / Yes____	
		Uses aileron only in correction for wing variation: No____ / Yes____	
	Bk. Pr. incrs: before____ / after____ Throttle / as____ cut		Bk. Pr. decrsd: before____ / after____ Throttle / as____ advanced
TACHOMETER	Throttle retarded to_____rpm		Throttle returned to: cruising_____rpm_____
	Camera turned on too late____		Camera turned off too soon____

LANDING (Man. No. 27) Flight No._____

	LEVEL-OFF	MOMENT OF LANDING	LANDING RUN
AIRSPEED	Airspeed at beginning of level off:_____MPH	A.S. at moment of landing_____	
LATERAL CONTROL	Wings: level_____ Low R_____ L_____ rolled_____	At moment of landing R_____ wing low L_____ wings level_____	
RUDDER CONTROL	Maximum swing No_____ Right___1___2___3___ Left_____ Degree 2 or greater-- Duration: 1___2___3___4___		Maximum swing No_____ Right_____ Left_____ Degree 2 or greater-- Duration: 1___2___3___
CONTROL INDICATOR	Bk. Pr. Incread: smoothly_____ irregul._____	Stick full back at M. of L. Yes_____ No_____	Stick held back during run Yes_____ No_____
	Walks rudder: No_____ Yes_____		Rudder walked: Yes_____ No_____
TACHOMETER THROTTLE	RPM during level off_____		
	Camera on too late_____	Landing: No correction_____ stick_____ throttle_____	Camera off too soon_____ Observer assisted_____

APPENDIX 2

RELIABILITY OF CHECK SHEET ENTRIES

APPENDIX 2

RELIABILITY OF CHECK SHEET ENTRIES

Two teams of four film readers each were used in the reading of the photographic records, one serving during the morning session and the other during the afternoon session. In order to obtain experimental data as to the accuracy of the readings, (and at the same time to provide an incentive for maintenance of as high a level of accuracy as possible), records were periodically selected for re-reading by either the same or the other team. At the time of the first reading, the fact that the record was to be re-read was not made known to the team doing the reading.

Comparison of the two sets of readings of the same record were made by tabulating the instances of agreement and disagreement between the two. Agreements in terms of the following tolerance limits were set up:

1. Airspeed: 5 miles per hour
2. RPM: 100 rpm
3. Bank: 5 degrees
4. Altitude: 10 feet
5. Rate of Climb: 100 feet per minute
6. Ball Bank: absolute agreement in degree readings

The tables in this Appendix indicate the consistency with which [illegible] records were read and re-read by the same teams, and the consistency with which given records were read by the two teams independently. The columns and rows of the tables are interpreted as follows:

1. The first four columns give the frequencies in the various row categories, and the second four columns give the percentages in the various row categories. (If the frequencies were less than 30 for each of the teams separately, the percentage values were not determined.)

2. Within each unit of four columns the column headings are interpreted as follows:

(a) Team 1: The frequencies or percentages of comparisons of original and re-read records (morning team).

(b) Team 2: The frequencies or percentages of comparisons of original and re-read records (afternoon team).

(c) Combined: The frequencies or percentages of comparisons of original and re-read records for morning and afternoon teams combined.

(d) Cross Checks: The frequencies or percentages of comparisons of given records read by the two teams independently.

3. The rows under the frequency columns are interpreted as follows:

(a) Row A denotes agreement within tolerance limits.

(b) Row D_1 represents non-critical discrepancies, defined as follows in terms of those items to which the category applies.

(1) Altitude: Discrepancies greater than 10 feet, but less than 20 feet (the unit in which the instrument was calibrated).

(2) Nose Position: Discrepancies in absolute reading, both readings representing undesirable aspects of performance. If one paper were marked "Nose Wandered," the other "Nose Low," this would constitute a non-critical discrepancy.

(3) Ball Bank: Discrepancies in absolute readings, both readings representing undesirable aspects of performance. If one paper were marked "Right 1, Left 3" and the other paper were marked "Left 3 (right zero, i.e., not marked)" this would constitute a non-critical discrepancy.

(4) Wing position in maneuvers other than turns: Defined comparably to "Nose Position" above; for example, "Wing Low" vs. "Wings Rolled" constitutes a non-critical discrepancy.

(5) Rate of turn in maneuvers other than turns: Defined comparably to "Ball Bank" above.

(c) Row D_2 represents discrepancies outside tolerance limits other than non-critical discrepancies.

(d) Row D all discrepancies outside basic tolerance limits.

(e) Row O all omissions.

4. The rows under the percentage columns are interpreted as follows:

(a) Row A (no percentages computed).

(b) Row D_1 represents D_1 divided by total minus omissions.

(c) Row D_2 represents D_2 divided by total minus omissions.

(d) Row D represents D divided by total minus omissions.

(e) Row O represents O divided by total.

TABLE 13

TURNS

(90° Shallow Turn Right, 90° Shallow Turn Left, 180° Turn Right, 180° Turn Left, 360° Turn Right, 360° Turn Left)

Item		Team 1	Team 2	Combined	Cross Check	Team 1	Team 2	Combined	Cross check
Altitude & Altitude Variation	A	326	267	593	246	-	-	-	-
	D_1	12	4	16	7	.03	.01	.03	.03
	D_2	9	9	18	4	.03	.03	.03	.02
	D	21	13	34	11	.06	.05	.05	.04
	O	13	20	33	13	.04	.07	.05	.05
Airspeed	A	342	279	621	256	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	4	4	8	1	.01	.01	.01	.00
	D	4	4	8	1	.01	.01	.01	.00
	O	14	17	31	13	.04	.06	.05	.05
Airspeed Variation	A	119	95	214	89	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	0	0	0	0	.00	.00	.00	.00
	D	0	0	0	0	.00	.00	.00	.00
	O	1	5	6	1	.01	.05	.03	.01
Rate of Climb	A	341	278	619	254	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	5	4	9	4	.01	.01	.01	.02
	D	5	4	9	4	.01	.01	.01	.02
	O	14	18	32	12	.04	.06	.05	.04
Bank: smooth-irregular	A	216	172	388	154	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	3	9	12	7	.01	.05	.03	.04
	D	3	9	12	7	.01	.05	.03	.04
	O	21	19	40	19	.09	.09	.09	.11
Average Bank	A	115	92	207	80	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	0	0	0	3	.00	.00	.00	.04
	D	0	0	0	3	.00	.00	.00	.04
	O	5	8	13	7	.05	.08	.06	.08
Bank Variation	A	113	91	204	81	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	2	1	3	1	.02	.01	.01	.01
	D	2	1	3	1	.02	.01	.01	.01
	O	5	8	13	7	.04	.08	.06	.08
Over-recovers	A	101	81	182	66	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	7	9	16	13	.06	.10	.08	.16
	D	7	9	16	13	.06	.10	.08	.16
	O	12	11	23	11	.10	.10	.10	.12

TABLE 13

TURNS (Continued)

Item		Team 1	Team 2	Com-bined	Cross check	Team 1	Team 2	Com-bined	Cross check
Nose Position	A	155	134	289	113	-	-	-	-
	D_1	0	3	3	3	.00	.02	.01	.02
	D_2	40	29	69	33	.21	.17	.19	.22
	D	40	32	72	36	.21	.19	.20	.24
	O	21	14	35	13	.10	.08	.09	.08
Ball Bank-Direction	A	324	261	585	245	-	-	-	-
	D_1	15	20	35	14	.04	.07	.06	.05
	D_2	3	1	4	0	.01	.00	.01	.00
	D	18	21	39	14	.05	.07	.06	.05
	O	18	18	36	11	.05	.06	.05	.04
Ball Bank-Degree	A	306	239	545	205	-	-	-	-
	D_1	21	26	47	21	.06	.09	.07	.08
	D_2	18	18	36	33	.05	.06	.06	.13
	D	39	44	83	54	.11	.16	.13	.21
	O	15	17	32	11	.04	.06	.05	.03
Aileron-Rudder Coordination--Beginning of entry & recovery	A	60	57	117	41	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	10	9	19	15	.14	.14	.14	.27
	D	10	9	19	15	.14	.14	.14	.27
	O	26	14	40	16	.27	.18	.23	.22
Aileron-Rudder Coordination--End of entry & recovery	A	57	54	111	39	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	13	11	24	17	.19	.17	.18	.30
	D	13	11	24	17	.19	.17	.18	.30
	O	26	15	41	16	.27	.19	.23	.22
Walks Rudder	A	115	96	211	-	-	-	-	-
	D_1	0	0	0	-	-	-	-	-
	D_2	1	0	1	-	.01	.00	.00	.00
	D	1	0	1	-	.01	.00	.00	.00
	O	4	4	8	-	.03	.04	.04	.04
RPM	A	345	285	630	250	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	1	2	3	9	.00	.01	.00	.03
	D	1	2	3	9	.00	.01	.00	.03
	O	14	13	27	11	.04	.04	.04	.04

TABLE 14

STRAIGHT MANEUVERS

(Straight and Level, Climb, Glide)

Item		Team 1	Team 2	Com-bined	Cross check	Team 1	Team 2	Com-bined	Cross check
Altitude-diff. beginning & end	A	32	26	58	25	-	-	-	-
	D_1	1	1	2	1	.03	.03	.03	.04
	D_2	1	2	3	0	.03	.07	.05	.00
	D	2	3	5	1	.06	.10	.08	.04
	0	2	1	3	1	.06	.03	.05	.04
Altitude-Maximum Variation	A	10	10	20	8				
	D_1	1	0	1	0				
	D_2	1	0	1	1				
	D	2	0	2	1				
	0	0	0	0	0				
Airspeed	A	35	28	63	27	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	0	1	1	0	.00	.03	.02	.00
	D	0	1	1	0	.00	.03	.02	.00
	0	1	1	2	0	.03	.03	.03	.00
Airspeed Variation	A	34	28	62	26	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	1	1	2	1	.03	.03	.03	.04
	D	1	1	2	1	.03	.03	.03	.04
	0	1	1	2	0	.03	.03	.03	.00
Maximum Rate of Climb	A	22	17	39	17				
	D_1	0	0	0	0				
	D_2	1	1	2	1				
	D	1	1	2	1				
	0	1	2	3	0				
Wing Position	A	25	18	43	18	-	-	-	-
	D_1	1	2	3	0	.04	.07	.05	.00
	D_2	2	9	11	9	.07	.31	.19	.33
	D	3	11	14	9	.11	.38	.25	.33
	0	8	1	9	0	.22	.03	.14	.00
Nose Position	A	6	9	15	8				
	D_1	0	0	0	0				
	D_2	1	1	2	0				
	D	1	1	2	0				
	0	5	0	5	1				

TABLE 14

STRAIGHT MANEUVERS (Continued)

Item		Team 1	Team 2	Com-bined	Cross check	Team 1	Team 2	Com-bined	Cross check
Rate of Turn	A	28	23	51	14	-	-	-	-
	D_1	4	4	8	7	.11	.14	.12	.29
	D_2	3	2	5	3	.09	.07	.08	.12
	D	7	6	13	10	.20	.21	.20	.42
	O	1	1	2	0	.03	.03	.03	.00
Bell Bank-Direction-Degree	A	34	26	60	24	-	-	-	-
	D_1	0	0	0	1	.00	.00	.00	.04
	D_2	1	3	4	4	.03	.10	.06	.15
	D	1	3	4	5	.03	.10	.06	.19
	O	1	1	2	0	.03	.03	.03	.00
Back-Pressure-Throttle Coordinated	A	13	19	32	16				
	D_1	0	0	0	0				
	D_2	3	0	3	1				
	D	3	0	3	1				
	O	8	1	9	1				
Walks Rudder	A	21	19	40	18				
	D_1	0	0	0	0				
	D_2	0	0	0	0				(Climb and Glide only)
	D	0	0	0	0				
	O	3	1	4	0				
Uses Aileron only	A	26	28	54	23	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	6	0	6	1	.19	.00	.10	.04
	D	6	0	6	1	.19	.00	.10	.04
	O	4	2	6	3	.11	.07	.09	.11
RPM	A	58	46	104	43	-	-	-	-
	D_1	0	0	0	0	-	-	-	-
	D_2	0	2	2	1	.00	.04	.02	.02
	D	0	2	2	1	.00	.04	.02	.02
	O	2	2	4	1	.03	.04	.04	.02

TABLE 15

STALL, TAKE-OFF, LANDING

Item		Team 1	Team 2	Combined	Cross check	Team 1	Team 2	Combined	Cross check	
Airspeed	A	50	36	86	35	-	-	-	-	
	D_1	0	0	0	0	-	-	-	-	
	D_2	0	4	4	2	.00	.10	.04	.05	
	D	0	4	4	2	.00	.10	.04	.05	
	0	10	10	20	8	.17	.20	.18	.18	
Rate of Turn	A	39	30	69	22	-	-	-	-	
	D_1	5	6	11	6	.10	.16	.13	.17	
	D_2	5	2	7	8	.10	.05	.08	.22	
	D	10	8	18	14	.20	.21	.21	.39	
	0	11	12	23	9	.18	.24	.21	.20	
Ball Bank Direction	A	11	7	18	6					(Take-off only)
	D_1	0	1	1	0					
	D_2	0	0	0	0					
	D	0	1	1	0					
	0	1	2	3	3					
Ball Bank Degree	A	9	7	16	6					(Take-off only)
	D_1	0	1	1	0					
	D_2	2	0	2	0					
	D	2	1	3	0					
	0	1	2	3	3					
Walks Rudder	A	39	37	76	30	-	-	-	-	
	D_1	0	0	0	0	-	-	-	-	
	D_2	6	2	8	6	.13	.05	.10	.17	
	D	6	2	8	6	.13	.05	.10	.17	
	0	15	11	26	9	.25	.22	.24	.20	
Flown off or Stalled off	A	11	8	19	5					(Take-off only)
	D_1	0	0	0	0					
	D_2	0	0	0	1					
	D	0	0	0	1					
	0	1	2	3	3					
Stick back smooth - irregular	A	31	24	55	19	-	-	-	-	
	D_1	0	0	0	0	-	-	-	-	
	D_2	2	2	4	4	.06	.08	.07	.05	
	D	2	2	4	4	.06	.08	.07	.05	
	0	3	4	7	4	.08	.13	.11	.05	
RPM	A	46	34	79	31	-	-	-	-	
	D_1	0	0	0	0	-	-	-	-	
	D_2	0	0	0	1	.00	.00	.00	.03	
	D	0	0	0	1	.00	.00	.00	.03	
	0	3	6	9	4	.06	.15	.10	.11	

TABLE 15

STALL, TAKE-OFF, LANDING (Continued)

Item		Team 1	Team 2	Combined	Cross check	Team 1	Team 2	Combined	Cross check	
Back Pressure released - dive or recovery	A	12	9	21	9					
	D_1	0	0	0	0					(Stall only)
	D_2	0	0	0	0					
	D	0	0	0	0					
	0	0	1	1	0					
Forward Pressure Used	A	11	9	20	8					
	D_1	0	0	0	0					(Stall only)
	D_2	1	0	1	1					
	D	1	0	1	1					
	0	0	1	1	0					
RPM during dive or recovery	A	11	8	19	8					
	D_1	0	0	0	0					(Stall only)
	D_2	0	0	0	1					
	D	0	0	0	1					
	0	1	2	3	0					
Uses Rudder-Aileron in Stall	A	11	7	18	6					
	D_1	0	0	0	0					(Stall only)
	D_2	1	2	3	3					
	D	1	2	3	3					
	0	0	1	1	0					
Altitude	A	33	24	57	26	-	-	-	-	
	D_1	1	0	1	0	.03	.00	.02	.00	(Stall only)
	D_2	1	1	2	1	.03	.04	.03	.04	
	D	2	1	3	1	.06	.04	.05	.04	
	0	1	5	6	0	.03	.17	.09	.00	
Wing Position	A	47	38	85	33	-	-	-	-	
	D_1	0	1	1	2	.00	.02	.01	.05	
	D_2	6	2	8	9	.11	.05	.08	.20	
	D	6	3	9	11	.11	.07	.10	.24	
	0	7	9	16	1	.12	.13	.15	.02	
Landing - correction	A	8	4	12	3					
	D_1	0	0	0	0					(Landing only)
	D_2	0	0	0	0					
	D	0	0	0	0					
	0	4	6	10	6					

APPENDIX 3

DIFFERENCE BETWEEN PLANES

APPENDIX 3

TABLE 16

AVERAGE AIRSPEED

(Difference Between Planes)

	N		Mean		Diff. between		
	Cont.	Fkn.	Cont.	Fkn.	Means	t value	p value
Take-off							
Swings 1 & 2							
Flight I	14	15	52.0	52.3	-.3	.179	-
Flight II			51.3	51.7	-.4	.230	-
Swings 3 & 4							
Flight I	16	19	51.8	49.3	2.5	1.718	-
Flight II			52.8	48.4	4.4	2.855	.01
Straight and Level							
Swings 1 & 2							
Flight I	17	19	73.3	68.2	5.1	3.602	.01
Flight II			73.9	68.7	5.2	3.121	.01
Swings 3 & 4							
Flight I	24	24	75.4	67.3	8.1	8.608	.01
Flight II			76.8	68.3	8.5	6.218	.01
Straight Climb and Recovery							
Swings 1 & 2							
Flight I	20	21	65.3	62.3	3.0	2.055	.05
Flight II			65.4	61.2	4.2	3.811	.01
Swings 3 & 4							
Flight I	23	23	66.9	58.7	8.2	6.147	.01
Flight II			66.2	59.0	7.2	5.995	.01
90° Climbing Turn Right 45° Bank							
Swings 1 & 2							
Flight I	22	20	63.9	61.1	2.8	2.191	.05
Flight II			63.4	59.6	3.8	3.571	.01
Swings 3 & 4							
Flight I	26	24	64.7	58.4	6.3	5.459	.01
Flight II			64.2	59.0	5.2	3.226	.01

TABLE 16

AVERAGE AIRSPEED (Continued)

	N		Mean		Diff. between Mean	t value	p value
	Cont.	Fkn.	Cont.	Fkn.			
90° Climbing Turn Left 45° Bank							
Swings 1 & 2							
Flight I	20	17	63.1	60.1	3.0	1.970	.05
Flight II			62.4	58.6	3.8	2.955	.01
Swings 3 & 4							
Flight I	26	21	63.4	56.9	6.5	4.660	.01
Flight II			63.2	56.7	6.5	5.444	.01
90° Turn Left 15° Bank							
Swings 1 & 2							
Flight I	20	20	71.5	66.2	5.3	4.080	.01
Flight II			71.5	65.4	6.1	4.815	.01
Swings 3 & 4							
Flight I	26	23	73.0	64.1	8.9	8.468	.01
Flight II			73.1	64.4	8.7	8.414	.01
90° Turn Right 15° Bank							
Swings 1 & 2							
Flight I	22	20	72.2	65.9	6.3	4.446	.01
Flight II			70.0	65.4	4.6	3.569	.01
Swings 3 & 4							
Flight I	27	21	73.7	64.6	9.1	9.401	.01
Flight II			72.4	63.8	8.6	8.669	.01
180° Turn Left 15° Bank							
Swings 1 & 2							
Flight I	20	21	71.9	65.4	6.5	4.501	.01
Flight II			71.0	65.0	6.0	4.292	.01
Swings 3 & 4							
Flight I	26	23	72.5	63.7	8.8	8.044	.01
Flight II			71.2	62.4	8.8	7.370	.01

TABLE 16

AVERAGE AIRSPEED (Continued)

	N		Mean		Diff. between Means	t value	p value
	Cont.	Fkn.	Cont.	Fkn.			
180° Turn Right 45° Bank							
Swings 1 & 2							
Flight I	23	22	70.7	65.4	5.3	4.285	.01
Flight II			70.5	65.7	4.8	3.718	.01
Swings 3 & 4							
Flight I	26	24	73.9	63.8	10.1	9.066	.01
Flight II			72.9	63.3	9.6	7.980	.01
360° Steep Turn Left 60° Bank							
Swings 1 & 2							
Flight I	23	21	70.5	64.5	6.0	3.390	.01
Flight II			70.4	64.7	5.7	3.389	.01
Swings 3 & 4							
Flight I	26	23	68.9	62.6	6.3	3.992	.01
Flight II			69.1	60.7	8.4	6.507	.01
360° Steep Turn Right 60° Bank							
Swings 1 & 2							
Flight I	19	20	69.4	65.3	4.1	2.618	.01
Flight II			68.6	64.5	4.1	2.559	.02
Swings 3 & 4							
Flight I	26	22	71.7	62.4	9.3	5.643	.01
Flight II			71.0	62.6	8.4	5.253	.01
Normal Power-off Stall							
Swings 1 & 2							
Flight I	17	11	45.5	37.5	8.0	8.575	.01
Flight II			45.1	37.2	7.9	6.470	.01
Swings 3 & 4							
Flight I	20	14	45.8	37.2	8.6	8.007	.01
Flight II			44.9	37.2	7.7	8.902	.01

TABLE 16

AVERAGE AIRSPEED (Continued)

	N		Mean		Diff. between Mean	t value	p value
	Cont.	Fkn.	Cont.	Fkn.			
Straight Glide and Recovery							
Swings 1 & 2							
Flight I	20	19	69.0	63.1	5.9	4.777	.01
Flight II			70.1	62.4	7.7	6.537	.01
Swings 3 & 4							
Flight I	23	19	71.3	63.4	7.9	6.650	.01
Flight II			69.4	62.3	7.1	6.611	.01
90° Glide Turn Right 15° Bank							
Swings 1 & 2							
Flight I	22	18	64.5	59.6	4.9	3.917	.01
Flight II			64.0	59.0	5.0	3.953	.01
Swings 3 & 4							
Flight I	21	15	66.4	60.5	5.9	5.996	.01
Flight II			66.0	59.8	6.2	5.631	.01
90° Glide Turn Left 15° Bank							
Swings 1 & 2							
Flight I	21	18	65.2	59.7	5.5	5.041	.01
Flight II			65.0	60.5	4.5	3.710	.01
Swings 3 & 4							
Flight I	17	16	65.9	58.8	7.1	6.196	.01
Flight II			64.8	58.8	6.0	6.936	.01
Landing							
Moment of Landing							
Swings 1 & 2							
Flight I	14	13	47.5	39.8	7.7	8.244	.01
Flight II			46.1	39.9	6.2	5.377	.01
Swings 3 & 4*							
Flight I	9	7	-	-	-	-	-
Flight II			-	-	-	-	-

*Omitted: N < 8

TABLE 17

RPM

(Difference Between Planes)

	N		Mean		Diff. between Means	t value	p value
	Cont.	Fkn.	Cont.	Fkn.			
Take-off							
Swings 1 & 2							
Flight I	14	15	2029	2137	-108	6.407	.01
Flight II			2032	2157	-125	7.616	.01
Swings 3 & 4							
Flight I	17	18	2015	2095	-80	7.360	.01
Flight II			2024	2092	-68	3.804	.01
Straight and Level							
Swings 1 & 2							
Flight I	18	19	2020	2050	-30	1.534	-
Flight II			2017	2032	-15	.840	-
Swings 3 & 4							
Flight I	24	24	2034	1988	46	3.336	.01
Flight II			2042	2000	42	2.777	.01
Straight Climb and Recovery							
Swings 1 & 2							
Flight I	20	21	2048	2095	-47	2.062	.05
Flight II			2043	2074	-31	1.400	-
Swings 3 & 4							
Flight I	23	23	2055	2055	0	.000	-
Flight II			2065	2102	-37	2.147	.05
90° Climbing Turn Right 45° Bank							
Swings 1 & 2							
Flight I	22	19	2055	2113	-58	3.227	.01
Flight II			2039	2111	-72	4.590	.01
Swings 3 & 4							
Flight I	26	24	2054	2090	-36	2.303	.05
Flight II			2054	2102	-48	2.818	.01

TABLE 17

RPM (Continued)

	N		Mean		Diff. between Means	t value	p value
	Cont.	Ekn.	Cont.	Ekn.			
90° Climbing Turn Left 45° Bank							
Swings 1 & 2							
Flight I	20	17	2045	2091	-46	2.115	.05
Flight II			2035	2089	-54	3.378	.01
Swings 3 & 4							
Flight I	26	21	2052	2091	-39	2.469	.02
Flight II			2056	2105	-49	3.245	.01
90° Turn Left 15° Bank							
Swings 1 & 2							
Flight I	20	21	2015	2022	-7	.422	-
Flight II			2005	2034	-29	1.774	-
Swings 3 & 4							
Flight I	25	23	2026	1998	28	1.779	-
Flight II			2028	1992	36	2.776	.01
90° Turn Right 15° Bank							
Swings 1 & 2							
Flight I	22	21	1989	2019	-30	1.700	-
Flight II			1978	2019	-41	2.563	.02
Swings 3 & 4							
Flight I	27	21	2013	1998	15	.796	-
Flight II			2013	1984	29	2.461	.02
180° Turn Left 45° Bank							
Swings 1 & 2							
Flight I	20	21	2013	2026	-13	.740	-
Flight II			2010	2024	-14	.770	-
Swings 3 & 4							
Flight I	26	23	2025	2007	18	1.031	-
Flight II			2000	1998	2	.132	-

TABLE 17

RPM (Continued)

	N		Mean		Diff. between Mean	t value	p value
	Cont.	Fkn.	Cont.	Fkn.			
180° Turn Right 45° Bank							
Swings 1 & 2							
Flight I	23	22	1998	2037	-39	2.359	.02
Flight II			2007	2032	-25	1.525	-
Swings 3 & 4							
Flight I	26	24	2027	2004	23	1.637	-
Flight II			2020	1994	26	1.651	-
360° Steep Turn Left 60° Bank							
Swings 1 & 2							
Flight I	23	21	2068	2138	-70	3.156	.01
Flight II			2061	2136	-75	2.740	.01
Swings 3 & 4							
Flight I	26	23	2075	2096	-21	1.070	-
Flight II			2070	2102	-32	1.621	-
360° Steep Turn Right 60° Bank							
Swings 1 & 2							
Flight I	19	20	2048	2108	-60	2.299	.05
Flight II			2040	2113	-73	3.068	.01
Swings 3 & 4							
Flight I	26	23	2073	2100	-27	1.368	-
Flight II			2068	2102	-34	1.330	-
Straight Glide and Recovery							
Swings 1 & 2							
Flight I	18	17	867	768	99	1.662	-
Flight II			922	738	184	2.694	.01
Swings 3 & 4							
Flight I	22	19	750	871	-121	3.467	.01
Flight II			716	974	-258	3.283	.01

TABLE 17

RPM (Continued)

	N		Mean		Diff. between Means	t value	p value
	Cont.	Fkn.	Cont.	Fkn.			
90° Gliding Turn Right 15° Bank							
Swings 1 & 2							
Flight I	19	18	874	784	90	1.394	-
Flight II			845	742	103	2.031	.05
Swings 3 & 4							
Flight I	20	16	745	950	-205	2.947	.01
Flight II			738	894	-156	4.687	.01
90° Gliding Turn Left 15° Bank							
Swings 1 & 2							
Flight I	19	18	895	736	159	2.638	.01
Flight II			942	750	192	2.826	.01
Swings 3 & 4							
Flight I	16	16	750	863	-113	2.748	.02
Flight II			747	885	-138	3.581	.01
Landing During Level Off							
Swings 1 & 2							
Flight I	17	14	774	657	117	2.717	.02
Flight II			800	672	128	2.143	.05
Swings 3 & 4							
Flight I	13	10	727	840	-113	2.802	.02
Flight II			719	810	-91	2.249	.05

TABLE 18

MAXIMUM RATE OF CLIMB

(Difference Between Planes)

	N		Mean		Diff. between Means	t value	p value
	Cont.	Fkn.	Cont.	Fkn.			
Straight Climb and Recovery							
Swings 1 & 2							
Flight I	20	21	418	229	189	5.025	.01
Flight II			435	231	204	5.472	.01
Swings 3 & 4							
Flight I	22	23	455	223	232	7.081	.01
Flight II			466	263	203	5.363	.01
90° Climbing Turn Right 45° Bank							
Swings 1 & 2							
Flight I	22	20	346	190	156	3.544	.01
Flight II			375	203	172	4.248	.01
Swings 3 & 4							
Flight I	26	24	383	206	177	5.551	.01
Flight II			389	215	174	5.754	.01
90° Climbing Turn Left 45° Bank							
Swings 1 & 2							
Flight I	20	18	325	189	136	3.367	.01
Flight II			308	208	100	2.917	.01
Swings 3 & 4							
Flight I	26	21	419	186	233	7.747	.01
Flight II			452	221	231	6.273	.01
Straight Glide and Recovery							
Swings 1 & 2							
Flight I	21	19	-786	-350	-436	8.457	.01
Flight II			-645	-390	-255	3.872	.01
Swings 3 & 4							
Flight I	22	19	-805	-318	-487	7.470	.01
Flight II			-748	-297	-451	7.234	.01

TABLE 18

MAXIMUM RATE OF CLIMB (Continued)

	N		Mean		Diff. between Means	t value	p value
	Cont.	Fkn.	Cont.	Fkn.			
90° Gliding Turn Right 15° Bank							
Swings 1 & 2							
Flight I	22	18	-816	-406	-410	8.038	.01
Flight II			-884	-383	-501	11.662	.01
Swings 3 & 4							
Flight I	20	16	-845	-303	-542	12.912	.01
Flight II			-699	-316	-383	5.074	.01
90° Gliding Turn Left 15° Bank							
Swings 1 & 2							
Flight I	21	18	-848	-400	-448	7.198	.01
Flight II			-857	-397	-460	11.925	.01
Swings 3 & 4							
Flight I	17	17	-827	-300	-527	12.977	.01
Flight II			-797	-315	-482	11.327	.01

TABLE 19

ALTITUDE DIFFERENCE

(Difference Between Planes)

	N		Mean		Diff. between Means	t value	p value
	Cont.	Exp.	Cont.	Exp.			
Straight and Level							
Swings 1 & 2							
Flight I	17	19	20	14	6	.600	-
Flight II			7	19	-12	.677	-
Swings 3 & 4							
Flight I	24	23	-3	-11	8	1.165	-
Flight II			16	-7	23	2.724	.01
90° Turn Left 15° Bank							
Swings 1 & 2							
Flight I	20	21	14	18	-4	.296	-
Flight II			22	14	8	.756	-
Swings 3 & 4							
Flight I	23	23	21	14	7	.617	-
Flight II			11	11	0	.000	-
90° Turn Right 15° Bank							
Swings 1 & 2							
Flight I	22	21	10	7	3	.360	-
Flight II			30	14	16	1.936	-
Swings 3 & 4							
Flight I	24	18	9	8	1	.111	-
Flight II			57	11	46	.956	-
180° Turn Left 45° Bank							
Swings 1 & 2							
Flight I	20	21	-11	3	-14	1.516	-
Flight II			2	-1	3	.497	-
Swings 3 & 4							
Flight I	25	23	2	3	-1	.138	-
Flight II			7	6	1	.179	-

TABLE 19

ALTITUDE DIFFERENCE (Continued)

	N		Mean		Diff. between Means	t value	p value
	Cont.	Fkn.	Cont.	Fkn.			
180° Turn Right 45° Bank							
Swings 1 & 2							
Flight I	22	22	4	2	2	.281	-
Flight II			-2	1	-3	.349	-
Swings 3 & 4							
Flight I	26	23	8	8	0	.000	-
Flight II			5	11	-6	.919	-
360° Steep Turn Left 60° Bank							
Swings 1 & 2							
Flight I	23	21	-7	-13	6	.463	-
Flight II			1	-11	12	.770	-
Swings 3 & 4							
Flight I	26	23	15	-24	39	3.788	.01
Flight II			5	-1	6	.689	-
360° Steep Turn Right 60° Bank							
Swings 1 & 2							
Flight I	19	20	-5	-20	15	1.125	-
Flight II			-8	-11	3	.270	-
Swings 3 & 4							
Flight I	26	22	2	-13	15	1.401	-
Flight II			-14	-3	-11	1.111	-

APPENDIX 4

DIFFERENCES BETWEEN SWINGS 1 AND 2 AND SWINGS 3 AND 4

APPENDIX 4

TABLE 20

RATE OF CLIMB

(Differences Between Swings 1 and 2 and Swings 3 and 4)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
Straight Climb and Recovery (in Climb)							
Continental							
Flight I	20	22	418	455	-37	.859	
Flight II			435	466	-31	.635	
Franklin							
Flight I	21	23	229	223	6	.233	
Flight II			231	263	-32	1.381	
90° Climbing Turn Right 45° Bank							
Continental							
Flight I	22	26	346	383	-37	.795	
Flight II			375	389	-14	.339	
Franklin							
Flight I	20	24	190	206	-16	.719	
Flight II			203	215	-12	.473	
90° Climbing Turn Left 45° Bank							
Continental							
Flight I	20	26	325	419	-94	2.200	.05
Flight II			308	452	-144	3.305	.01
Franklin							
Flight I	18	21	189	186	3	.167	
Flight II			208	221	-13	.614	
Straight Glide and Recovery							
Continental							
Flight I	21	22	-786	-805	19	.336	
Flight II			-645	-748	103	1.239	
Franklin							
Flight I	19	19	-350	-318	-32	.889	
Flight II			-390	-297	-93	2.850	.01

TABLE 20

RATE OF CLIMB (Continued)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
30° Gliding Turn Left 15° Bank							
Continental							
Flight I	22	20	-816	-845	29	.564	-
Flight II			-884	-699	-185	2.608	.01
Franklin							
Flight I	18	16	-406	-303	-103	2.690	.01
Flight II			-383	-316	-67	2.041	.05
30° Gliding Turn Left 15° Bank							
Continental							
Flight I	21	17	-848	-827	-21	.327	-
Flight II			-857	-797	-60	1.259	-
Franklin							
Flight I	18	17	-400	-300	-100	2.563	.02
Flight II			-397	-315	-82	2.747	.01

TABLE 21

AVERAGE BANK

(Differences Between Swings 1 and 2 and Swings 3 and 4)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
90° Climbing Turn Right 45° Bank							
Continental							
Flight I	21	21	23.2	20.7	2.5	1.141	-
Flight II			26.0	22.2	3.8	2.011	.05
Franklin							
Flight I	16	13	18.8	20.5	-1.7	.622	-
Flight II			18.3	16.5	1.8	.737	-
90° Climbing Turn Left 45° Bank							
Continental							
Flight I	19	20	22.1	18.6	3.5	1.803	-
Flight II			22.2	20.7	1.5	.791	-
Franklin							
Flight I	13	12	19.9	23.3	-3.9	1.398	-
Flight II			19.4	21.8	-2.4	1.198	-
90° Turn Left 15° Bank							
Continental							
Flight I	19	21	8.5	10.8	-2.3	1.474	-
Flight II			9.0	11.8	-2.8	1.904	-
Franklin							
Flight I	16	14	7.6	13.6	-6.0	2.452	.02
Flight II			11.3	9.1	2.2	1.061	-
90° Turn Right 15° Bank							
Continental							
Flight I	21	22	8.8	14.1	-5.3	3.435	.01
Flight II			11.0	15.2	-4.2	2.233	.05
Franklin							
Flight I	16	14	8.6	7.3	1.3	.788	-
Flight II			9.6	10.9	-1.3	.516	-

TABLE 21

AVERAGE BANK (Continued)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
180° Turn Left 45° Bank							
Continental							
Flight I	20	21	25.8	26.0	-.2	.079	-
Flight II			26.8	26.8	0.0	.000	-
Franklin							
Flight I	16	15	23.5	27.1	-3.6	1.651	-
Flight II			25.3	29.1	-3.8	1.758	-
180° Turn Right 45° Bank							
Continental							
Flight I	19	22	26.1	26.3	-.2	.088	-
Flight II			28.2	28.6	-.4	.191	-
Franklin							
Flight I	16	16	22.8	26.1	-3.3	1.180	-
Flight II			25.3	25.0	.3	.127	-
360° Steep Turn Left 60° Bank							
Continental							
Flight I	18	22	40.7	41.6	-.9	.399	-
Flight II			38.9	42.3	-3.4	1.358	-
Franklin							
Flight I	14	13	42.2	45.5	-3.3	1.099	-
Flight II			44.8	43.5	1.3	.396	-
360° Steep Turn Right 60° Bank							
Continental							
Flight I	13	21	41.8	44.3	-2.5	1.049	-
Flight II			45.0	46.2	-1.2	.383	-
Franklin							
Flight I	10	13	39.3	44.5	-5.2	.922	-
Flight II			44.9	42.6	2.3	.643	-

TABLE [illegible]

AVERAGE BAN[illegible] (Continued)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
90° Gliding Turn Left 15° Bank							
Continental							
Flight I	19	14	9.7	12.6	-2.9	2.182	.05
Flight II			10.0	14.4	-4.4	3.014	.01
Franklin							
Flight I	10	8	15.4	17.0	-1.6	.603	-
Flight II			13.3	13.0	.3	.121	-
90° Gliding Turn Right 15° Bank							
Continental							
Flight I	20	18	13.9	16.4	-2.5	1.412	-
Flight II			14.7	16.3	-1.6	.848	-
Franklin							
Flight I	10	8	12.3	14.6	-2.3	.697	-
Flight II			11.7	11.3	.4	.198	-

TABLE 22

BANK VARIES

(Differences Between Swings 1 and 2 and Swings 3 and 4)

	N		Mean		Diff.		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	between Means	t value	p value
180° Turn Left 45° Bank							
Continental							
Flight I	20	21	8.3	9.5	-1.2	.880	-
Flight II			7.1	7.4	-.3	.236	-
Franklin							
Flight I	16	15	11.0	8.8	2.2	1.360	-
Flight II			11.3	10.3	1.0	.375	-
180° Turn Right 45° Bank							
Continental							
Flight I	20	22	8.2	9.1	-.9	.620	-
Flight II			8.5	9.1	-.6	.550	-
Franklin							
Flight I	16	16	9.3	9.1	.2	.128	-
Flight II			9.4	10.6	-1.2	.504	-
360° Steep Turn Left 60° Bank							
Continental							
Flight I	18	22	10.0	10.7	-.7	.361	-
Flight II			11.9	10.2	1.7	.920	-
Franklin							
Flight I	14	13	10.0	10.0	0.0	.000	-
Flight II			9.3	11.6	-2.3	.881	-
360° Steep Turn Right 60° Bank							
Continental							
Flight I	13	21	13.9	12.1	1.8	.760	-
Flight II			14.2	11.1	3.1	1.433	-
Franklin							
Flight I	10	13	12.0	11.9	.1	.037	-
Flight II			10.6	12.5	-1.9	.589	-

TABLE 22

BANK VARIES (Continued)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
90° Climbing Turn Right 45° Bank							
Continental							
Flight I	20	21	5.9	6.1	-.2	.180	-
Flight II			4.3	5.2	-.9	.734	-
Franklin							
Flight I	15	13	4.7	6.9	-2.2	1.508	-
Flight II			5.9	9.0	-3.1	1.860	-
90° Climbing Turn Left 45° Bank							
Continental							
Flight I	17	20	4.3	4.3	0.0	.000	-
Flight II			4.0	5.5	-1.5	.844	-
Franklin							
Flight I	13	12	4.6	4.8	-.2	.144	-
Flight II			6.6	6.2	.4	.267	-
90° Turn Left 15° Bank							
Continental							
Flight I	19	21	8.1	6.4	1.7	1.081	-
Flight II			6.8	5.2	1.6	1.013	-
Franklin							
Flight I	16	14	7.8	8.0	-.2	.104	-
Flight II			5.4	6.4	-1.0	.614	-
90° Turn Right 15° Bank							
Continental							
Flight I	21	22	7.4	5.0	2.4	2.365	.02
Flight II			8.3	5.1	3.2	2.348	.02
Franklin							
Flight I	16	13	8.6	8.2	.4	.261	-
Flight II			8.5	5.7	2.8	1.819	-

TABLE 22

BANK VARIES (Continued)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
90° Gliding Turn Right 15° Bank							
Continental							
Flight I	20	18	6.4	5.9	.5	.336	-
Flight II			7	5.8	1.6	1.057	-
Franklin							
Flight I	10	8	7.8	10.6	-2.8	.543	-
Flight II			7.1	4.8	2.3	1.194	-
90° Gliding Turn Left 15° Bank							
Continental							
Flight I	19	14	7.6	6.6	1.0	.672	-
Flight II			7.2	5.8	1.4	.979	-
Franklin							
Flight I	10	7	8.5	8.6	-.1	.048	-
Flight II			8.7	6.0	2.7	1.034	-

TABLE 23

AIRSPEED

(Differences Between Swings 1 and 2 and Swings 3 and 4)

	N		Mean		Diff. between Means	t value	p value
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4			
Take-off							
Continental							
Flight I	14	16	52.0	51.8	.2	.153	-
Flight II			51.3	52.8	-1.5	1.049	-
Franklin							
Flight I	15	19	52.3	49.3	3.0	1.734	-
Flight II			51.7	48.4	3.3	1.858	-
Straight and Level							
Continental							
Flight I	17	24	73.3	75.4	-2.1	1.536	-
Flight II			73.9	76.8	-2.9	2.077	.05
Franklin							
Flight I	19	24	68.2	67.3	.9	.971	-
Flight II			68.7	68.3	.4	.249	-
Straight Climb and Recovery (in Climb)							
Continental							
Flight I	20	23	65.3	66.9	-1.6	1.140	-
Flight II			65.4	66.2	-.8	.694	-
Franklin							
Flight I	21	23	62.3	58.7	3.6	2.592	.01
Flight II			61.2	59.0	2.2	1.876	-
90° Climbing Turn Right 45° Bank							
Continental							
Flight I	22	26	63.9	64.7	-.8	.697	-
Flight II			63.4	64.2	-.8	.737	-
Franklin							
Flight I	20	24	61.1	58.4	2.7	2.098	.05
Flight II			59.6	59.0	.6	.345	-
90° Climbing Turn Left 45° Bank							
Continental							
Flight I	20	26	63.1	63.4	-.3	.220	-
Flight II			62.4	63.2	-.8	.668	-
Franklin							
Flight I	17	21	60.1	56.9	3.2	2.031	.05
Flight II			58.6	56.7	1.9	1.473	-

TABLE 23

AIRSPEED (Continued)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
90° Turn Left 15° Bank							
Continental							
Flight I	20	26	71.5	73.0	-1.5	1.243	-
Flight II			71.5	73.1	-1.6	1.498	-
Franklin							
Flight I	20	23	66.2	64.1	2.1	1.872	-
Flight II			65.4	64.4	1.0	.817	-
90° Turn Right 15° Bank							
Continental							
Flight I	22	27	72.2	73.7	-1.5	1.195	-
Flight II			70.0	72.4	-2.4	2.089	.05
Franklin							
Flight I	20	21	65.9	64.6	1.3	1.222	-
Flight II			65.4	63.8	1.6	1.464	-
180° Turn Left 45° Bank							
Continental							
Flight I	20	26	71.9	72.5	-.6	.447	-
Flight II			71.0	71.2	-.2	.154	-
Franklin							
Flight I	21	23	65.4	63.7	1.7	1.462	-
Flight II			65.0	62.4	2.6	2.019	.05
180° Turn Right 45° Bank							
Continental							
Flight I	23	26	70.7	73.9	-3.2	2.536	.02
Flight II			70.5	72.9	-2.4	1.761	-
Franklin							
Flight I	22	24	65.4	63.8	1.6	1.509	-
Flight II			65.7	63.3	2.4	2.196	.05
360° Steep Turn Left 60° Bank							
Continental							
Flight I	23	26	70.5	68.9	1.6	.895	-
Flight II			70.4	69.1	1.3	.984	-
Franklin							
Flight I	21	23	64.5	62.6	1.9	1.268	-
Flight II			64.7	60.7	4.0	2.420	.02

TABLE 23

AIRSPEED (Continued)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
360° Steep Turn Right 60° Bank							
Continental							
Flight I	19	26	69.4	71.7	-2.3	1.381	-
Flight II			68.6	71.0	-2.4	1.478	-
Franklin							
Flight I	20	22	65.3	62.4	2.9	1.814	-
Flight II			64.5	62.6	1.9	1.179	-
Normal Power-off Stall (at Break)							
Continental							
Flight I	17	20	45.5	45.8	-.3	.336	-
Flight II			45.1	44.9	.2	.299	-
Franklin							
Flight I	11	14	37.5	37.2	.3	.253	-
Flight II			37.2	37.2	0.0	.000	-
Straight Glide and Recovery (in Glide)							
Continental							
Flight I	20	23	69.0	71.3	-2.3	1.873	-
Flight II			70.1	69.4	.7	.599	-
Franklin							
Flight I	19	19	63.1	63.4	-.3	.255	-
Flight II			62.4	62.3	.1	.095	-
90° Glide Turn Right 15° Bank							
Continental							
Flight I	22	21	64.5	66.4	-1.9	1.825	-
Flight II			64.0	66.0	-2.0	2.043	.05
Franklin							
Flight I	18	16	59.6	60.5	-.9	.717	-
Flight II			59.0	59.8	-.8	.548	-
90° Glide Turn Left 15° Bank							
Continental							
Flight I	21	17	65.2	65.9	-.7	.624	-
Flight II			65.8	64.6	.2	.185	-
Franklin							
Flight I	18	15	58.7	58.8	-.9	.808	-
Flight II			60.5	58.8	1.7	1.557	-

TABLE 29

AIRSPEED (Continued)

	N		Mean		Diff. between Means	t value	p value
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4			
Landing (Moment of Landing)							
Continental							
Flight I	14	9	47.5	45.9	1.6	1.597	-
Flight II			46.1	45.4	.7	.815	-
Franklin *							
Flight I	13	7	-	-	-	-	-
Flight II			-	-	-	-	-

*Omitted N < 8

TABLE 24

ALTITUDE DIFFERENCE

(Differences Between Swings 1 and 2 and Swings 3 and 4)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
Straight and Level							
Continental							
Flight I	17	24	20	-3	23	2.513	.02
Flight II			7	16	-9	.900	-
Franklin							
Flight I	19	23	14	-11	25	3.364	.01
Flight II			19	-7	26	1.726	-
90° Climbing Turn Right 45° Bank							
Continental							
Flight I	22	25	28	46	-18	1.902	-
Flight II			29	28	1	.112	-
Franklin							
Flight I	20	24	41	29	12	1.649	-
Flight II			31	33	-2	.284	-
90° Climbing Turn Left 45° Bank							
Continental							
Flight I	20	26	18	38	-20	1.593	-
Flight II			20	39	-19	2.592	.01
Franklin							
Flight I	17	22	36	23	13	1.440	-
Flight II			37	30	7	1.197	-
90° Turn Left 15° Bank							
Continental							
Flight I	20	23	14	21	-7	.785	-
Flight II			22	11	11	1.193	-
Franklin							
Flight I	21	23	18	14	4	.267	-
Flight II			14	11	3	.309	-

TABLE 24

ALTITUDE DIFFERENCE (Continued)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
90° Turn Right 15° Bank							
Continental							
Flight I	22	24	10	9	1	.141	-
Flight II			30	57	-27	.622	-
Franklin							
Flight I	21	18	7	8	-1	.096	-
Flight II			14	11	3	.384	-
180° Turn Left 45° Bank							
Continental							
Flight I	20	25	-11	2	-13	1.975	.05
Flight II			2	7	-5	.981	-
Franklin							
Flight I	21	23	3	3	0	.000	-
Flight II			-1	6	-7	1.079	-
180° Turn Right 45° Bank							
Continental							
Flight I	22	26	4	8	-4	.644	-
Flight II			-2	5	-7	.974	-
Franklin							
Flight I	22	23	2	8	-6	.791	-
Flight II			1	11	-10	1.262	-
360° Steep Turn Left 60° Bank							
Continental							
Flight I	23	26	-7	15	-22	2.294	.05
Flight II			1	5	-4	.354	-
Franklin							
Flight I	21	23	-13	-24	11	.807	-
Flight II			-11	-1	-10	.751	-

TABLE 24

ALTITUDE DIFFERENCE (Continued)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
360° Steep Turn Right 60° Bank							
Continental							
Flight I	19	26	-5	2	-7	.741	-
Flight II			-8	-14	6	.590	-
Franklin							
Flight I	20	22	-20	-13	-7	.492	-
Flight II			-11	-3	-8	.735	-
90° Gliding Turn Right 15° Bank							
Continental							
Flight I	22	21	-132	-134	2	.114	-
Flight II			-117	-123	6	.279	-
Franklin							
Flight I	17	15	-92	-115	23	.330	-
Flight II			-139	-113	-26	1.270	-
90° Gliding Turn Left 15° Bank							
Continental							
Flight I	21	15	-138	-129	-9	.156	-
Flight II			-177	-129	-48	1.544	-
Franklin							
Flight I	18	16	-158	-112	-46	1.468	-
Flight II			-133	-136	3	.088	-

TABLE 25

ALTITUDE VARIES

(Differences Between Swings 1 and 2 and Swings 3 and 4)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
Straight and Level							
Continental							
Flight I	16	23	25.0	14.3	10.7	1.393	-
Flight II			13.1	30.9	-17.8	2.268	.05
Franklin							
Flight I	19	23	22.6	25.2	-2.6	.339	-
Flight II			29.5	13.0	16.5	1.723	-
90° Turn Left 15° Bank							
Continental							
Flight I	20	26	30.0	28.1	1.9	.220	-
Flight II			25.0	19.6	5.4	.621	-
Franklin							
Flight I	20	23	28.5	29.6	-1.1	.101	-
Flight II			27.0	20.0	7.0	1.162	-
90° Turn Right 15° Bank							
Continental							
Flight I	22	27	22.7	18.9	3.8	.717	-
Flight II			30.5	14.4	16.1	2.272	.05
Franklin							
Flight I	21	22	22.9	24.1	-1.2	.162	-
Flight II			21.4	20.5	.9	.151	-
180° Turn Left 45° Bank							
Continental							
Flight I	19	26	14.7	16.2	-1.5	.311	-
Flight II			9.5	14.6	-5.1	1.274	-
Franklin							
Flight I	21	23	26.2	21.7	4.5	.737	-
Flight II			21.0	17.0	4.0	.811	-

TABLE 25

ALTITUDE VARIES (Continued)

	N		Mean		Diff. between		
	Sw. 1 & 2	Sw. 3 & 4	Sw. 1 & 2	Sw. 3 & 4	Means	t value	p value
180° Turn Right 45° Bank							
Continental							
Flight I	22	25	17.7	18.8	-1.1	.243	-
Flight II			18.6	16.4	2.2	.447	-
Franklin							
Flight I	22	23	20.5	16.5	4.0	.788	-
Flight II			26.8	21.3	5.5	.731	-
360° Turn Left 60° Bank							
Continental							
Flight I	22	26	[illegible]	[illegible]	[illegible]	.012	-
Flight II			[illegible]	[illegible]	[illegible]	1.356	-
Franklin							
Flight I	21	23	[illegible]	[illegible]	6.2	.698	-
Flight II			[illegible]	[illegible]	[illegible]	2.212	.05
360° Turn Right 60° Bank							
Continental							
Flight I	[illegible]	26	[illegible]	[illegible]	[illegible]	.857	-
Flight II			[illegible]	[illegible]	[illegible]	.715	-
Franklin							
Flight I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.317	-
Flight II			[illegible]	[illegible]	[illegible]	.830	

APPENDIX 5

DIFFERENCE BETWEEN FLIGHTS

APPENDIX 5

TABLE 26

AIRSPEED

(Difference between Flights)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
Take-off						
Continental						
Swings 1 & 2	14	52.0	51.3	.7	.534	-
		4.2	3.5			
Swings 3 & 4	16	51.8	52.8	-1.0	.952	-
		2.6	4.0			
Franklin						
Swings 1 & 2	15	52.3	51.7	.6	.690	-
		4.5	5.3			
Swings 3 & 4	19	49.3	48.4	.9	.763	-
		5.1	4.7			
Straight and Level						
Continental						
Swings 1 & 2	17	73.3	73.9	-.6	.561	-
		4.7	4.4			
Swings 3 & 4	24	75.4	76.8	-1.4	1.217	-
		3.8	4.2			
Franklin						
Swings 1 & 2	19	68.2	68.7	-.5	.382	-
		3.5	5.2			
Swings 3 & 4	24	67.3	68.3	-1.0	.917	-
		2.4	5.0			
Straight Climb						
Continental						
Swings 1 & 2	20	65.3	65.4	-.1	.099	-
		4.6	3.0			
Swings 3 & 4	23	66.9	66.2	.7	.636	-
		4.4	4.2			
Franklin						
Swings 1 & 2	21	62.3	61.2	1.1	.859	-
		4.5	3.8			
Swings 3 & 4	23	58.7	59.0	-.3	.345	-
		4.5	3.8			

TABLE 26

AIRSPEED (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Climbing Turn Right 45° Bank						
Continental						
Swings 1 & 2	22	63.9 3.9	63.4 2.8	.5	.538	-
Swings 3 & 4	26	64.7 3.9	64.2 4.3	.5	.495	-
Franklin						
Swings 1 & 2	20	61.1 4.2	59.6 3.9	1.5	1.136	-
Swings 3 & 4	24	58.4 4.1	59.0 6.7	-.6	.368	-
90° Climbing Turn Left 45° Bank						
Continental						
Swings 1 & 2	20	63.1 4.2	62.4 3.6	.7	.745	-
Swings 3 & 4	26	63.4 4.7	63.2 4.2	.2	.187	-
Franklin						
Swings 1 & 2	17	60.1 4.8	58.6 4.0	1.5	1.049	-
Swings 3 & 4	21	56.9 4.6	56.7 3.7	.2	.175	-
90° Turn Left 15° Bank						
Continental						
Swings 1 & 2	20	71.5 4.2	71.5 4.1	0.0	.000	-
Swings 3 & 4	26	73.0 3.8	73.1 3.0	-.1	.103	-
Franklin						
Swings 1 & 2	20	66.2 3.8	65.4 3.7	.8	.748	-
Swings 3 & 4	23	64.1 3.4	64.4 4.1	-.3	.316	-

APPENDIX (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Turn Right						
15° Bank						
Continental						
Swings 1 & 2	22	72.2	70.0	2.2	2.444	.05
		5.1	4.4			
Swings 3 & 4	27	73.7	72.4	1.3	1.667	-
		3.5	3.5			
Franklin						
Swings 1 & 2	20	66.9	65.4	.5	.735	-
		3.7	3.7			
Swings 3 & 4	21	64.6	63.8	.8	1.013	-
		2.9	3.1			
180° Turn Left						
45° Bank						
Continental						
Swings 1 & 2	20	71.9	71.0	.9	.978	-
		4.7	5.1			
Swings 3 & 4	26	72.5	71.2	1.3	1.688	-
		4.2	3.5			
Franklin						
Swings 1 & 2	21	65.4	65.0	.4	.396	-
		4.3	3.5			
Swings 3 & 4	23	63.7	62.4	1.3	1.733	-
		3.2	4.7			
180° Turn Right						
45° Bank						
Continental						
Swings 1 & 2	23	70.7	70.5	.2	.238	-
		4.7	5.0			
Swings 3 & 4	26	73.9	72.9	1.0	1.075	-
		4.0	4.4			
Franklin						
Swings 1 & 2	22	65.4	65.7	-.3	.361	-
		3.3	3.3			
Swings 3 & 4	24	63.8	63.3	.5	.781	-
		3.7	3.9			

TABLE 26

AIRSPEED (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. betw en Means	t value	p value
360° Steep Turn Left 60° Bank						
Continental						
Swings 1 & 2	23	70.5 6.1	70.4 5.0	.1	.092	-
Swings 3 & 4	26	68.9 6.2	69.1 4.1	-.2	.253	-
Franklin						
Swings 1 & 2	21	64.5 5.3	64.7 5.9	-.2	.187	-
Swings 3 & 4	23	62.6 4.4	60.7 4.8	1.9	3.016	.01
360° Steep Turn Right 60° Bank						
Continental						
Swings 1 & 2	19	69.4 5.1	68.6 4.6	.8	.860	-
Swings 3 & 4	26	71.7 5.6	71.0 5.7	.7	.875	-
Franklin						
Swings 1 & 2	20	65.3 4.4	64.5 5.1	.8	.537	-
Swings 3 & 4	22	62.4 5.6	62.6 5.1	-.2	.217	-
Normal Power-off Stall						
Continental						
Swings 1 & 2	17	45.5 1.5	45.1 1.8	.4	.702	-
Swings 3 & 4	20	45.8 3.3	44.9 2.1	.9	.968	-
Franklin						
Swings 1 & 2	11	37.5 3.2	37.2 4.3	.3	.270	-
Swings 3 & 4	14	37.2 2.5	37.2 2.8	0.0	.000	-

	N	Means and Standard Deviations		Diff. between Means	t value	p value
Straight Glide and Recovery						
Continental						
Swings 1 & 2	18	69.7 3.6	70.1 3.9	-1.1	1.692	-
Swings 3 & 4	23	70.3 4.2	69.4 3.6	1.9	1.900	-
Franklin						
Swings 1 & 2	16	63.1 3.8	62.4 3.2	.7	.875	-
Swings 3 & 4	19	63.4 3.1	62.3 3.4	1.1	1.964	-
90° Gliding Turn Right 15° Bank						
Continental						
Swings 1 & 2	22	64.5 3.7	64.0 3.5	.5	.581	-
Swings 3 & 4	21	66.4 2.9	66.0 2.7	.4	.635	-
Franklin						
Swings 1 & 2	18	59.6 4.0	59.0 4.3	.6	.625	-
Swings 3 & 4	15	60.6 2.7	59.9 3.7	.7	.729	-
90° Gliding Turn Left 15° Bank						
Continental						
Swings 1 & 2	21	64.2 3.4	64.0 3.8	.2	.256	-
Swings 3 & 4	27	65.6 2.6	64.5 2.3	1.1	1.447	-
Franklin						
Swings 1 & 2	15	60.1 3.4	60.9 3.9	-.8	.941	-
Swings 3 & 4	15	66 2.8	66.8	0.0	.000	-

TABLE 26

AIRSPEED (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
Landing						
Continental						
Swings 1 & 2	14	47.5 1.8	46.1 2.0	1.4	1.795	-
Swings 3 & 4	9	45.9 2.8	45.4 1.8	.5	.459	-
Franklin						
Swings 1 & 2	13	39.8 2.8	39.9 3.6	-.1	.099	-
Swings 3 & 4*	7	-	-	-	-	-

*Omitted: N < 8

TABLE [illegible]

RPM

(Difference Between Flights)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
Take-off						
Continental						
Swings 1 & 2	14	2029 31	2032 36	-3	.320	-
Swings 3 & 4	17	2015 29	2024 57	-9	.657	-
Franklin						
Swings 1 & 2	15	2137 53	2157 48	-20	3.096	.01
Swings 3 & 4	18	2095 33	2092 45	3	.374	-
Straight and Level						
Continental						
Swings 1 & 2	18	2020 63	2017 50	3	.223	-
Swings 3 & 4	24	2034 57	2042 54	-8	.611	-
Franklin						
Swings 1 & 2	19	2050 52	2032 55	18	1.455	-
Swings 3 & 4	24	1988 3[illegible]	2000 48	-12	1.249	-
Straight Climb and Recovery						
Continental						
Swings 1 & 2	20	2048 70	2043 58	5	.260	-
Swings 3 & 4	[illegible]	[illegible] 62	2055 46	-10	.707	-
Franklin						
Swings 1 & 2	[illegible]	2074 72	2074 78	21	1.008	-
Swings 3 & 4	[illegible]	2057 [illegible]	[illegible] 63	-47	2.670	.02

TABLE 27

RPM (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Climbing Turn Right 45° Bank						
Continental						
Swings 1 & 2	22	2055	2039	16	1.340	-
		56	45			
Swings 3 & 4	26	2054	2054	00	.000	-
		37	59			
Franklin						
Swings 1 & 2	19	2113	2111	2	.141	-
		56	53			
Swings 3 & 4	24	2090	2102	-12	.843	-
		68	59			
90° Climbing Turn Left 45° Bank						
Continental						
Swings 1 & 2	20	2045	2035	10	.656	-
		65	53			
Swings 3 & 4	26	2052	2056	-4	.270	-
		47	55			
Franklin						
Swings 1 & 2	17	2091	2089	2	.094	-
		63	39			
Swings 3 & 4	21	2091	2105	-14	.994	-
		59	44			
90° Turn Left 15° Bank						
Continental						
Swings 1 & 2	20	2015	2005	10	.677	-
		48	61			
Swings 3 & 4	25	2026	2028	-2	.167	-
		53	49			
Franklin						
Swings 1 & 2	21	2022	2034	-12	.972	-
		55	39			
Swings 3 & 4	23	1998	1992	6	.422	-
		54	38			

RPM (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Turn Right						
15° Bank						
Continental						
Swings 1 & 2	22	1989	1978	11	.637	-
		54	60			
Swings 3 & 4	27	2013	2013	00	.000	-
		65	40			
Franklin						
Swings 1 & 2	21	2019	2019	00	.000	-
		59	40			
Swings 3 & 4	21	1998	1984	14	1.047	-
		61	39			
180° Turn Left						
45° Bank						
Continental						
Swings 1 & 2	20	2013	2010	3	.174	-
		61	70			
Swings 3 & 4	26	2025	2000	25	1.630	-
		69	57			
Franklin						
Swings 1 & 2	21	2026	2024	2	.187	-
		48	40			
Swings 3 & 4	23	2007	1998	9	.926	-
		48	46			
180° Turn Right						
45° Bank						
Continental						
Swings 1 & 2	23	1998	2007	-9	.581	-
		54	60			
Swings 3 & 4	26	2027	2020	7	.455	-
		51	64			
Franklin						
Swings 1 & 2	22	2037	2032	5	.354	-
		55	47			
Swings 3 & 4	24	2004	1994	10	1.199	-
		46	42			

TABLE 27

RPM (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
360° Steep Turn Left 60° Bank						
Continental						
Swings 1 & 2	23	2068	2061	7	.409	-
		76	91			
Swings 3 & 4	26	2075	2070	5	.349	-
		59	67			
Franklin						
Swings 1 & 2	21	2138	2136	2	.123	-
		67	86			
Swings 3 & 4	23	2096	2102	-6	.462	-
		76	69			
360° Steep Turn Right 60° Bank						
Continental						
Swings 1 & 2	19	2048	2040	8	.473	-
		75	68			
Swings 3 & 4	26	2073	2068	5	.329	-
		61	87			
Franklin						
Swings 1 & 2	20	2108	2113	-5	.358	-
		83	76			
Swings 3 & 4	23	2100	2102	-2	.134	-
		75	89			
Straight Glide and Recovery						
Continental						
Swings 1 & 2	18	867	922	-55	1.330	-
		173	228			
Swings 3 & 4	22	750	716	34	1.320	-
		139	109			
Franklin						
Swings 1 & 2	17	768	738	30	2.521	.05
		168	154			
Swings 3 & 4	19	871	974	-103	1.318	-
		56	340			

TABLE 27

RPM (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Gliding Turn Right 15° Bank						
Continental						
Swings 1 & 2	19	874	845	29	.693	-
		176	84			
Swings 3 & 4	20	745	738	7	.764	-
		109	117			
Franklin						
Swings 1 & 2	18	784	742	42	1.065	-
		204	196			
Swings 3 & 4	16	950	894	56	.821	-
		276	61			
90° Gliding Turn Left 15° Bank						
Continental						
Swings 1 & 2	19	895	942	-47	.865	-
		166	235			
Swings 3 & 4	16	750	747	3	.101	-
		153	142			
Franklin						
Swings 1 & 2	18	736	750	-14	.638	-
		189	155			
Swings 3 & 4	15	863	885	-22	1.699	-
		42	44			
Landing						
Continental						
Swings 1 & 2	17	774	800	-26	.734	-
		93	171			
Swings 3 & 4	13	727	719	8	.413	-
		114	116			
Franklin						
Swings 1 & 2	14	657	672	-15	.890	-
		138	146			
Swings 3 & 4	10	840	810	30	1.609	-
		49	44			

TABLE 26

AIRSPEED VARIATION

(Difference Between Flights)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
Straight and Level						
Continental						
Swings 1 & 2	17	4.2	3.7	.5	.735	-
		1.9	2.5			
Swings 3 & 4	24	4.1	3.9	.2	.267	-
		2.0	2.8			
Franklin						
Swings 1 & 2	19	5.4	3.8	1.6	1.481	-
		5.0	2.2			
Swings 3 & 4	23	3.9	3.5	.4	.615	-
		2.2	1.7			
Straight Climb and Recovery						
Continental						
Swings 1 & 2	20	7.6	8.0	-.4	.345	-
		4.1	3.3			
Swings 3 & 4	23	10.0	8.8	1.2	.759	-
		5.0	5.7			
Franklin						
Swings 1 & 2	21	7.0	7.6	-.6	.455	-
		4.2	3.2			
Swings 3 & 4	23	6.7	7.7	-1.0	1.000	-
		3.4	3.6			
90° Climbing Turn Right 45° Bank						
Continental						
Swings 1 & 2	22	2.8	2.2	.6	.759	-
		2.8	2.5			
Swings 3 & 4	26	4.1	2.9	1.2	2.069	.05
		2.9	1.6			
Franklin						
Swings 1 & 2	20	4.4	3.5	.9	.865	-
		3.0	2.4			
Swings 3 & 4	24	3.6	3.0	.6	1.034	-
		2.0	1.9			

TABLE 28

AIRSPEED VARIATION (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II.	Diff. between Means	t value	p value
90° Climbing Turn Left 45° Bank						
Continental						
Swings 1 & 2	20	2.3 2.1	2.6 2.5	-.3	.429	-
Swings 3 & 4	26	3.2 2.8	3.1 1.8	.1	.145	-
Franklin						
Swings 1 & 2	17	4.1 2.2	4.9 3.0	-.8	1.290	-
Swings 3 & 4	21	3.4 3.3	4.4 2.1	-1.0	1.493	-
90° Turn Left 15° Bank						
Continental						
Swings 1 & 2	20	4.7 2.5	3.7 2.9	1.0	1.087	-
Swings 3 & 4	25	5.1 2.6	3.8 2.2	1.3	2.364	.05
Franklin						
Swings 1 & 2	20	3.0 1.9	4.0 2.1	-1.0	1.538	-
Swings 3 & 4	23	4.1 2.4	4.2 1.8	-.1	.192	-
90° Turn Right 15° Bank						
Continental						
Swings 1 & 2	22	4.5 2.5	5.2 2.8	-.7	.886	-
Swings 3 & 4	27	4.5 2.4	4.3 2.6	.2	.313	-
Franklin						
Swings 1 & 2	19	4.5 1.9	4.5 3.4	.0	.000	-
Swings 3 & 4	22	4.3 2.6	3.6 1.4	.7	1.346	-

TABLE 28

AIRSPEED VARIATION (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
180° Turn Left 45° Bank						
Continental						
Swings 1 & 2	20	4.5	3.0	1.5	1.786	-
		2.9	2.1			
Swings 3 & 4	26	3.9	4.2	-.3	.732	-
		2.0	2.1			
Franklin						
Swings 1 & 2	21	4.6	5.0	-.4	.667	-
		2.4	2.6			
Swings 3 & 4	23	4.9	5.2	-.3	.370	-
		1.9	2.9			
180° Turn Right 45° Bank						
Continental						
Swings 1 & 2	23	4.7	4.4	.3	.390	-
		3.0	3.1			
Swings 3 & 4	26	5.1	4.5	.6	.811	-
		2.7	2.1			
Franklin						
Swings 1 & 2	22	5.2	3.8	1.4	2.000	-
		3.3	2.5			
Swings 3 & 4	24	4.9	5.1	-.2	.282	-
		2.2	2.6			
360° Steep Turn Left 60° Bank						
Continental						
Swings 1 & 2	23	4.8	6.2	-1.4	1.359	-
		2.6	4.5			
Swings 3 & 4	26	6.9	5.3	1.6	2.105	.05
		4.1	2.9			
Franklin						
Swings 1 & 2	21	5.9	5.7	.2	.244	-
		2.3	3.1			
Swings 3 & 4	23	6.4	5.3	1.1	1.028	-
		2.8	3.1			

AIRSPEED VARIATION (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
360° Steep Turn Right 60° Bank						
Continental						
Swings 1 & 2	19	5.5 2.9	5.8 3.2	-.3	.361	-
Swings 3 & 4	26	5.4 2.9	5.6 3.7	-.2	.244	-
Franklin						
Swings 1 & 2	20	6.4 2.8	6.6 3.9	-.2	.215	-
Swings 3 & 4	23	6.4 3.4	5.9 3.4	.5	.658	-
Straight Glide and Recovery						
Continental						
Swings 1 & 2	20	5.4 3.4	4.5 2.4	.9	1.154	-
Swings 3 & 4	23	6.4 3.1	6.5 1.8	-.1	.130	-
Franklin						
Swings 1 & 2	19	5.4 2.0	5.7 2.3	-.3	.353	-
Swings 3 & 4	19	5.3 2.0	5.4 2.9	-.1	.128	-
90° Gliding Turn Right 15° Bank						
Continental						
Swings 1 & 2	22	3.4 2.4	3.2 1.7	.2	.317	-
Swings 3 & 4	21	4.6 2.0	3.7 2.8	.9	1.324	-
Franklin						
Swings 1 & 2	18	4.1 2.4	4.2 2.5	-.1	.122	-
Swings 3 & 4	15	3.7 1.9	5.2 2.6	-1.5	2.206	.05

TABLE 28

AIRSPEED VARIATION (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Gliding Turn Left 15° Bank						
Continental						
Swings 1 & 2	21	3.4 2.1	3.4 1.9	.0	.000	-
Swings 3 & 4	17	2.7 1.6	3.0 1.4	-.3	.732	-
Franklin						
Swings 1 & 2	18	3.9 2.1	4.8 2.5	-.9	1.268	-
Swings 3 & 4	17	4.6 2.5	4.0 2.5	.6	.682	-

TABLE 2[illegible]

AVERAGE BANK

(Difference Between Flights)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Climbing Turn Right 45° Bank						
Continental						
Swings 1 & 2	21	23.2 7.0	26.0 6.1	-2.8	1.750	-
Swings 3 & 4	21	20.7 6.8	22.2 5.8	-1.5	1.034	-
Franklin						
Swings 1 & 2	16	18.8 7.0	18.3 6.3	.5	.221	-
Swings 3 & 4	13	20.5 7.1	16.5 6.3	4.0	2.381	.05
90° Climbing Turn Left 45° Bank						
Continental						
Swings 1 & 2	19	22.1 4.9	22.2 4.7	-.1	.104	-
Swings 3 & 4	20	18.6 6.7	20.7 6.6	-2.1	1.373	-
Franklin						
Swings 1 & 2	13	19.9 4.4	19.4 5.3	.5	.463	-
Swings 3 & 4	12	23.8 8.5	21.8 4.2	2.0	.952	-
90° Turn Left 15° Bank						
Continental						
Swings 1 & 2	19	8.5 3.5	9.0 3.9	-.5	.455	-
Swings 3 & 4	21	10.5 5.1	11.8 5.0	-1.0	.752	-
Franklin						
Swings 1 & 2	[illegible]	[illegible] 4.6	11.3 6.0	-3.7	2.313	.05
Swings 3 & 4	[illegible]	[illegible] 8.[illegible]	9.1 [illegible].8	4.5	1.807	-

TABLE 29

AVERAGE BANK (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Turn Right						
15° Bank						
Continental						
Swings 1 & 2	21	8.8	11.0	-2.2	2.750	.02
		2.9	4.3			
Swings 3 & 4	22	14.1	15.2	-1.1	.840	-
		5.3	7.3			
Franklin						
Swings 1 & 2	16	8.6	9.6	-1.0	.676	-
		5.1	5.2			
Swings 3 & 4	14	7.3	10.9	-3.6	1.809	-
		3.3	8.0			
180° Turn Left						
45° Bank (in Turn)						
Continental						
Swings 1 & 2	20	25.8	26.8	-1.0	.685	-
		8.9	10.0			
Swings 3 & 4	21	26.0	26.8	-.8	.533	-
		6.9	6.2			
Franklin						
Swings 1 & 2	16	23.5	25.3	-1.8	1.639	-
		5.9	4.8			
Swings 3 & 4	15	27.1	29.1	-2.0	.866	-
		5.8	6.7			
180° Turn Right						
45° Bank (in Turn)						
Continental						
Swings 1 & 2	19	26.1	28.2	-2.1	1.296	-
		8.5	7.3			
Swings 3 & 4	22	26.3	28.6	-2.3	2.371	.05
		5.5	5.8			
Franklin						
Swings 1 & 2	16	22.8	25.3	-2.5	2.119	-
		8.9	7.3			
Swings 3 & 4	16	26.1	25.0	1.1	.764	-
		6.1	5.5			

TABLE 29

AVERAGE BANK (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
360° Steep Turn Left 60° Bank						
Continental						
Swings 1 & 2	18	40.7	38.9	1.8	1.118	-
		8.0	7.4			
Swings 3 & 4	22	41.6	42.3	-.7	.395	-
		5.9	7.9			
Franklin						
Swings 1 & 2	14	42.2	44.8	-2.6	1.300	-
		9.2	10.0			
Swings 3 & 4	13	45.5	43.5	2.0	1.316	-
		5.1	5.7			
360° Steep Turn Right 60° Bank						
Continental						
Swings 1 & 2	13	41.8	45.0	-3.2	1.221	-
		6.1	9.6			
Swings 3 & 4	21	44.3	46.2	-1.9	1.407	-
		6.8	7.9			
Franklin						
Swings 1 & 2	10	39.3	44.9	-5.6	2.343	.05
		10.6	10.0			
Swings 3 & 4	13	44.5	42.6	1.9	.955	-
		6.3	6.3			
90° Gliding Turn Right 15° Bank						
Continental						
Swings 1 & 2	20	13.9	14.7	-.8	.491	-
		5.1	5.5			
Swings 3 & 4	18	16.4	16.3	.1	.071	-
		5.5	5.8			
Franklin						
Swings 1 & 2	10	12.3	11.7	.6	.223	-
		6.1	4.5			
Swings 3 & 4	8	14.6	11.3	3.3	1.227	-
		7.1	3.3			

TABLE 29

AVERAGE BANK (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Gliding Turn Left 15° Bank						
Continental						
Swings 1 & 2	19	9.7 3.7	10.0 4.3	-.3	.275	-
Swings 3 & 4	14	12.6 3.6	14.4 3.6	-1.8	1.714	-
Franklin						
Swings 1 & 2	10	15.4 6.1	13.3 5.7	2.1	.913	-
Swings 3 & 4	8	17.0 4.0	13.0 3.7	4.0	2.286	-

(Difference Between Flights)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Climbing Turn Right 45° Bank						
Continental						
Swings 1 & 2	20	5.9	4.3	1.6	1.168	-
		2.8	4.3			
Swings 3 & 4	21	6.1	5.2	.9	.957	-
		4.0	3.3			
Franklin						
Swings 1 & 2	15	4.7	5.9	-1.2	1.062	-
		2.7	3.3			
Swings 3 & 4	13	6.9	9.0	-2.1	1.628	-
		4.6	5.2			
90° Climbing Turn Left 45° Bank						
Continental						
Swings 1 & 2	17	4.3	4.0	.3	.160	-
		3.6	5.8			
Swings 3 & 4	20	4.3	5.5	-1.2	.968	-
		3.6	4.7			
Franklin						
Swings 1 & 2	13	4.5	6.6	-2.0	1.481	-
		3.7	3.4			
Swings 3 & 4	12	4.8	6.2	-1.4	.892	-
		2.9	3.8			
90° Turn Left 15° Bank						
Continental						
Swings 1 & 2	19	3.1	6.8	1.3	.802	-
		4.2	5.2			
Swings 3 & 4	21	6.4	5.2	1.2	.870	-
		5.1	4.5			
Franklin						
Swings 1 & 2	16	2.8	5.4	2.4	1.412	-
		4.3	4.3			
Swings 3 & 4	14	2.2	6.4	1.6	.762	-
		5.8	4.3			

TABLE 30

BANK VARIATION (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Turn Right						
15° Bank						
Continental						
Swings 1 & 2	21	7.4	8.3	-.9	.841	-
		2.7	4.8			
Swings 3 & 4	22	5.0	5.1	-.1	.090	-
		3.7	3.9			
Franklin						
Swings 1 & 2	16	8.6	8.5	.1	.069	-
		3.9	4.1			
Swings 3 & 4	13	8.2	5.7	2.5	1.366	-
		4.0	3.8			
180° Turn Left						
45° Bank						
Continental						
Swings 1 & 2	20	8.3	7.1	1.2	1.053	-
		4.3	4.7			
Swings 3 & 4	21	9.5	7.4	2.1	1.750	-
		4.2	3.1			
Franklin						
Swings 1 & 2	16	11.0	11.3	-.3	.143	-
		5.0	7.3			
Swings 3 & 4	15	8.8	10.3	-1.5	.728	-
		3.5	7.0			
180° Turn Right						
45° Bank						
Continental						
Swings 1 & 2	20	8.2	8.5	-.3	.196	-
		4.7	3.9			
Swings 3 & 4	22	9.1	9.1	.0	.000	-
		4.5	3.0			
Franklin						
Swings 1 & 2	16	9.3	9.4	-.1	.069	-
		4.3	5.3			
Swings 3 & 4	16	9.1	10.6	-1.5	.685	-
		4.2	7.5			

TABLE 30

BANK VARIATION (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
360° Steep Turn Left 60° Bank						
Continental						
Swings 1 & 2	18	10.0	11.9	-1.9	1.173	-
		5.5	6.9			
Swings 3 & 4	22	10.7	10.2	.5	.338	-
		6.3	4.4			
Franklin						
Swings 1 & 2	14	10.0	9.3	.7	.372	-
		2.7	5.6			
Swings 3 & 4	13	10.0	11.6	-1.6	.556	-
		4.8	7.4			
360° Steep Turn Right 60° Bank						
Continental						
Swings 1 & 2	13	13.9	14.2	-.3	.109	-
		5.6	7.8			
Swings 3 & 4	21	12.1	11.1	1.0	.637	-
		7.0	4.4			
Franklin						
Swings 1 & 2	10	12.0	10.6	1.4	.455	-
		5.1	6.5			
Swings 3 & 4	13	11.9	12.5	-.6	.179	-
		6.8	7.9			
90° Gliding Turn Right 15° Bank						
Continental						
Swings 1 & 2	20	6.4	7.4	-1.0	.735	-
		4.3	4.8			
Swings 3 & 4	18	5.9	5.8	.1	.075	-
		4.6	4.2			
Franklin						
Swings 1 & 2	10	7.8	7.1	.7	.258	-
		8.7	3.3			
Swings 3 & 4	8	10.6	4.8	5.8	1.043	-
		11.9	4.4			

TABLE 30

BANK VARIATION (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Gliding Turn Left 15° Bank						
Continental						
Swings 1 & 2	19	7.6 4.3	7.2 4.1	.4	.299	-
Swings 3 & 4	14	6.6 3.8	5.8 3.7	.8	.635	-
Franklin						
Swings 1 & 2	10	8.5 3.0	8.7 5.4	-.2	.086	-
Swings 3 & 4	7	8.6 5.1	6.0 4.3	2.6	1.079	-

TABLE 31

ALTITUDE GAIN OR LOSS

(Difference Between Flights)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
Straight and Level						
Continental						
Swings 1 & 2	17	20	7	13	1.295	-
		33	21			
Swings 3 & 4	24	-3	16	-19	1.990	-
		24	36			
Franklin						
Swings 1 & 2	19	14	19	-5	.284	-
		25	68			
Swings 3 & 4	23	-11	-7	-4	.726	-
		22	17			
90° Climbing Turn Right 45° Bank						
Continental						
Swings 1 & 2	22	28	29	-1	.100	-
		29	39			
Swings 3 & 4	25	46	28	18	2.671	.02
		34	19			
Franklin						
Swings 1 & 2	20	41	31	10	1.379	-
		27	21			
Swings 3 & 4	24	29	33	-4	.693	-
		20	24			
90° Climbing Turn Left 45° Bank						
Continental						
Swings 1 & 2	20	18	20	-2	.367	-
		17	18			
Swings 3 & 4	26	38	39	-1	.092	-
		53	28			
Franklin						
Swings 1 & 2	17	36	37	-1	.171	-
		31	23			
Swings 3 & 4	22	23	30	-7	1.468	-
		24	12			

TABLE 31

ALTITUDE GAIN OR LOSS (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Turn Left 15° Bank						
Continental						
Swings 1 & 2	20	14	22	-8	.742	-
		18	34			
Swings 3 & 4	23	21	11	10	1.305	-
		29	25			
Franklin						
Swings 1 & 2	21	18	14	4	.303	-
		52	32			
Swings 3 & 4	23	14	11	3	.264	-
		45	31			
90° Turn Right 15° Bank						
Continental						
Swings 1 & 2	22	10	30	-20	2.358	.05
		23	32			
Swings 3 & 4	24	9	57	-48	1.138	-
		24	197			
Franklin						
Swings 1 & 2	21	7	14	-7	.830	-
		30	19			
Swings 3 & 4	18	8	11	-3	.269	-
		33	28			
180° Turn Left 45° Bank						
Continental						
Swings 1 & 2	20	-11	2	-13	2.309	.05
		22	13			
Swings 3 & 4	25	2	7	-5	1.018	-
		21	19			
Franklin						
Swings 1 & 2	21	3	-1	4	.458	-
		34	23			
Swings 3 & 4	23	3	6	-3	.537	-
		28	19			

TABLE 31

ALTITUDE GAIN OR LOSS (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
180° Turn Right 45° Bank						
Continental						
Swings 1 & 2	22	4	-2	6	.889	-
		20	27			
Swings 3 & 4	26	8	5	3	.651	-
		22	22			
Franklin						
Swings 1 & 2	22	2	1	1	.131	-
		26	29			
Swings 3 & 4	23	8	11	-3	.421	-
		24	23			
360° Steep Turn Left 60° Bank						
Continental						
Swings 1 & 2	23	-7	1	-8	.738	-
		33	49			
Swings 3 & 4	26	15	5	10	1.946	-
		33	27			
Franklin						
Swings 1 & 2	21	-13	-11	-2	.277	-
		50	52			
Swings 3 & 4	23	-24	-1	-23	3.324	.01
		38	33			
360° Steep Turn Right 60° Bank						
Continental						
Swings 1 & 2	19	-5	-8	3	.338	-
		27	30			
Swings 3 & 4	26	2	-14	16	2.532	.02
		33	35			
Franklin						
Swings 1 & 2	20	-20	-11	-9	.966	-
		50	37			
Swings 3 & 4	22	-13	-3	-10	.968	-
		40	32			

TABLE 31

ALTITUDE GAIN OR LOSS (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
90° Gliding Turn Right 15° Bank						
Continental						
Swings 1 & 2	22	-132 56	-117 81	-15	.656	-
Swings 3 & 4	21	-134 56	-123 53	-11	.747	-
Franklin						
Swings 1 & 2	17	-92 256	-139 59	47	.732	-
Swings 3 & 4	15	-115 55	-113 52	-2	.095	-
90° Gliding Turn Left 15° Bank						
Continental						
Swings 1 & 2	21	-138 207	-177 99	39	.896	-
Swings 3 & 4	15	-129 75	-129 73	00	.000	-
Franklin						
Swings 1 & 2	18	-138 105	-133 123	-25	.760	-
Swings 3 & 4	16	-112 64	-136 51	24	1.876	-

TABLE 32

ALTITUDE VARIATION

(Difference Between Flights)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
Straight and Level						
Continental						
Swings 1 & 2	16	25.0 29.2	13.1 18.9	11.9	1.228	-
Swings 3 & 4	23	14.3 17.4	30.9 26.2	-16.6	2.726	.02
Franklin						
Swings 1 & 2	19	22.6 20.5	29.5 41.6	-6.9	.708	-
Swings 3 & 4	23	25.2 26.8	13.0 15.2	12.2	1.776	-
90° Turn Left 15° Bank						
Continental						
Swings 1 & 2	20	30.0 33.9	25.0 32.6	5.0	.427	-
Swings 3 & 4	26	28.1 23.5	19.6 25.2	8.5	1.252	-
Franklin						
Swings 1 & 2	20	28.5 32.0	27.0 23.9	1.5	.152	-
Swings 3 & 4	23	29.6 37.5	20.0 [illegible]	9.6	1.106	-
90° Turn Right 15° Bank						
Continental						
Swings 1 & 2	[illegible]	22.7 19.3	30.5 31.4	-7.8	.877	-
Swings 3 & 4	27	18.9 17.3	14.4 16.2	4.5	1.236	-
Franklin						
Swings 1 & 2	21	22.9 20.3	21.4 14.2	1.5	.258	-
Swings 3 & 4	22	24.2 26.7	20.5 22.9	3.6	.462	-

TABLE 32

ALTITUDE VARIATION (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
180° Turn Left 45° Bank						
Continental						
Swings 1 & 2	19	14.7	9.5	5.2	.904	-
		16.0	13.2			
Swings 3 & 4	26	16.2	14.6	1.6	.469	-
		15.4	12.8			
Franklin						
Swings 1 & 2	21	26.2	21.0	5.2	.781	-
		21.9	20.4			
Swings 3 & 4	23	21.7	17.0	4.7	1.061	-
		17.6	10.4			
180° Turn Right 45° Bank						
Continental						
Swings 1 & 2	22	17.7	18.6	-.9	.181	-
		13.1	16.9			
Swings 3 & 4	25	18.8	16.4	2.4	.512	-
		16.8	16.2			
Franklin						
Swings 1 & 2	22	20.5	26.8	-6.3	1.173	-
		20.1	31.0			
Swings 3 & 4	23	16.5	21.3	-4.8	1.260	-
		12.7	16.8			
360° Steep Turn Left 60° Bank						
Continental						
Swings 1 & 2	22	25.5	32.7	-7.2	.814	-
		28.2	37.4			
Swings 3 & 4	26	25.4	21.2	4.2	.913	-
		26.6	18.7			
Franklin						
Swings 1 & 2	21	41.9	43.3	-1.4	.219	-
		29.2	31.5			
Swings 3 & 4	23	35.7	25.7	10.0	1.468	-
		28.4	19.1			

TABLE 32

ALTITUDE VARIATION (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
360° Steep Turn Right 60° Bank						
Continental						
Swings 1 & 2	19	23.7	23.7	.00	.00	-
		16.3	19.8			
Swings 3 & 4	26	28.8	28.8	.00	.00	-
		21.2	23.3			
Franklin						
Swings 1 & 2	20	40.5	36.5	4.0	.522	-
		38.1	27.4			
Swings 3 & 4	23	32.6	26.5	6.1	.913	-
		21.1	18.8			

TABLE 33

MAXIMUM RATE OF CLIMB

(Difference Between Flights)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
Straight Climb and Recovery						
Continental						
Swings 1 & 2	20	418	435	-17	.353	-
		144	151			
Swings 3 & 4	22	455	466	-11	.229	-
		129	158			
Franklin						
Swings 1 & 2	21	229	231	-2	.089	-
		84	68			
Swings 3 & 4	23	223	263	-40	1.579	-
		83	81			
90° Climbing Turn Right 45° Bank						
Continental						
Swings 1 & 2	22	346	375	-29	.849	-
		178	167			
Swings 3 & 4	26	383	389	-6	.207	-
		139	113			
Franklin						
Swings 1 & 2	20	190	203	-13	.568	-
		77	62			
Swings 3 & 4	24	206	215	-9	.412	-
		67	95			
90° Climbing Turn Left 45° Bank						
Continental						
Swings 1 & 2	20	325	308	17	.425	-
		155	132			
Swings 3 & 4	26	419	452	-33	.804	-
		129	152			
Franklin						
Swings 1 & 2	18	189	208	-19	.957	-
		64	53			
Swings 3 & 4	21	186	221	-35	1.756	-
		44	72			

TABLE 3

MAXIMUM RATE OF CLIMB (Continued)

	N	Means and Standard Deviations Fl. I	Fl. II	Diff. between Means	t value	p value
Straight Glide and Recovery						
Continental						
Swings 1 & 2	21	-786 195	-645 264	-141	1.844	-
Swings 3 & 4	22	-805 257	-748 248	-57	.818	-
Franklin						
Swings 1 & 2	19	-350 103	-390 94	40	1.155	-
Swings 3 & 4	19	-318 112	-297 101	-21	.524	-
90° Gliding Turn Right 15° Bank						
Continental						
Swings 1 & 2	22	-816 186	-884 155	68	1.602	-
Swings 3 & 4	20	-845 133	-699 282	-146	2.018	-
Franklin						
Swings 1 & 2	18	-406 110	-383 96	-23	.650	-
Swings 3 & 4	16	-303 105	-316 88	13	.332	-
90° Gliding Turn Left 15° Bank						
Continental						
Swings 1 & 2	21	-848 229	-857 134	9	.183	-
Swings 3 & 4	17	-827 130	-797 150	-30	.593	-
Franklin						
Swings 1 & 2	18	-400 124	-397 92	-3	.094	-
Swings 3 & 4	17	-300 97	-315 78	15	.585	-