Distribution of practice and the Müller-Lyer illusion¹

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Two experiments were conducted to determine the influence of distribution of practice on the decrement of the Müller-Lyer illusion. In the first experiment, Ss judged the illusion figure 100 times per session in five sessions separated by intervals of seven days. In the second, Ss judged the figure 200 times in a single session. The data were compared with those from an earlier experiment (Dewar, 1967) in which Ss judged the figure 100 times per session in five sessions separated by 24 h. In all three experiments two configurations of the illusion were used—one with a 60° angle between the oblique lines and one with a 120° angle. The distribution of practice did not influence the decrement of the illusion for the 120° figure. The only effect of this variable was to produce a more rapid practice decrement for the 60° figure when sessions of 100 trials were separated by a 24-h interval.

One variable which has been shown to influence a great many learning tasks is the distribution of practice or trials. According to Hull's theory (1943) distributed practice should produce better results than massed practice, since this allows for the reactive inhibition which has built up to dissipate between trials. Hull's prediction has been confirmed as it relates to eyeblink conditioning (Spence & Norris, 1950; Prokasy, Grant & Myers, 1958). It has also been supported by work on such motor skill tasks as upside down alphabet printing (Kientzle, 1946) and the pursuit rotor task (Ammons, 1950). On these tasks performance has been found to be somewhat better with distributed practice than under conditions of massed practice. However, it has been argued that the distribution of practice influences performance rather than learning. Evidence in support of this criticism as related to the pursuit rotor task has been presented by Adams and Reynolds (1954).

Distributed practice has been found to be more effective than massed practice in avoidance learning (Murphy & Miller, 1956) and in serial learning of nonsense syllables (Hovland, 1939; Underwood, 1951). Research on the relationship of distribution of practice to paired-associate learning has produced somewhat inconsistent findings.

It appears that, in general, distributed practice is somewhat more effective than massed practice for a variety of learning tasks. One type of learning for which the conditions of practice have been studied very little is perceptual learning. The earliest systematic study reporting a relationship between distribution of practice and improvement in a perceptual

task was that of Lewis (1908). He reported that distributed practice led to a more rapid decrement in the size of the Müller-Lyer illusion than did massed practice. Lewis reported that a day's interval between daily sessions of 100 trials speeded up the decrement in the illusion over a large number of trials. Köhler and Fishback (1950) also reported that a day's rest between series of trials results in a greater decrement in the size of the illusion. However, Mountjoy (1961) found no difference in the amount of decrement within a given number of trials when these trials were administered under different conditions of distribution of practice. Although the limited evidence available does suggest that distributed practice is more effective than massed practice in bringing about the decrement of the Müller-Lyer illusion, this factor has not been investigated systematically.

Early investigations of the practice decrement of the Müller-Lyer illusion suggested that the illusion will disappear within several hundred trials (Judd, 1902; Lewis, 1908). However, a recent investigation by the author (Dewar, 1967) has indicated that the illusion does not disappear over a series of 1000 trials. Two configurations of the stimulus were used in that experiment—one with a 60° angle between the oblique lines, and one with a 120° angle. The nature of the practice decrement was somewhat different for the two figures. For the small-angled figure the magnitude of the illusion decreased rapidly within the first daily session of 100 trials. Thereafter it decreased gradually for the next 400 trials, followed by no further change for the last 500 trials. The 120° figure showed a very slight decrement over the first 500 trials, followed by no further change. Both figures appeared to reach an asymptotic level at about 5% illusion. This experiment employed 100 trials per session in 10 daily sessions separated by approximately 24 h, except for the weekend between Sessions 5 and 6. Since the illusion did not disappear, as other authors had found, this raised the possibility that the practice was not sufficiently distributed to bring about the maximum learning in this particular task. In order to investigate this possibility, trials were distributed over a greater time interval in the first experiment to be described and were more massed in the second experiment.

EXPERIMENT 1

Apparatus and Procedure

The apparatus consisted of a rectangular wooden panel 48 in. wide and 26 in. high, to the center of which

was attached the stimulus (the Müller-Lyer figure). The horizontal segment of the figure was 20 cm in length. Through a series of strings and pulleys the center arrowhead of the Müller-Lyer figure could be moved in either direction by E or by S. Details of the apparatus and procedure are described in an earlier paper (Dewar, 1967). The apparatus was set on a table 60 in. from S's head, which was held in a chin rest. The S was instructed to adjust the center arrowhead so that the two horizontal segments of the figure appeared to be equal in length. At the beginning of each trial, the adjustable center arrowhead was set by E obviously too far to the right or left of the center position.

The Ss were assigned at random to one of two experimental groups, and judged a Müller-Lyer figure with either a 60° angle or a 120° angle between the oblique lines. All Ss judged the figure 100 times per session in five experimental sessions separated by intervals of seven days. For both figures the oblique lines were 3 cm in length, painted flat black, and connected with a white horizontal segment. All Ss were paid \$1.25 per session.

Subjects

The Ss were undergraduate university students. Their mean age was 20.1 years.

Results

Each S's trials were divided into blocks of 10 for the purpose of analysis. Since an earlier experiment (Dewar, 1967) had indicated no decrement in the illusion beyond 500 trials, it was decided that this number of trials would be sufficient for further investigations of the extended practice effect. Forty Ss (20 per group) participated in the experiment. An analysis of variance indicated a greater illusion produced by the 60° figure ($F=5.24$, $df=1/38$, $p<.05$). There was also a significant practice effect ($F=4.29$, $df=49/1862$, $p<.001$) and a trials by figure interaction ($F=1.44$, $df=49/1862$, $p=.05$). The illusion produced by the 120° figure decreased gradually to about the 200th trial, showed no further decrease for the next 200 trials, then dropped slightly on the final session. The illusion produced by the 60° figure showed a more rapid decrement within the first 220 trials, followed by no further decrease in the illusion. The magnitude of the illusion did not approach zero for either figure.

EXPERIMENT 2

The purpose of this experiment was to investigate the effects of massing a large number of trials in one session. The apparatus and procedure were the same as in the first experiment. The Ss were undergraduate university students (20 per group). Again, Ss judged either a 60° or a 120° figure. The main difference was that all Ss judged the illusion for 200 trials within a single session. (It was felt that more than 200 trials would be too long and tiresome a task.)

Results

The magnitude of the illusion decreased with practice ($F=8.97$, $df=19/722$, $p<.001$). The 60° figure produced a greater illusion than did the larger-angled figure ($F=20.20$, $df=1/38$, $p<.001$). There was no trials by figure interaction. The illusion produced by the 60° figure reduced within the 200 trials by about the same amount that it had in Experiment 1. (In view of the surprisingly small decrease in the illusion produced by the 60° figure over 200 massed trials, the same experiment was later repeated using a different sample of Ss. The results of this replication in the case of both figures used were almost identical to those just reported. This suggests that the results cannot be attributed to the specific sample of Ss used in Experiment 2.)

Direct comparisons were made between the data from the present experiments and from the experiment described in an earlier paper (Dewar, 1967). Two-way analyses of variance were performed on the data comparing daily vs weekly sessions, daily vs massed (all trials on one day) trials, and weekly vs massed trials for each figure separately. For the 120° figure there was no difference due to the distribution of trials. For the 60° figure the only difference was that due to the daily experimental sessions. The decrement in the illusion was greater with sessions spaced at one-day intervals than with either weekly intervals or massed trials.

DISCUSSION

The purpose of these two experiments was to compare previous findings (Dewar, 1967) with data gathered under different conditions of distribution of practice. The results of the present experiments indicate that trials administered over a greater time interval and trials administered more closely together do not lead to as great a learning effect as do series of trials spaced at one-day intervals. On the basis of Hull's (1943) formulation, more distributed practice should have led to greater learning. This is because any inhibition which was built up would have dissipated over a longer period of time.

The procedure used here was somewhat different than that used in many studies of massed and distributed practice. A large number of trials was given within a single session, and the sessions were either massed or distributed. In other studies of this phenomenon, it has been common to manipulate the distribution of single trials by changing the intertrial interval or the length of trials by allowing periodic rests during learning. This approach is now being used in a further study of the practice variable influencing this perceptual learning task.

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Note

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Errata

Bixler, E. O., Bartlett, N. R., and Lansing, R. W. Latency of the blink reflex and stimulus intensity. *Percept. and Psychophys.*, 1967, 2, 559-560. Instead of what appears in lines 9 and 10 under Method, the sentence describing intensity loss should read "...with an intensity loss of about 85%..."

In the February issue of this Journal, there were two cases of the reversal of pages. In Part A, pages 107 and 108 were reversed, and in Part B pages 153 and 154 were reversed.