BILATERAL TRANSFER "REMINISCENCE" AS A FUNCTION OF SEX DIFFERENCE AND HANDEDNESS

By

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BILATERAL TRANSFER "REMINISCENCE" AS A FUNCTION OF SEX DIFFERENCE AND HANDEDNESS

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W T W

I. INTRODUCTION

Reminiscence, an increment in the performance of a partially learned task following an interpolated rest, has been demonstrated repeatedly in a variety of psychological investigations concerned with learning. One of the approaches by which the phenomenon has been studied is the pursuit rotor. Research involving this apparatus dates back to at least until 1937 (5, 7). McGeoch and Irion (21) have indicated some of the task variables which have been investigated in relation to reminiscence. These variables are: reminiscence as a function of chronological age (21, p. 161); reminiscence as a function of length of the interpolated rest interval (6, 15, 20); and reminiscence as a function of the previous degree of distribution of practice (3, 19).

In a general consideration of the problem of transfer of training, it has been found that transfer of training occurs (21, p. 299) "whenever the existence of a previously established habit has an influence upon the acquisition, performance, or relearning of a second habit." Such transfer effects may be positive as when initial training facilitates the acquisition, performance, or relearning of a second activity. Negative transfer effects occur when

initial training inhibits the acquisition, performance, or relearning of a subsequent activity. When there are neither positive nor negative transfer effects, the effects of first learning upon second learning are indeterminate. Few experiments have yielded results of the latter type (21, p. 299).

There are numerous studies (1, 13, 17) which indicate that skill acquired by practice with one hand in a given task often can be carried over to the other hand or to other body members. As early as 1903, Swift demonstrated this type of learning in a ball-tossing experiment (24).

The phenomenon of bilateral transfer of training may be defined as "a change of performance in a member on one side of the body as a result of training the corresponding member on the other side (11)."

Kimble (18), in an inverted alphabet printing task, tested his interpretation of Hull's two factor theory of aggregate inhibitory potential, $\mathring{I}_R$, (composed of reactive inhibition, I_R, and conditioned inhibition, ${}_SI_R$,) modified for motor learning. He related the increase in performance, reminiscence, after an interpolated rest to reactive inhibition (I_R). Hull suggested that a response produces I_R which is both an inhibitor to reaction and which acts as a negative drive. He indicated that I_R dissipates spontaneously with the passage of time and that it is a simple decay function of elapsed time. Response repetition results in increments of I_R; summation occurs. I_R also combines with

${}_{S}I_{R}$ to produce aggregate inhibitory potential, $\dot{I}_{R}$. I_{R} is reduced during a rest (non-activity). Conditioned non-activity is what Hull refers to as conditioned inhibition, ${}_{S}I_{R}$.

Kimble, in the printing task, demonstrated that I_{R} remains relatively constant from 5 to 15 trials and then decreases in value. But, ${}_{S}I_{R}$ develops as a negatively accelerated (habit) function of the number of trials in the experiment. In that ${}_{S}I_{R}$ is considered a habit, it does not dissipate with the passage of time.

Since the discovery of bilateral transfer "reminiscence," numerous investigations have been made in an attempt to discover whether ordinary and bilateral reminiscence are the same phenomenon or like phenomena. This has been done (15, 16) by attempting to determine whether or not these two gain scores are like functions of the same variables. Grice and Reynolds (14) studied these two types of gain (ordinary and bilateral reminiscence) as functions of the length of the rest interval. Their results indicated that bilateral transfer "reminiscence" is an increasing function of interpolated rest (at least up to 10 minutes). In this respect it is similar to the function of ordinary reminiscence. While the authors maintained that this fact did not identify the phenomenon of bilateral transfer "reminiscence" as being identical to ordinary reminiscence, it, at least, suggested that the two may be subject to the same interpretation.

In a search for the locus of the ordinary and, later, bilateral transfer "reminiscence" effects, three major theories have been offered. They are the Work theories, the Perseveration theories, and the Differential Forgetting theories.

Essentially, the general Work theory assumes that there is a by-product left behind as a result of an activity which tends to prevent the recurrence of this activity or, at least, to lower the efficiency of the later performance. It is speculated that this inhibitory by-product of work dissipates during periods of inactivity. An interpolated rest condition then would tend to aid the performance of a partially learned task following the interpolated rest. The amount of facilitation is related to the amount of I_R generated during the pre-rest practice period and whether or not the interpolated rest was sufficiently long to dissipate this I_R.

The classical Perseveration theory assumes that effects of neural activity involved in learning will be built up over the pre-rest practice period. These effects will persist during the rest condition and into the post-rest trials. The interpolated rest permits further strengthening of associations and their consolidation. This should result then in an improved post-rest performance.

The Differential Forgetting theory holds that, while a subject is practicing, he learns not only the correct responses, but also incorrect and conflicting responses

which retard the fixation and interfere with the performance. Usually the incorrect and/or conflicting responses may be expected to be less well learned than the correct responses. Under this theory it is assumed further that these incorrect and conflicting responses because they are less well learned will be forgotten more rapidly than the well learned correct responses during the interpolated rest (21).

Research on the role of various subject (organismic) variables in both ordinary and bilateral transfer "reminiscence" is pertinent in any attempt to identify and/or localize these two "different" instances of gain scores and for maintaining controlled experimental conditions in such perceptual motor learning (15, 16).

II. STATEMENT OF THE PROBLEM

In this study the roles of the subject (organismic) variables, handedness and sex difference, have been studied in a bilateral transfer "reminiscence" investigation. There was no attempt to relate these subject variables to ordinary reminiscence. Such a comparison, though desirable, was not feasible under the current time and subject limitations.

There is only a limited number of references concerned with the role of sex differences and handedness in this type of motor learning.

Ammons, Alfin, and Ammons (5), in their study of rotary pursuit performance of pre-adult subjects, found a marked over-all increase of proficiency in this skill with an increase in age. Boys in comparison to girls showed an increasing superiority during the course of practice.

Buxton and Grant (9) also studied gain in motor learning with respect to sex differences. They found that males exceeded the females in initial and final ability.

Rotary pursuit tracking as a function of handedness was studied by Grant and Kraestner (12). Their results indicated that handedness scores were related to the direction in which the rotary pursuit turn-table revolves. Right-handed subjects obtained higher scores when the apparatus

revolved in a clockwise direction. Left-handed subjects performed more proficiently when the task involved a counter-clockwise movement.

Simon, Decrow, Lincoln, and Smith (23) have studied the effects of handedness on tracking accuracy with a hand-wheel control apparatus. They found no significant differences in the performance of right-handed or left-handed individuals.

In 1956 an investigation performed by Miles and Lewis (22) suggested that age might be a significant factor in determining both the rate of acquisition of skill and the over-all level of performance in a pursuitmeter task. The experimenters found no significant differences between the performance scores of the two different handedness groups.

The purpose of this experiment was to investigate the function of the two subject (organismic) variables, sex difference and handedness, in bilateral transfer "reminiscence." It is hoped that this research will help to establish the relationship of these variables in bilateral transfer "reminiscence."

III. EXPERIMENTAL PROCEDURE

A. General Methodology

The general procedure of this research was to conduct an experiment in rotary-pursuit learning in order to study bilateral transfer reminiscence as a function of sex difference and/or handedness.

In order to study gain as a function of the two variables, sex difference and handedness, correlation coefficients were computed for the sum of trials 11-15 with the sum of trials 16-20, that is, the sum of the last five trials before the shift in hands with the first five trials after the shift in hands. This was done for each control group and under each of the major experimental conditions.

From these data linear regression equations were determined for each of the appropriate experimental conditions in order to predict post-rest performance from pre-rest performance for each of the experimental conditions. Gain scores were computed by subtracting the predicted scores from the observed scores. Such a statistical technique takes into account both correlation and variability. This will result in a measure of reminiscence in accord with the classical definition of the term. Then, reminiscence is a gain in performance over what would be expected if practice

continued under massed conditions or, in other words, an improvement in performance attributable to an interpolated rest.

There were four experimental groups and four control groups in which the independent variables were rest condition, sex difference, and handedness:

1. Group I was a control group of right-handed females. Their 15 practice trials with the preferred hand were followed by a shift in hands during the 10 second inter-trial interval which was followed then by 10 more trials with the non-preferred hand (15 R--no rest--10 L).
2. Group II was an experimental group of right-handed females. Their 15 practice trials with the preferred hand were followed by a five minute interpolated rest, a shift in hands, and 10 more trials with the non-preferred hand (15 R--5 minute rest--10 L).
3. Group III was a control group of left-handed females, who practiced 15 trials with the preferred hand and then 10 trials with the non-preferred hand; the shift in hands took place during the normal 10 second inter-trial interval (15 L--no rest--10 R).
4. Group IV was an experimental group of left-handed females, who also practiced 15 trials with the

preferred hand and then 10 trials with the non-preferred hand; the shift in hands took place during the normal 10 second inter-trial interval which occurred during the five minute interpolated rest between trials 15 and 16 (15 L--5 minute rest--10 R).

5. Group V was a control group of right-handed males, who practiced 15 trials with the preferred hand and then 10 trials with the non-preferred hand; the shift in hands took place during the normal 10 second inter-trial interval (15 R--no rest--10 L).
6. Group VI was an experimental group of right-handed males who also practiced 15 trials with the preferred hand and then, after a five minute interpolated rest, practiced 10 more trials with the non-preferred hand (15 R--5 minute rest--10 L).
7. Group VII was a control group of left-handed males who practiced 15 trials with the preferred hand and then 10 trials with the non-preferred hand; the shift in hands took place during the normal 10 second inter-trial interval (15 L--no rest--10 R).
8. Group VIII was an experimental group of left-handed males. Their 15 practice trials with the preferred hand were followed by a five minute interpolated rest, a shift in hands, and 10 more trials with the non-preferred hand (15 L--5 minute rest--10 R).

B. Subjects

A total of 120 subjects (Ss) were used in the experiment; there were 60 females and 60 males. These two groups were in turn each equally divided into two groups of subjects (30 right-handed and 30 left-handed). In turn, each of these groups of 30 Ss was divided into an experimental group and a control group, with 15 Ss in each group. The study then involved eight such groups.

C. Apparatus

Two modified Koerth pursuit rotors, revolving at 60 r.p.m., were used. The two units were arranged so that the Ss were facing each other with a partition between them. Trials and rest intervals were timed automatically. Time on the target was recorded for each trial in units of .01 seconds on two Standard Electric Timers. The diameter of the target was three-fourths of an inch; the total length of the stylus was six and three-fourths inches; the diameter of the turntable was four inches; and the target was three inches from the center of the turntable.

D. Procedure

The Ss used their preferred hand (R or L) for 15 trials, which for the experimental group were followed by a five minute interpolated rest. This was followed then by

10 post-rest practice trials with the other hand. Each trial of practice was 30 seconds long with a 10 second inter-trial interval. Three seconds before the beginning of each trial, a buzzer sounded as a "ready" warning to the Ss.

A modified version of the Standard Air Force Rotary Pursuit Instructions was used (16). Appendix A contains the instructions read to each S. Modification of these instructions was determined by the experimental conditions. All Ss were informed during the instruction period that they might be asked to change hands during the course of the experiment. All groups were allowed an equal amount of time to change the stylus from one hand to the other. This was 10 seconds, which was the inter-trial interval.

For each of the four experimental groups (right-handed females, left-handed females, right-handed males, and left-handed males) which received a five minute interpolated rest, there was a control group which had the same amount of practice but had no interpolated rest. There was a total of 120 Ss for all conditions (experimental and control).

The regression equations for predicting the four experimental (reminiscence) groups' post-rest performance from their pre-rest performance were computed from the sum of trials 11-15 (pre-rest) and the sum of trials 16-20 for each subject in each control group. The appropriate derived coefficient of correlation then was used in the regression equation for predicting post-rest (trials 16-20) performance from pre-rest (trials 11-15) performance for each subject in

each of the four appropriate experimental conditions. Obtained scores then were compared with predicted scores for each S under each of the experimental (rest) conditions. When the obtained score was greater than the predicted score, there was evidence of a gain score or the reminiscence phenomenon.

Subjects in each group received 10 trials of practice after the rest interval and/or shift in hands in order that the post-rest performance curves could be used to graphically demonstrate the reminiscence effect.

The experimenter (E) was present at all times. He gave instructions, proctored, and recorded the scores for each trial.

During the interpolated rest, the Ss were permitted to talk with E, but they were not allowed to discuss the experiment or to manipulate or to inspect the apparatus. Any questions they asked which concerned the investigation were deferred until after the experiment had been concluded.

IV. RESULTS

In order to study gain as a function of sex difference and handedness, linear regression coefficients were obtained first for each of the four conditions involving sex difference and handedness. The Pearson product-moment equations used in the prediction of total performance on sum of the first five (16-20) post-rest trials from the sum of the total performance score on the last five (11-15) pre-rest trials for each condition are presented in Table I. Three of the four correlation coefficients were .91 or above, indicating a high level of accuracy in prediction by regression equations. In the case of the fourth correlation, the one for the left-handed females, control condition, the correlation coefficient was .78, which afforded only moderate accuracy in prediction.

A Chi-square test of linearity of the regression was performed on each of the coefficients in the four control (no rest) groups. This test yielded results which were significant at beyond the .001 level of confidence. This indicated that the assumption of linearity was met and, therefore, justified the use of a regression equation for estimating post-rest performance from pre-rest performance

for the various experimental conditions as determined by their appropriate control conditions.

TABLE I

CORRELATION COEFFICIENT AND REGRESSION EQUATION FOR EACH CONTROL (NO REST) CONDITION

Group	Pre-rest control trials	Post-rest control trials	r	Regression equation
Right-handed females	11-15	16-20	.91	y = .71X-13.40
Left-handed females	11-15	16-20	.78	y = .62X-4.05
Right-handed males	11-15	16-20	.95	y = 1.06X-18.52
Left-handed males	11-15	16-20	.97	y = .92X-8.38

In this experiment, the basic data are given in units of .01 seconds on the target. In order to eliminate negative values before making analyses, a constant of 30 was added to each raw gain score. The mean values with the constant added are presented in Table II. Here the differences between predicted scores and obtained scores (gain scores) are considered measures of reminiscence. The gain scores for each experimental (rest) group are shown in Figure 1. The mean performance scores of the eight experimental groups are listed in Appendix B. These gain scores as a function of handedness for males are presented graphically

in Figure 2. Figure 3 shows the like gain scores for the females.

TABLE II

MEAN VALUE FOR TIME ON TARGET IN SECONDS FOR EACH EXPERIMENTAL GROUP (PLUS A CONSTANT OF 30)

Group	Total last 5 pre-rest trials	Predicted total first 5 post-rest trials	Obtained total first 5 post-rest trials	Mean gain (plus constant of 30)
Right-handed females	40.24	15.14	31.79	46.65
Left-handed females	49.61	27.32	48.87	51.55
Right-handed males	60.00	45.08	45.70	30.62
Left-handed males	52.94	40.32	56.65	46.33

A simple analysis of variance was set up on the sum of the five pre-rest trials (11-15) for all eight experimental conditions. The test showed no significant variation from that expected if chance alone were operating. Table III presents the results of this analysis of variance. This would indicate that there was no significant difference in performance of these eight experimental conditions before the introduction of a shift in hands and/or rest condition.

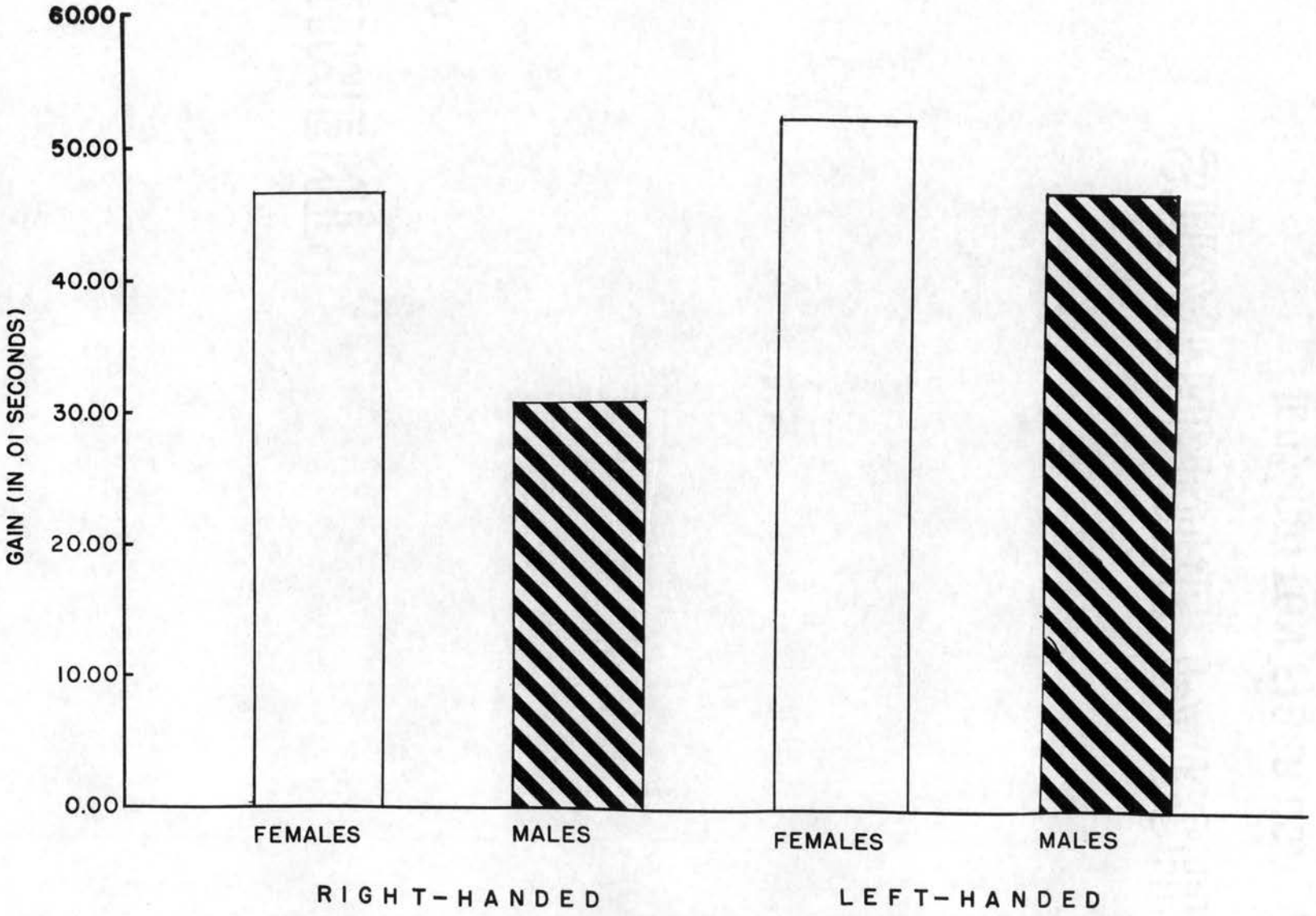

Figure 1. Bar Graph of Gain Scores for Major Experimental (Rest) Conditions

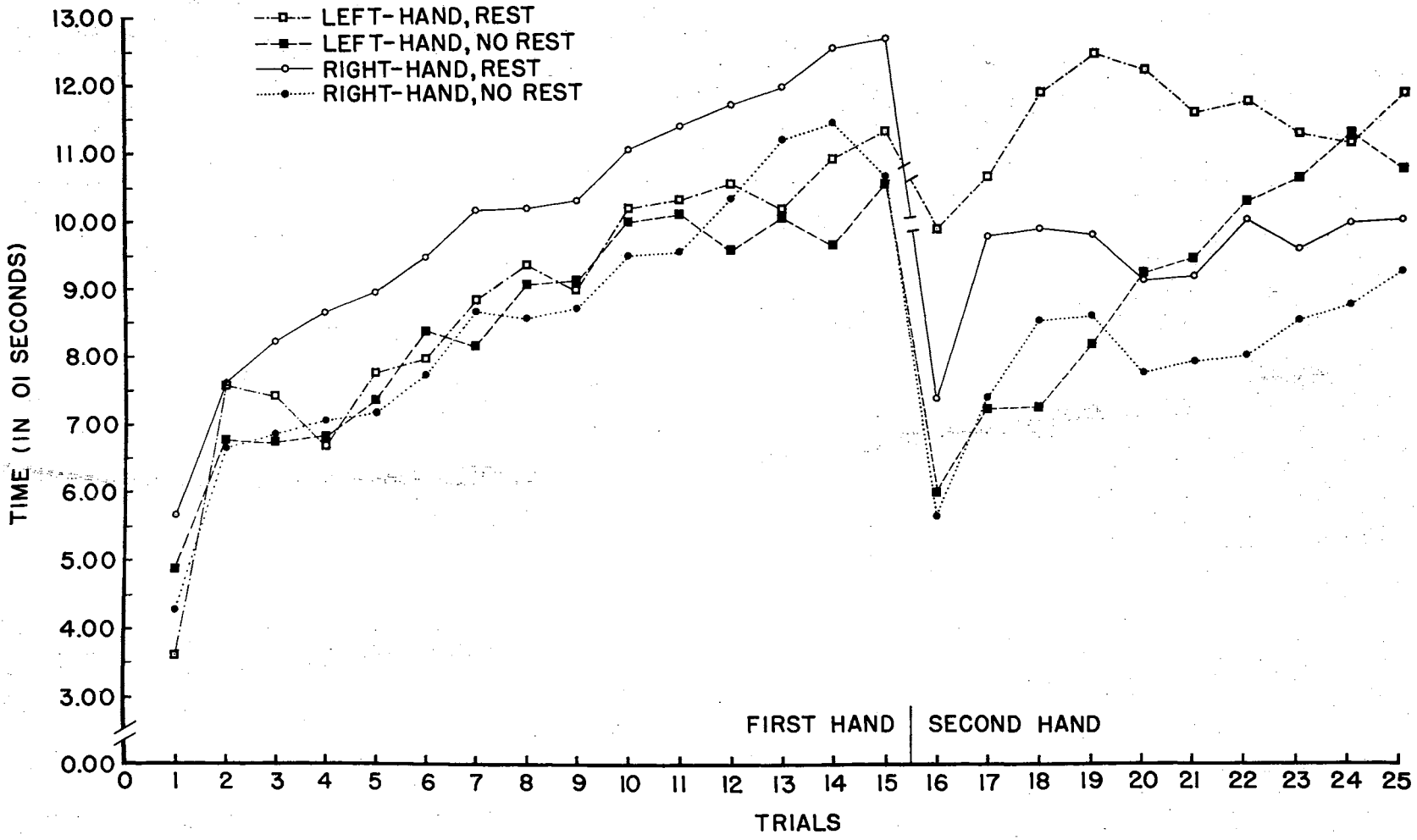

Figure 2. Performance Curves for Males Under Experimental Conditions of Handedness and Rest

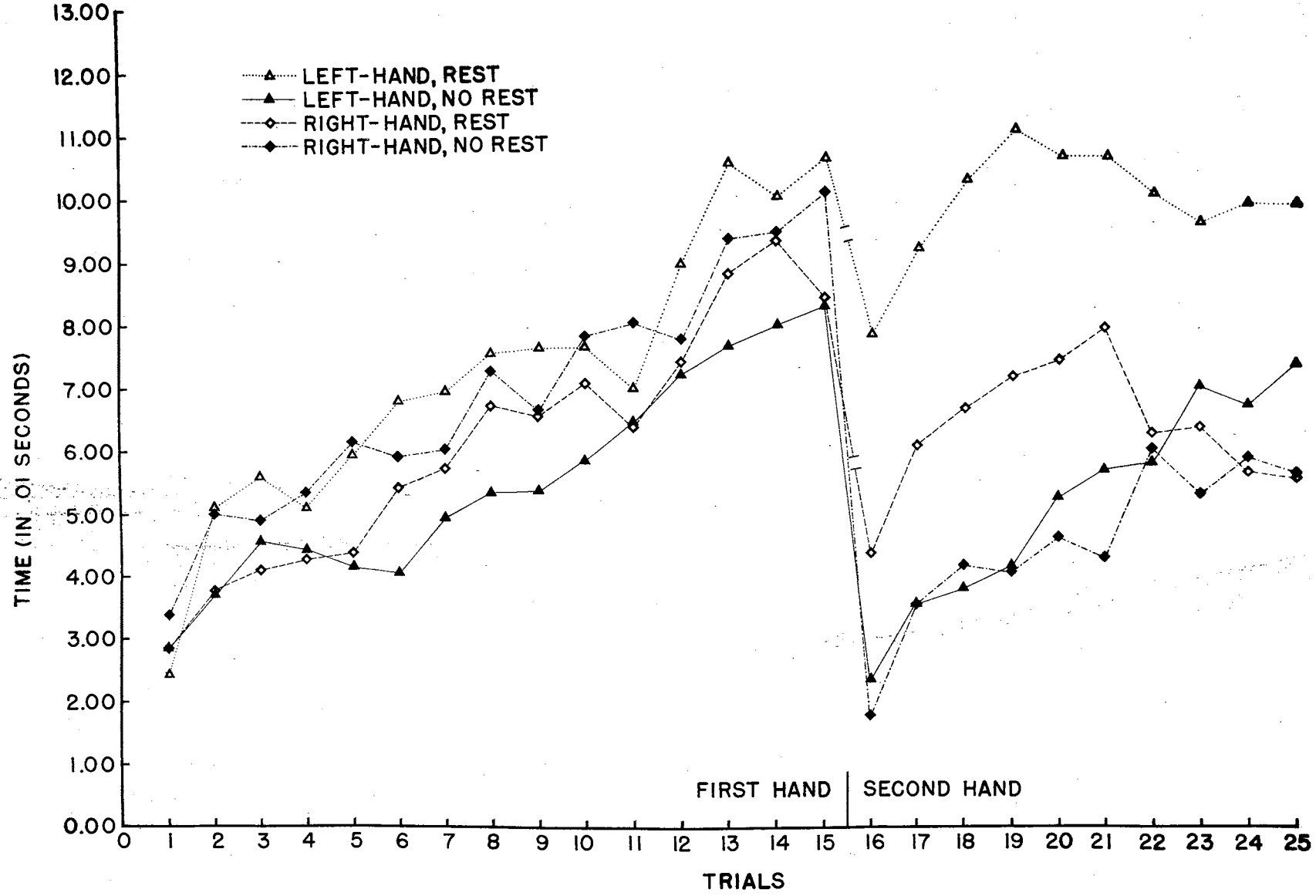

Figure 3. Performance Curves for Females Under Experimental Conditions of Handedness and Rest

Therefore, one may infer that any significant variations that result in the analysis of the sum of the five post-rest trials (16-20) are due to the presence or absence of the interpolated rest and/or the relationship of the major variables of sex difference and/or handedness and/or interactions of these three variables with the rest condition.

TABLE III

ANALYSIS OF VARIANCE OF SUMS OF FIVE PRE-REST TRIALS (11-15) FOR ALL EIGHT EXPERIMENTAL GROUPS

Source of Variation	Sum of squares	Degrees of freedom	Mean Square	F
Between groups	5,595	7	799.3	2.36
Within groups	37,961	112	338.9	(P>.05)
Total	43,556	119		

An analysis of variance was performed on the sum of the five post-rest trials (16-20), but the Bartlett's test (10) indicated heterogeneity of variance ($P < .01$). After a logarithmic transformation was made of the sum of the five post-rest raw scores, a second Bartlett's test indicated homogeneity of variance ($P > .05$).

An analysis of variance which then was performed on the sum of these five post-rest logarithmic transformed scores (trials 16-20) revealed an F-ratio which was significant at the .001 level of confidence. The sums of squares between groups for this analysis were partitioned further into

component parts. The results of this test are given in Table IV. The F-ratio for the experimental variables of rest condition, sex difference, and handedness were highly significant ($P < .01$). The interaction between rest condition and sex difference was also significant at the .05 level of confidence. The other interaction factors were found to be non-significant.

TABLE IV

COMPLETE ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED SUMS OF FIVE POST-REST TRIALS

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Between groups:				
Rest condition	2.080	1	2.080	43.650 (P<.01)
Sex difference	1.350	1	1.350	29.348 (P<.01)
Handedness	.350	1	.350	7.609 (P<.05)
Interaction:				
Rest condition X sex difference	.193	1	.193	4.916 (P<.05)
Rest condition X handedness	.076	1	.076	1.652 (P>.05)
Sex difference X handedness	.001	1	.001	.022 (P>.05)
Sex difference X handedness X rest condition	.050	1	.050	1.087 (P>.05)
Within groups	5.210	112	.046	
Total	9.310	119		

A 2 X 2 analysis of variance of the logarithmic transformed gain scores for the four experimental groups (right-handed females, left-handed females, right-handed males, and left-handed males) then was computed. Results of this test are presented in Table V.

TABLE V

ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED GAIN SCORES FOR FOUR EXPERIMENTAL CONDITIONS CONCERNING SEX DIFFERENCE AND HANDEDNESS

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Between groups	.610	3	.537	8.010
Within groups	1.870	56	.067	(P<.01)
Total	2.480	59		

The results of this analysis appear to permit the inference that there are significant differences in gain scores due to sex difference and/or handedness.

A complete analysis of variance was set up on the gain scores for the four experimental (rest) conditions concerning sex difference, handedness, and the interaction of these two variables. The results of this test are given in Table VI. Both sex difference and handedness were found to be significant ($P < .01$). The results further indicated that interaction of sex difference and handedness was not significant at the 5 per cent level of confidence.

TABLE VI

COMPLETE ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED GAIN SCORES FOR FOUR EXPERIMENTAL CONDITIONS CONCERNING SEX DIFFERENCE AND HANDEDNESS

Source of variation	Sum of squares	Degrees of Freedom	Mean square	F
Sex difference	.310	1	.310	9.394 (P<.01)
Handedness	.200	1	.200	6.061 (P<.01)
Interaction:				
Sex difference X handedness	.100	1	.100	3.030 (P>.05)
Within groups	1.870	56	.033	
Total	2.480	59		

Since the Bartlett's test indicated homogeneity of variance for the logarithmic transformed scores, further analyses of variance were computed for the subgroups of each of the experimental conditions. The two principle subgroup comparisons were between males vs. females and between right-handed vs. left-handed Ss. In Table VII it can be seen that the analysis of variance for right-handed vs. left-handed Ss was significant at the .05 level of confidence. Table VIII contains the results of the analysis of variance of the logarithmic transformed gain scores of males vs. females for right-handed and left-handed Ss. The test indicated results which were significant at beyond the 1 per cent confidence level.

TABLE VII

ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED GAIN SCORES OF RIGHT-HANDED VS. LEFT-HANDED MALE AND FEMALE SUBJECTS

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Between groups	.20	1	.20	5.128
Within groups	2.28	58	.039	(P<.05)
Total	2.48	59		

TABLE VIII

ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED GAIN SCORES OF MALES VS. FEMALES FOR RIGHT-HANDED AND LEFT-HANDED SUBJECTS

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Between groups	.31	1	.31	8.378
Within groups	2.17	58	.037	(P<.01)
Total	2.48	59		

Tables IX to XIV contain the results of the analyses of the comparisons for the subgroups. Significant F-ratios at the .01 level of confidence were obtained for right-handed females vs. right-handed males, left-handed females vs. right-handed males, and left-handed males vs. right-handed males. The former in each of the above comparisons was the superior group in reminiscence (gain score) performance.

TABLE IX

ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED GAIN SCORES OF RIGHT-HANDED FEMALES VS. RIGHT-HANDED MALES

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Between groups	.38	1	.38	11.520
Within groups	.93	28	.033	(P<.01)
Total	1.31	29		

TABLE X

ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED GAIN SCORES OF LEFT-HANDED MALES VS. LEFT-HANDED FEMALES

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Between groups	.03	1	.03	.882
Within groups	.94	28	.034	(P>.05)
Total	.97	29		

TABLE XI

ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED GAIN SCORES OF LEFT-HANDED FEMALES VS. RIGHT-HANDED MALES

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Between groups	.51	1	.51	14.167
Within groups	1.02	28	.036	(P<.001)
Total	1.53	29		

TABLE XII

ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED GAIN SCORES OF RIGHT-HANDED FEMALES VS. LEFT-HANDED MALES

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Between groups	.01	1	.01	.330
Within groups	.85	28	.030	(P>.05)
Total	.86	29		

TABLE XIII

ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED GAIN SCORES OF RIGHT-HANDED MALES VS. LEFT-HANDED MALES

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Between groups	.29	1	.29	5.800
Within groups	1.40	28	.05	(P<.05)
Total	1.69	29		

TABLE XIV

ANALYSIS OF VARIANCE OF LOGARITHMIC TRANSFORMED GAIN SCORES OF LEFT-HANDED FEMALES VS. RIGHT-HANDED FEMALES

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Between groups	.01	1	.01	.599
Within groups	.47	28	.017	(P>.05)
Total	.48	29		

F-ratios which were not significant ($P > .05$) were found for the subgroup comparisons of left-handed males vs. left-handed females, right-handed females vs. left-handed males, and left-handed females vs. right-handed females. Interactions for these analyses were also non-significant.

The performance curves for the male and female groups are presented in Figures 4 and 5. Here gain scores may be observed by comparing post-rest performance levels of the experimental (rest) and control (no rest) groups. Following the rest and/or shift in hands, there is a distinct difference in performance.

Though there are decreases in the performance level, that is, in shifting from the preferred hand to the non-preferred hand, inspection reveals that these decreases are considerably less in each case for the rest groups. In each combination of control and experimental groups for the major conditions of sex difference and handedness, it can be see that these curves have the same general shape, but they are at different performance levels. The rest group curve was usually higher than the curve for its appropriate control group.

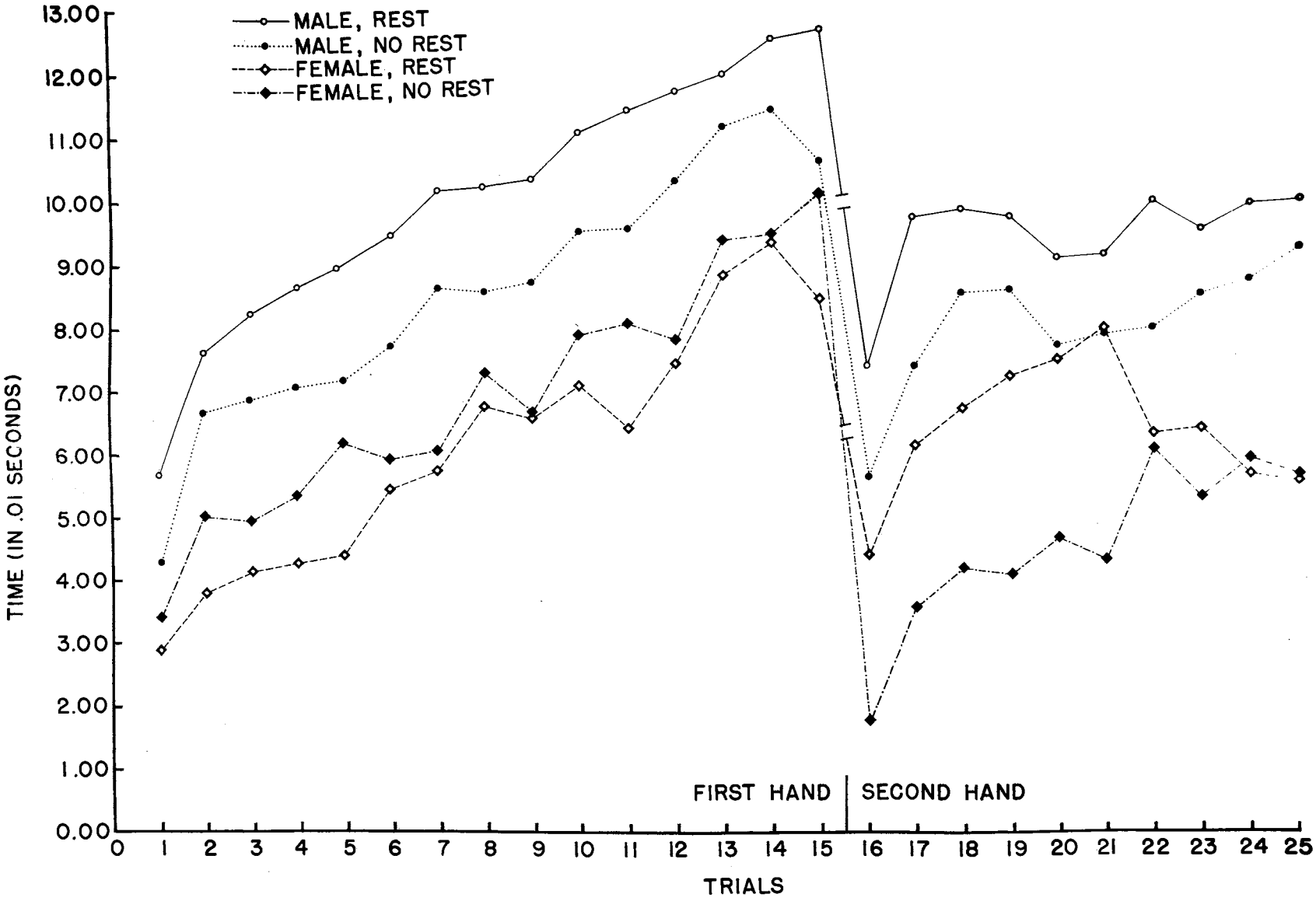

Figure 4. Performance Curves for Right-Handed Subjects Under Experimental Conditions of Sex Difference and Rest

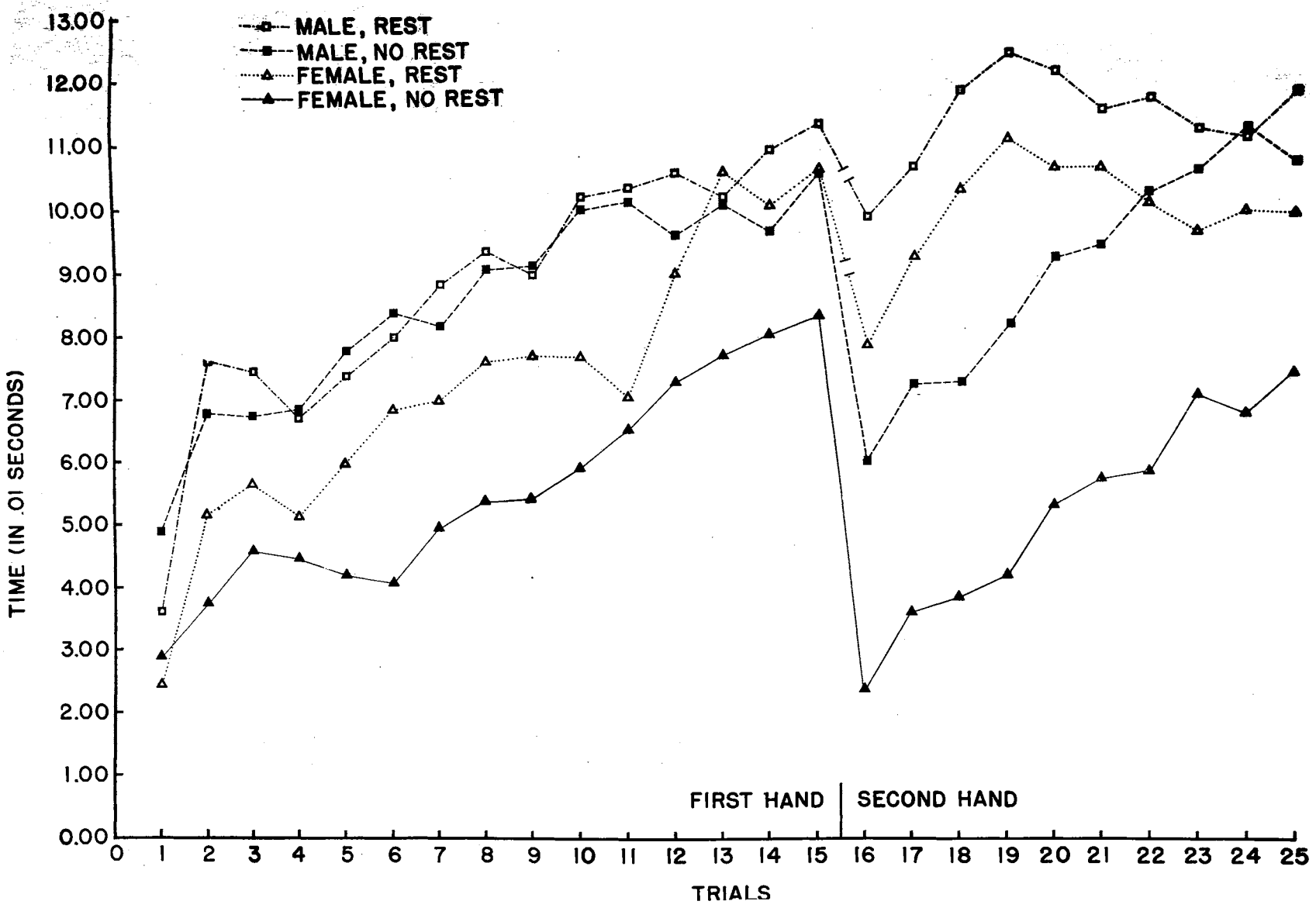

Figure 5. Performance Curves for Left-Handed Subjects Under Experimental Conditions of Sex Difference and Rest

V. DISCUSSION

Statistical analyses of the results obtained from the present study indicate that the null hypothesis for bilateral transfer "reminiscence" as a function of sex difference and/or handedness should be rejected. In comparing the experimental variables, both sex difference and handedness were found to be significantly related to bilateral transfer "reminiscence" at the .01 level of confidence.

There appeared to be little interaction between the variables of sex difference and handedness, which were the major variables dealt with in this investigation. The analysis which treated the interaction of these two factors resulted in a non-significant F-test ($P > .05$). It should be noted, however, that, when an analysis of variance was performed on the relationship of the variables, sex difference and handedness, to bilateral transfer "reminiscence" (gain scores), the only significant interaction that resulted was between sex difference and gain scores (see Table IV). It also should be noted that the other interactions concerning (1) handedness X rest condition, (2) sex difference X handedness, and (3) sex difference X handedness X rest condition were non-significant when a complete

analysis of variance of logarithmic transformed sums of the five post-rest trials was performed.

In Figures 4 and 5, it can be seen that the males started performing on trial 1 at a higher mean performance level than did the females. The males also finished at a higher performance level on trial 25 than did the females. However, in gain score performance, the females' group obtained the highest mean gain score. With regard to the handedness factor, the left-handed Ss (males and females) were superior in terms of gain score performance. The left-handed female group attained the highest mean gain score of the four experimental (reminiscence) groups. The lowest mean gain score was found in the right-handed male group. The mean gain scores for the right-handed females and left-handed males fell in between these two extremes.

In this study, it appears that bilateral transfer "reminiscence" is related to the subject (organismic) variables of sex difference and handedness. The author's survey of the literature revealed no experimental research concerned with both these variables in a comparable investigation. The only relevant research that was located dealt with the subject variable of sex difference. Buxton and Grant (9) found that males were more proficient in this type of perceptual-motor skill in terms of initial and final ability. This finding is consistent with the results of the present study. Ammons, et al., (4) found that males showed, in comparison to females, an increasing superiority

throughout the practice trials. In the current study, the males, in general, attained higher mean scores than the females, but there were no statistical analyses performed to indicate whether males' higher mean performance level was maintained throughout the experiment. This was not done because the main point of interest in the current investigation was to study the difference in performance on the pursuit-rotor after an interpolated rest in relation to sex difference and handedness. Then, in general, the performance curves in the present investigation are consistent with previous findings (4, 9) which were concerned mainly with the acquisition of a perceptual-motor skill. These studies did not concern the reminiscence phenomenon.

The only relevant study which treated the handedness factor in a perceptual-motor skill was reported by Simon, et al. (23). They found no significant differences in the performance of right-handed and left-handed individuals in an experiment which utilized a hand-wheel control apparatus. The Simon study reported results which were concerned with the acquisition of skill on the hand-wheel control apparatus and was not concerned with reminiscence. In the current study, the purpose was to investigate bilateral transfer "reminiscence" in a different perceptual-motor activity, one involving the pursuit-rotor. Such apparatus differences and design variations might help to explain some of the differences in the results for the two investigations.

The marked differences in mean gain score performance for the right-handed males in the present study as compared to the like performance of right-handed males in other studies (14, 16) and the other experimental groups in this study (see Figure 1) suggest the possibility of a sampling error.

Because of the possible sampling error in the present investigation, it would seem advisable to replicate or perform comparable studies concerning the variables of sex difference and/or handedness.

It also would be advisable to conduct a study which would investigate the same variables but in a conventional (unilateral) transfer "reminiscence" experiment. This should be done in a further attempt to discover whether ordinary and bilateral transfer "reminiscence" are the same phenomenon, or like phenomena.

Results of the present investigation would appear to suggest that, for control purposes, future research on bilateral transfer "reminiscence" should take into account the possible significant differences that might arise due to the differential effects of sex difference and handedness.

VI. SUMMARY AND CONCLUSIONS

1. An experiment was conducted in which the major variables of sex difference and handedness were investigated in order to determine the relationship of these variables to bilateral transfer "reminiscence" in a pursuit-rotor study. There were eight experimental groups with 15 Ss in each group. Four of the groups were run under no rest (massed practice) control conditions, while the other four groups, reminiscence conditions, were given a five minute interpolated rest in the course of practice. Regression equations derived from the performance of the massed practice (no rest) control group were utilized to predict post-rest performance for the appropriate experimental (rest) conditions from their pre-rest performance. The difference between predicted and obtained scores afforded a measure of "reminiscence" (gain score) for the experimental groups. All possible variations in the two differences in sex and handedness variables were represented in each of the four experimental groups with a comparable variation in these variables for each of the four control groups. Subjects used the

preferred hand before the rest and/or shift in hands to the non-preferred hand.

2. In considering gain over predicted massed practice score for each of the experimental conditions concerned with sex difference, it may be concluded that, in this study, bilateral transfer "reminiscence" is significantly related to this variable. Females demonstrated significantly greater amounts of bilateral transfer "reminiscence" than did the males.
3. The left-handed Ss, both males and females, were significantly superior to right-handed Ss of both sexes in amount of bilateral transfer "reminiscence."
4. For each of the experimental (rest) conditions involving the variations in sex difference and handedness, the benefit of the interpolated rest was temporary and tended to disappear in additional practice.

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APPENDICES

APPENDIX A

INSTRUCTIONS

This is a test of your ability to follow a moving target. Your task will be to keep the point of this stylus on the round brass target while it is moving. Hold the cord and handle like this (demonstrate), and keep the stylus on the target as it goes around. You will do best if you develop a smooth, free-swinging motion of the arm and shoulder.

Stand in an erect position, directly in front of the apparatus. Put the palms of your hands on the corners of the apparatus, stand erect, and move back until your arms are straight. Hold the cord at the marker, like this (demonstrate). Hold the handle and metal rod exactly level. The end of the metal rod is flat and makes a better contact if held level. Don't raise the handle. Hold the handle with the tips of your thumb and fingers (demonstrate).

Now show me the correct method for holding the cord and stylus. Subject demonstrated.

You may be asked to change hands during the test. If you are, just change the stylus to the other hand and continue as before.

You will start with your right (left) hand.

Lift your stylus about an inch off the target while I finish the directions. You will be given a series of test periods and short rest intervals. There is no practice. When the disc starts, get on the target and try to stay on it. Your score begins to count when the disc starts. When the disc stops, lift your stylus off the target and keep it off until the disc starts again.

Remember, your score is the total amount of time you stay on the target. The rest periods are very short, and the disc starts after a three second warning buzzer. Are there any questions?

. . . . . .

(Immediately at the end of the last pre-rest practice trial, each 10 second no rest group is told): "Change the stylus to the other hand and continue as before."

(At the end of the last pre-rest practice trial, the five minute rest groups are instructed): "Put down the stylus and rest."

Fifteen seconds before the time to resume practice they are told): "Change the stylus to the other hand and continue as before."

APPENDIX B

APPENDIX TABLE 1

MEAN PERFORMANCE SCORES (IN .01 SECONDS) FEMALES

Trials	Right-handed		Left-handed	
	Control Group I	Experimental Group II	Control Group III	Experimental Group IV
1.	3.39	2.44	2.44	2.86
2.	5.02	3.75	3.71	5.12
3.	4.90	4.14	4.60	5.61
4.	5.35	4.26	4.41	5.14
5.	6.15	4.36	4.19	5.94
6.	5.91	5.43	4.07	6.81
7.	6.04	5.74	4.96	6.96
8.	7.23	6.72	5.35	7.55
9.	6.66	6.56	5.39	7.64
10.	7.80	7.08	5.82	7.67
11.	8.03	6.39	6.42	9.66
12.	7.78	7.39	7.20	8.93
13.	9.31	8.79	7.64	10.49
14.	9.40	9.29	7.94	9.98
15.	10.02	8.38	8.26	10.55
16.	1.79	4.37	2.34	7.81
17.	3.57	6.11	3.58	9.21
18.	4.19	6.71	3.80	10.25
19.	4.07	7.17	4.12	11.06
20.	4.59	7.43	5.24	10.61
21.	4.27	7.95	5.69	10.63
22.	5.02	6.25	5.80	10.07
23.	5.29	6.33	6.99	9.62
24.	5.87	5.66	6.73	9.88
25.	5.60	5.55	7.33	9.88

APPENDIX TABLE 2

MEAN PERFORMANCE SCORES (IN .01 SECONDS) MALES

	Right-handed		Left-handed	
Trials	Control Group V	Experimental Group VI	Control Group VII	Experimental Group VIII
1.	4.26	5.67	4.88	3.69
2.	6.68	7.60	6.76	7.54
3.	6.86	8.21	6.79	7.43
4.	7.09	8.64	6.79	6.71
5.	7.20	8.95	7.37	7.78
6.	7.71	9.48	8.37	7.96
7.	8.66	10.17	8.14	8.83
8.	8.55	10.19	9.05	9.33
9.	8.70	10.28	9.12	8.99
10.	9.47	11.02	9.97	10.16
11.	9.52	11.35	10.08	10.27
12.	10.38	11.65	9.55	10.51
13.	11.14	11.90	10.03	10.12
14.	11.39	12.48	9.62	10.85
15.	10.58	12.61	10.49	11.25
16.	5.61	7.33	5.96	9.81
17.	7.32	9.73	7.21	10.61
18.	8.46	9.83	7.21	11.80
19.	8.54	9.75	8.11	12.32
20.	7.73	9.07	9.16	12.10
21.	7.86	9.11	9.38	11.50
22.	7.96	9.95	10.22	11.67
23.	8.47	9.58	10.55	11.18
24.	8.76	9.90	11.17	11.05
25.	9.20	9.94	10.70	11.78

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