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Don Lewis
State University of Iowa

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By Don Lewis

As part of an extensive investigation of the underlying variables in complex perceptual-motor performance, 35 male subjects were given practice under usual conditions on a Koerth-type pursuit rotor, and several days later practiced on the same unit at a slower speed with mirror-vision. The speed of the rotor for conventional direct-vision performance was 60 r.p.m. and for mirror-vision was 15 r.p.m. For direct-vision, the lengths of the work and rest periods were 10 and 20 sec., respectively, and for mirror-vision, 30 and 30 sec. Thirty trials of conventional practice were given, with a two-minute break after trial 15. The number of mirror-vision trials was 40, with two-minute breaks after trials 10, 20, and 30.

The lengths of the work and rest periods, the number of trials, and the speeds of rotation were adjusted so as to make the tasks about equally difficult and thus lead to approximately the same proficiency of performance throughout practice, as judged by per cent of time on target. The slow speed of rotation for the mirror-vision task was especially necessary.

The purpose of this paper is to present performance curves for the two learning situations, to summarize information on reliability, and to indicate the strengths of the relationships between performance measures for the two tasks at comparable points during practice.

Before the investigation was started, it was known from data reported by Melton (2) that the reliability of scores on the conventional Koerth-type rotor is high. Ruch (4) had found correlations of .90 and higher for mirror-vision scores on a pursuit unit, but it was of the *prod* type. Little or nothing was known about the reliability of mirror-vision scores on a continuously rotating unit. In fact, prior to 1948, apparently no investigator employed conditions that would lead to substantial amounts of learning. Pomeroy (3), for example, in a study of retroactive inhibition in motor performance, gave one group of subjects a total of 100 20-sec. trials with mirror-vision on a pursuit rotor having a rotation speed of 60 r.p.m. The mean time on target score on the 100th trial was about 0.8 sec.—about 4% of time on target. The amount of learning was so slight that the performance curves had little meaning, and noth-

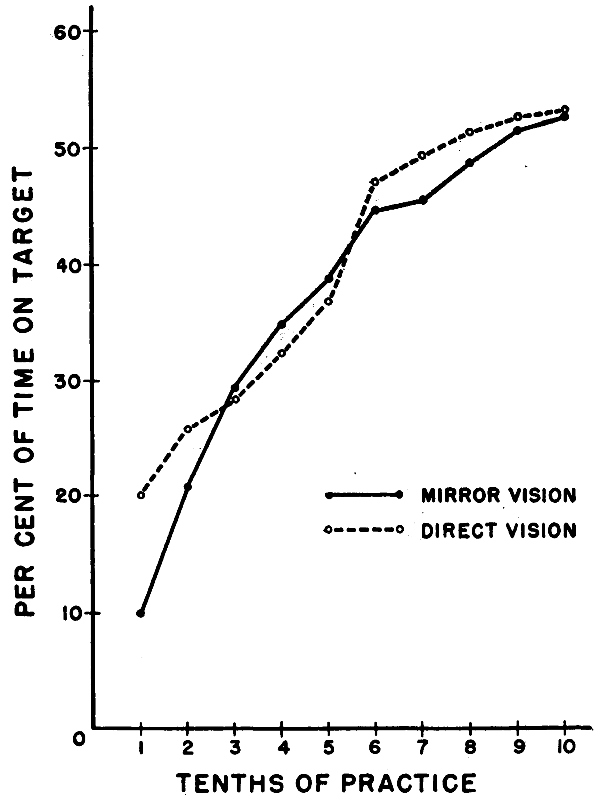

Figure 1. Performance curves for practice on the two tasks.

ing could be determined about the reliability of the scores. It was not until 1948 that investigators in the Iowa laboratory (1) developed a procedure that led to a reasonable degree of learning under mirror viewing conditions. The speed of rotation was 15 r.p.m., and special instructions were required—instructions to the effect that the "feel" of the correct movements should first be got—that kinesthetic cues were to be utilized initially and these were later to be coordinated with visual cues. The instructions were adapted for use in the present study.

Results

The treatment of the data for the 35 subjects involved a grouping of the trials into blocks and the computation of an average time on target score for each subject for each block of each task. The trials were grouped by threes for direct-vision and by fours for mirror-vision practice. In other words, the over all practice periods were divided into tenth-parts.

The means and standard deviations of the subjects' average scores for the 10 blocks of trials on each task are presented in Table 1. The last column of the table gives Pearson correlation coefficients for corresponding blocks of trials on the two tasks. As seen,

Table 1

Means and Standard Deviations of Average Time on Target Scores, in Seconds, for Blocks of Three Trials with Direct Vision and Blocks of Four Trials with Mirror Vision; and Pearson Correlation Coefficients between Average Scores on Corresponding Blocks. N = 35.

Block of Trials	Direct Vision		Mirror Vision		
	M	S.D.	M	S.D.	r
1	1.81	.76	2.90	2.19	.50
2	2.32	.86	6.01	3.52	.52
3	2.54	.91	8.51	4.25	.57
4	2.89	.99	10.15	4.63	.63
5	3.31	.96	11.21	4.78	.67
6	4.23	1.15	12.92	5.04	.69
7	4.45	1.02	13.16	4.50	.59
8	4.61	1.05	14.09	5.05	.59
9	4.71	1.05	14.95	4.99	.64
10	4.75	1.08	15.24	5.10	.51

values of r range from .50 to .69. As expected, they are generally higher than intercorrelations reported by Melton (2) for performance scores on the several "apparatus tests" used by the Air Force in the selection of air cadets.

As seen in Table 1, the mean on the tenth block of trials was 4.75 sec. for direct-vision and 15.24 sec. for mirror-vision practice. These values represent about 50% proficiency. To obtain the most meaningful values of r, it was necessary to keep performance well below the limits set by trial lengths. This was to avoid a possible artificial reduction in variances.

The means in Table 1 were converted into per cents of time on target, and the obtained values were plotted against tenths of practice. The resulting performance curves, shown in Figure 1, were negatively accelerated and fell at about the same level except on the initial block of trials. Incidentally, the per cents were computed by using a "trial period" of 9 sec. for direct-vision and one of 29 sec. for mirror-vision. The rationale was that, at the outset of each trial, the target moved rapidly from under the stylus and the typical subject needed about a second to catch up. The correction was of particular importance in relation to the direct-vision means.

The reliabilities of the scores on the several blocks of trials may be inferred from the intercorrelations for direct-vision in Table 2

Table 2

Intercorrelations Among Average Time on Target Scores for Blocks of Three 10-sec. Trials, with Direct Vision.

Blocks of Trials

	2	3	4	5	6	7	8	9	10
1	88	88	83	83	77	73	75	79	78
2		87	82	81	77	79	79	80	80
3			90	91	80	78	80	78	82
4				91	83	82	84	80	83
5					87	83	85	84	83
6						90	92	92	89
7							93	90	87
8								87	85
9									83

Table 3

Intercorrelations Among Average Time on Target Scores for Blocks of Four 30-sec. Trials, with Mirror Vision.

Blocks of Trials

	2	3	4	5	6	7	8	9	10
1	86	81	76	69	66	59	63	64	60
2		91	92	87	85	76	84	80	79
3			94	91	88	82	86	85	81
4				96	95	88	94	93	85
5					96	91	95	94	91
6						92	97	95	92
7							94	94	89
8								96	93
9									93

and those for mirror-vision in Table 3. The intercorrelations that are most revealing of reliability lie along the diagonals of the two tables and range from .83 to .96. The values for mirror-vision are, on the average, somewhat higher than those for direct-vision. The difference may have arisen from the longer practice periods for mirror-vision. The correlations in Table 2 for direct-vision are similar in magnitude to those reported by Melton (2) for performance on the SAM Pursuit Rotor Test.

The correlations in Tables 2 and 3 for adjacent blocks of trials are generally higher than those for blocks that were separated by one or more blocks. The values tend to become smaller with the remoteness of the blocks involved. For example, the value for blocks 10 and 9 of mirror-vision performance is .93 while the one for blocks 10 and 1 is only .60. Similarly, the correlation for blocks 1 and 2 for mirror-vision performance is .86 while that for blocks 1 and 7 is .59.

The decrease in correlation with remoteness is less marked for direct-vision than for mirror-vision practice. Part of this difference may be related to differences in the variances of the scores. As indicated in Table 1, the S.D. of scores on the first block of trials of mirror-vision is less than half that of the scores on any of the last 7 blocks. The change in the S.D.'s for direct-vision is smaller. Another fact to be mentioned is that the scores on the first block of trials of mirror-vision practice were truncated at the low-score end. This served to reduce the variance of the scores for this block and may have been partly responsible for the relatively low correlation coefficients in the first row of Table 3, all of which involve the scores for block 1. It should be noted, in this connection, that the correlations in the second row of Table 3 are similar in magnitude to those in the first and second rows of Table 2.

Summary

Thirty-five male subjects were given practice on a Koerth-type pursuit rotor, first for 30 trials with direct-vision and later for 40 trials with mirror-vision. The rotation speeds and the lengths of work and rest periods were adjusted to obtain tasks of approximately equal difficulty.

Total practice on each task was divided into 10 blocks, and average time on target scores were obtained for each subject on each block. The average scores were utilized in computing within-task and between-task coefficients of correlation. The reliability of the average scores for both tasks was judged to be high, the average estimate falling close to .90. The between-task correlations averaged about .60 showing that the performance of the two tasks depended to an appreciable degree on common factors.

The performance curves for the two tasks, with per cent of time on target plotted against tenths of practice, were negatively accelerated and tended to overlap except on the first block of trials.

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Department of Psychology
State University of Iowa
Iowa City, Iowa