7-1-1963

# The effect of drive level on performing a complex task

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by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts in Psychology in the
Graduate School of the University of Richmond

August 1963

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# THE INTRODUCTION

Hull (1943) proposed that habit strength (sHr) and drive (D) combine multiplicatively to produce behavior. Therefore an increase in D, where sHr is assumed to remain constant, should lead to an increase in such behavioral measures as frequency or magnitude of performance, speed of responding, and resistance to extinction.

Many studies have varied levels of drive to find the effect on performance. Perin (1942) trained rats under 23 hour food deprivation to push a bar to obtain food. The habit of bar pressing was then extinguished under 1, 3, 16, 23 hours food deprivation. The behavior potential, measured in terms of number of responses to extinction, increased with increasing time of deprivation. Kimble (1951) tested rats, which had learned to push a panel for food while 24 hours deprived, under 11 different deprivation conditions ranging from 0 to 24 hours. He found that the speed of responding increased gradually up to 24 hours. To control for any effect of change in drive level from training to testing, Yamaguchi (1951) trained a group of rats under 3, 12, 24, 43, 72 hours food deprivation and extinguished the response of bar pressing in each group at its original training level of deprivation. It was found that the number of responses to extinction increased progressively with deprivation time.

Using the same theory with human Ss, Taylor constructed a scale (MAS) of 65 MMPI items which were judged to measure anxiety. The test became employed as a measure of drive. High and low drive groups were composed of two groups of Ss chosen from the upper and lower ends of the scale. Assuming that MAS scores reflect drive, the results indicate that high drive facilitated performance in conditioning the eyelid response. (Taylor, 1951; Spence and Taylor, 1951)

In all of the above studies, a single dominant response is presumed to be present. When strong competing responses are present, increased general drive will theoretically increase the potential of these competing responses. If incorrect responses are higher in the hierarchy than the correct responses, the relative probability of incorrect responses occurring will be increased. In such cases, increasing drive might be expected to impair performance. For example, Farber and Spence (1953) found low drive Ss were superior to high drive Ss in errors and number of trials to mastery in learning a stylus maze. Montague (1953) varied intra-list similarity and Glaze association values in three verbal learning tasks. High drive Ss had fewer correct anticipations on the difficult task (high similarity and low association). As the task became easier (low similarity and low association) they showed improved performance. On the task where the least number of incorrect tendencies would be expected (low similarity and high association) the high drive S's performance was better than that of the low drive group. In each of the above studies using human Ss, drive level was defined in terms of MAS scores.

A complex or difficult task is defined as one where the correct response is not dominant in the S's hierarchy. In a choice situation, if the Ss were trained to make one choice, then if the correct response were changed to some other choice it might be assumed that the task is complex, since the dominant response is not the correct one.

Ramond (1954), using a double bar Skinner box and rats 4 and 22 hours food deprived, gave twice as many reinforced trials on one bar as the other. Trials were administered in blocks of three, the first trial being free and the other two forced so that in any one block two reinforced trials were given on one bar and one on the other. On free trials, the high drive group chose the more frequently reinforced bar a significantly greater number of times than the low drive group.

It follows that the low drive group ran more often to the other bar on free trials, since the Ss had to choose one bar or the other. If the experiment had then been changed to a reversal learning situation, where the previously incorrect bar was called "correct", it would seem that the performance of the low drive group would be superior to the high drive group, as might be predicted from drive theory.

Performance in a choice situation apparently varies with drive only if the frequency of making the alternative responses is not equated. When Ss are forced to make the same number of responses to positive and negative goals, drive level seems to have no effect on performance. Spènce, Goodrich, and Ross (1959) trained rats under 3 and 40 hours food deprivation to make a black-white discrimination. The Ss were reinforced at white and never at black. It was found that if the Ss were forced to run twice to white and twice to black, the percent choice was not affected by drive level. However, when the Ss ran twice to white and once to black, the percent choice was a function of drive level.

Buchwald and Yamaguchi (1955) used a reversal learning situation to test the hypothesis that increasing drive will impair performance when the strength of the correct response is relatively weak. Thirty-six rats on 1 1/2 and 20 1/2 hours water deprivation were trained in a single unit T maze with 4 trials per day. The Ss were randomly assigned to 4 groups: high-high, high-low, low-low, and low-high, "low" and "high" referring to drive level for original and reversal learning. When a criterion of 10 correct runs out of 12 was reached, they were trained to reverse the direction of the response. The previously negative goal became positive for all 4 groups, and the deprivation interval was changed for the high-low and low-high groups. Reversal learning can be considered a difficult task, since the most dominant response, the one just learned, becomes incorrect. The results indicated that reversal learning was more rapid for the high drive group.

These results are not easily predictable from drive theory. In reversal learning, the incorrect response is presumed to have greater habit strength than the correct response and increased drive should, by combining multiplicatively with the habit strengths of these responses, lead to relatively impaired performance, since the magnitude of the difference between the reaction potentials of the correct and incorrect responses will be greater for the high drive group.

Since the Buchwald and Yamaguchi study is the only one to show that a high drive group is superior on learning a complex task, the present study is a further investigation of the problem. The purpose of the present study is to attempt to replicate the unexpected findings of Buchwald and Yamaguchi.

# THE METHOD

Subjects-The Ss were 44 experimentally naive male albino rats of the Sprague-Dawley strain from the Holtzman Co. They were 60 to 88 days old at the beginning of the experiment.

Apparatus-The apparatus was modeled after that of Buchwald and Yamaguchi (1955) and consisted of a single unit T maze with a stem 18 1/2 in. long and arms 18 in. long. All alleys were 3 3/4 in. wide and 4 in. high and consisted of wooden walls, hardware cloth flooring and a hinged cover of hardware cloth. The maze rested on legs which supported it 1 in. above the table top. It was painted a flat black throughout. The starting box was 9 in. long and the goal boxes were 9 1/2 in. long. A soft drink cap to hold food was placed in each goal box. There were 4 guillotine doors in the maze; one for the starting box, one in the stem at the choice point, and one for each goal box.

Procedure-The Ss were randomly assigned to 4 groups corresponding to drive level during original and reversal learning respectively. One group was given original learning under high drive and reversal learning under low drive. A second group was given original and reversal learning under high drive. Another group was given original learning under low drive and changed to high drive for reversal learning. The last group was given original and reversal learning under low drive. The high and low drive conditions were established by running the Ss in the high drive group 22 hours after feeding; and the low drive Ss were run 1 hour after feeding. The Ss were run in squads of 4, one S chosen randomly from each group. The two Ss from each squad with original learning under the same drive level constituted a pair for the Wilcoxons test for paired replicates. A new squad was started every 2 days.

Upon receipt from the shipping company, the Ss were placed in individual living cages and fed and watered ad libitum for one week during which time they were handled daily. They were placed on the maintenance schedule for 10 days of habituation to a 23 hour deprivation schedule before the actual experiment began. All Ss had a 1 hour eating period each day. They were run at the same time but fed at different times so that at the time of running the low drive group was 1 hour deprived and the high drive group was 22 hours deprived.

Apparatus habituation took place during the last 3 days of maintenance habituation. The first day, the Ss were placed in the goal box alley with the choice point door closed. They were given 5 pellets of food in the food cup for running from one goal box to the other for a total of four reinforcements. After each reinforcement, the S was removed from the goal box and placed in it again so that the S could run to the opposite goal box for the next reinforcement. The location of the reinforcement was alternated. The goal box doors were open at all times. The next day the S was placed in the stem with the choice point door closed and allowed to explore for 60 seconds. On the third day of apparatus habituation, the Ss were fed in the goal box alley as on day one except that the goal box door was now closed after the S had started to eat. There were no systematic differences in time spent in the goal box or number of reinforcements during habituation.

The following day original learning was begun. The Ss were given 4 trials per day until a criterion of 10 correct runs in 3 consecutive days was reached. An error was recorded if the S had all 4 feet in the incorrect alley. Correction was allowed on all trials. The procedure for each trial was as follows: The S was put in the starting box; when S was facing the alley, the starting box and choice point doors were raised and timing started; the starting box and choice point doors were closed as soon as the S was clear; the goal box door was closed and timing stopped when the S started to eat. Each reinforcement consisted of five 45 mg. pellets. The S was removed from the goal box after 10 sec. regardless of how much had been eaten. There were 30 sec. between trials. The Ss were randomly assigned to subgroups which were reinforced either on the right or the left side, in an attempt to control for any initial direction preference.

Since the deprivation interval was changed for half of each group at the beginning of reversal learning, the Ss were not run the day following original learning.

Reversal learning procedure was the same as that used for original learning except that each S was reinforced in the previously negative goal box. Ss were run to the same criterion used for original learning. These procedures were, as nearly as possible, the same as those used by Buchwald and Yamaguchi.

# THE RESULTS

The mean and median days to criterion and errors for all groups for original and reversal learning are presented in Table I. and Table II. and Figures 1 and 2.

Following Buchwald and Yamaguchi (1955) a comparison of days to criterion in original learning was made between the low and high drive groups by means of Wilcoxon's test (1949) for paired replicates. In original learning, the difference in days to criterion between the low-original (low-low and low-high) and the high-original (high-low and high-high) Ss was not significant, although the high drive groups reached criterion an average of two days ahead of the low drive groups.

Using the same test, the days to criterion for original learning for the low-low and low-high groups were compared to test for initial ability difference. The difference was not significant. However when the high-high and high-low groups were compared, the difference was significant at the .05 level. The difference is probably accounted for by sampling errors in a relatively small group of Ss.

TABLE I

Days to Criterion for

Original and Reversal Learning

| Group | Days to Criterion | | | | | |
|---|---|---|---|---|---|---|
| | Original Learning | | | Reversal Learning | | |
| | Median | Mean | SD | Median | Mean | SD |
| low-low | 7.00 | 7.73 | 3.54 | 8.00 | 10.45 | 7.02 |
| low-high | 8.00 | 9.09 | 5.45 | 11.00 | 11.00 | 4.00 |
| high-high | 5.00 | 5.27 | 1.62 | 6.00 | 7.64 | 4.65 |
| high-low | 6.00 | 6.82 | 2.56 | 6.00 | 8.73 | 5.00 |

TABLE II

Errors for

Original and Reversal Learning

| Group | Errors | | | | | |
|---|---|---|---|---|---|---|
| | Original Learning | | | Reversal Learning | | |
| | Median | Mean | SD | Median | Mean | SD |
| low-low | 11.00 | 11.73 | 7.21 | 10.00 | 17.09 | 16.73 |
| low-high | 13.00 | 15.18 | 11.16 | 27.00 | 23.64 | 14.82 |
| high-high | 6.00 | 7.09 | 4.48 | 11.00 | 13.18 | 12.04 |
| high-low | 9.00 | 10.27 | 6.36 | 13.00 | 14.91 | 10.19 |

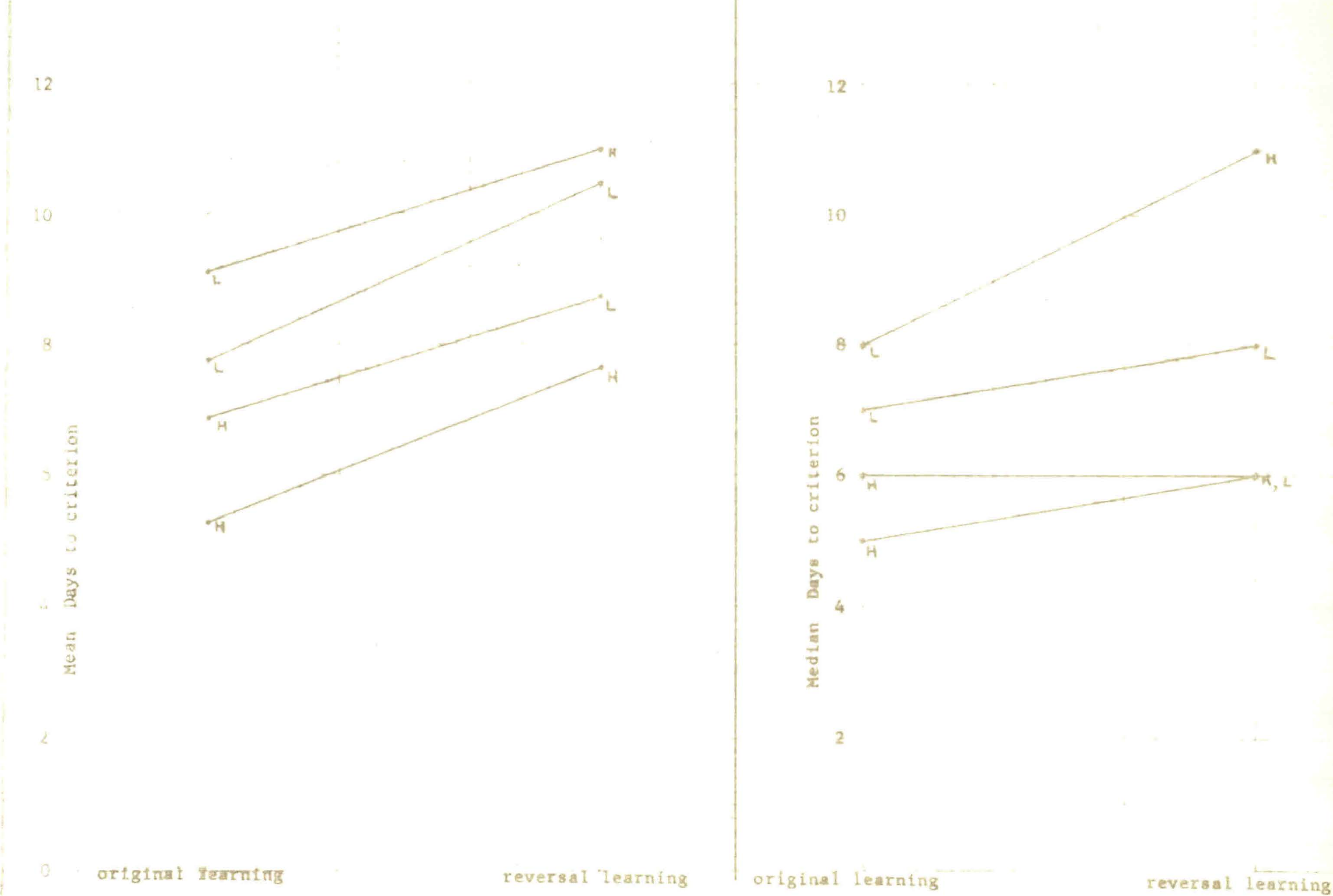


Figure 1. Mean and median days to criterion

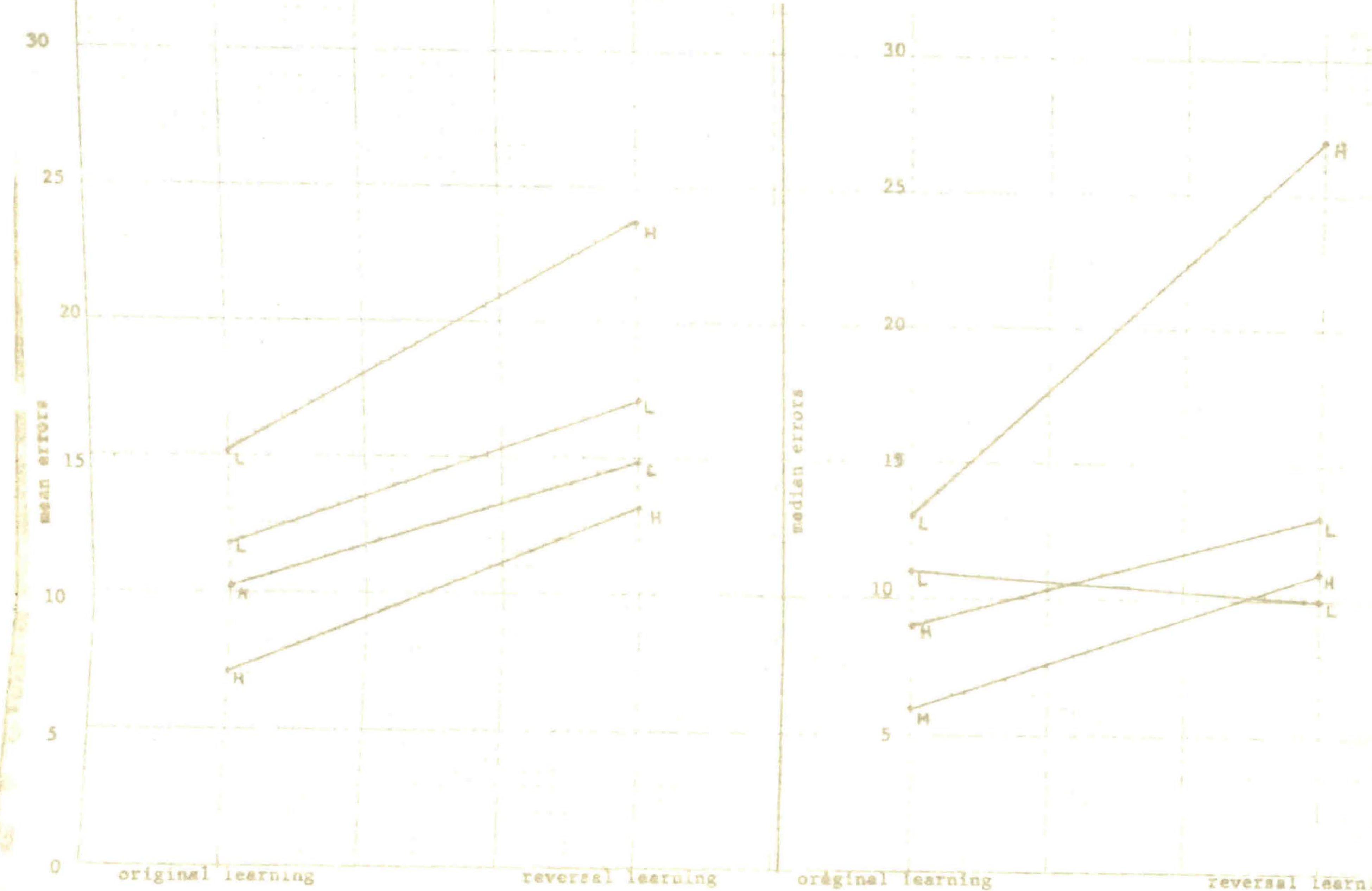


Figure 2. Mean and median errors

To test for any effect that the drive level during original learning might have on reversal learning, days to criterion for reversal learning for high-high and high-low (high original) and low-high and low-low (low original) Ss were compared. The differences were not significant even though the high original groups reached reversal learning criterion an average of over two days before the low original groups.

Comparing the days to criterion in reversal learning for the groups with unchanged drive in reversal learning (high-high and low-low) with the groups with changed reversal drive (high-low and low-high) showed that there was no significant difference between the groups.

For days to criterion in reversal learning, the two Ss in each squad which had run under the same drive level for original learning constituted a pair of Ss for the test. No significant differences were found either between the low-high Ss and their low-low running mates or between the high-high and high-low Ss.

Each of the above tests was also made using the number of errors as the dependent variable. No significant differences were found in any of the tests made using error scores.

The Mann Whitney U Test was also used for each of the above tests. No significant differences were found.

# THE DISCUSSION

In original learning, there was no significant difference between the Ss running under high drive (high-high and high-low ) and those under low drive (low-low and low-high) However, it is interesting to note that the high drive group reached criterion for original learning an average of two days ahead of the low drive groups, which is in agreement with Buchwald and Yamaguchi and drive theory.

For high-high vs. high-low groups, it was found that during original learning the high-high Ss took significantly fewer days to reach criterion. This difference is probably accounted for by an initial ability difference due to sampling errors.

The high-high and high-low groups cannot satisfactorily be compared for reversal learning because of the initial superiority of the high-high group. It is of interest that this group under high drive did not retain its superiority during reversal learning, since the difference between the high-high and high-low groups during reversal learning was not significant. This would suggest that the high drive did not facilitate and perhaps was detrimental to performance in reversal learning.

For reversal learning, the difference between the low-low group and the low-high group was not significant, but it was observed that six of the Ss under low drive reached criterion before their high drive running mates.

The decrement found in performance during reversal learning is more marked in groups under high drive in reversal learning. The median number of days to criterion for original learning for the low-high group was 8 days and 11 days for reversal, or an increment of 3 days. Their low-low running mates have an increment of only one day for reversal learning. Similarly, for the high-high group there was a one day increment during reversal learning and no increment for the high-low group. This would suggest that in this study reversal learning is less rapid under high drive rather than more rapid as found by Buchwald and Yamaguchi.

Although the difference is not significant, the high original Ss reached reversal criterion before the low original Ss. These results could be affected by the fact that correction was allowed on all trials. When correction is allowed, an S can run first to the incorrect side, then to the correct side. The S could be getting generalized secondary reinforcement for turning the incorrect way. Since generalization is broader for high drive, the high drive groups would get more reinforcement for the incorrect turn than the low drive groups during original learning. Therefore, when reversal learning starts, the high original Ss learn the previously incorrect response faster than the low original Ss.

Contrary to the findings of Buchwald and Yamaguchi, who found reversal learning was more rapid under high drive, this study found high drive did not facilitate reversal learning. Perhaps with a larger number of Ss, the superiority of the low drive groups in reversal learning would be significant, since the same trend was also found in an earlier pilot study. A larger number of Ss would most likely eliminate any initial ability differences as were found between the high-high and high-low groups in original learning. Without this difference, the test for reversal learning between these groups could be adequately made.

If correction was not allowed, there would be no chance to build up habit strength for the incorrect side due to secondary reinforcement. By using non-correction the interaction from this secondary reinforcement would be eliminated and a clearer picture of the effect of drive level on reversal learning might be obtained.

This study was unable to replicate the findings of Buchwald and Yamaguchi. Further investigation along these same lines is necessary to settle the issue. A larger number of Ss and/or a non-correction procedure might produce significant results.

# THE SUMMARY

The purpose of this study was to replicate the Buchwald and Yamaguchi study, which found that reversal learning was more rapid under high drive. Their results are not easily predictable from drive theory. The hypothesis tested here was that an increase in drive would impair performance on a complex task (reversal learning).

No significant difference was found between the high and low drive groups on reversal learning, contrary to the findings of Buchwald and Yamaguchi. The discrepancies between these results and those of Buchwald and Yamaguchi and the predicted results are discussed. Suggestions for futher investigations of the problem are made.

Despite the discrepancy between the two studies, the results of the present investigation and the Buchwald and Yamaguchi study are not in accordance with prediction from Hull-Spence drive theory.

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# Vita

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