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The Value of Demonstration in Human Maze Learning[1]

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Abstract. In a first experiment, forty subjects were assigned to one of four groups. Each of these groups received one, two or three demonstrations, or no demonstration at all of a task on a bolt-head maze. It was found that number of demonstrations and reduction of errors per trial were positively related up to two demonstrations but no additional increment in performance appeared for three demonstrations. In a second experiment, error making by a demonstrator was contrasted with skilled demonstration. Three demonstrations with errors resulted in significantly fewer errors per trial than two demonstrations with errors. Three skilled errorless demonstration was nonsignificantly superior to three demonstrations with errors.

Deliberate demonstration may be considered as one among many techniques employed in order to obtain learning of specific responses. This method is frequently employed in school instruction at all levels and in training workers and servicemen in machine related and other performance, as well as in other less formal social contexts. The use of demonstration as a technique for learning is well known to educators in these areas but the experimental literature on demonstrational learning has thus far been negligible. That is, little empirical knowledge is available as to the conditions under which demonstration produces the desired result or as to what variables facilitate or inhibit the demonstrational learning process.

The purpose of this paper is to present two rather elementary studies within a larger project, the aim of the project being to provide a fuller empirical basis on which to evaluate demonstrational procedures. We have quite deliberately chosen a task and developed a procedure that would enable us to meet certain minimal requirements of examining the demonstrational learning process. First we looked for a task that required minimal, if any, development of sheer manipulative skill; a task in which the motor responses can be considered to be present in the acquired response repertory of the subjects. This choice was based on our primary interest in the study of factors that influence simple associations of specific cues and responses rather than on more complex skills involving minute topographical details.

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A second requirement was that the task would be one that permits trial and error solution. We were not interested in a task in which the principal contribution of a demonstrator would be to reveal a trick to solution that would not be available to a naive performer. Finally, the task we chose had to be flexible enough to allow the investigation of a variety of independent variables without drastic shifts in the procedure. Yet the task could not be so simple that it could be learned completely during one skilled demonstration. This would prohibit study of the factors that facilitate or inhibit demonstrational learning.

In this paper we present two studies. The first is concerned with the reduction in error making as a function of the number of skilled demonstrations presented. The question we raise is, does performance continue to improve with an increase in the number of demonstrations presented?

The second experiment deals with the reduction in error making as a function of skilled versus unskilled demonstrations during the acquisition process of an observer. The available literature provides contradictory suggestions concerning the effect of error-making by a demonstrator.

Herbert & Harsh (1944) conducted an observational learning experiment in which cats observed the puzzle solving activities of other cats. They found that the observers profit more from the demonstrator's trial and error performance during learning, than they do from skilled performances. Klopfer (1959) used birds who observed partners who were learning a discrimination task. He found that the observers benefited more when the demonstration was presented by a trained bird during acquisition rather than by an unskilled bird. Research on individual human learning (McGeoch & Irion, 1952) suggests that performance of inadequate responses during acquisition facilitates the acquisition process. The hypothesis can therefore be offered in the present context that error making by a demonstrator will facilitate learning in contrast to skilled demonstration.

EXPERIMENT I

Procedure

The subjects were 40 male undergraduates from a course in elementary psychology.

The apparatus consisted of a simple bolt head maze, 12" by 14", mounted in a black, ¼" plywood frame, 30" x 30", which stood in a vertical position on an ordinary 30" high table. The maze was wired so that when a bolt was contacted with a metal stylus a circuit was completed which included a light. The first and last bolts on the maze path were encircled with white markers, and contact with these stops started and stopped a Standard Timer, calibrated in milleseconds. The timer was on a table to the right of the maze apparatus, and was shielded from S's view by a masonite board. A 24 stop maze path was used in this experiment.

Ten Ss were randomly assigned to each of 4 groups: no demonstration (ND), 1 demonstration (D1), 2 demonstrations (D2), and 3 demonstrations (D3). When S came into the experimental room, he was seated in a chair facing the maze and *E* read the following instructions:

"This is a bolt head maze. Your objective is to learn the correct path from the upper left-hand corner to the lower right-hand corner by moving from point to point with this stylus. The beginning and ending points are marked with the white circles. Please be sure to make contact with these circles when you begin and when you finish.

When you make a correct contact, the green light at the top of the board will light up; if you make an incorrect contact, no light will light up. In going from one contact to another always move either horizontally or vertically, but never move diagonally; do not skip over any point.

Move on from point to point with the stylus unless you make an error. If you make an error, go back to the last point at which you found a green light and go on from there. Do not start a trial over again because of errors. Finish it without going back any further than necessary to get on the right path. You will continue trials until you complete three errorless trials in a row, that is, three complete trials in which the green light lights at every point. There is only one path and it will not change.

As soon as you finish a trial, turn away from the maze and face the wall over here for a 30 second rest interval. Do not look at the maze until I instruct you to begin again. Do you have any questions?"

E indicated by demonstration at appropriate points the various features of the procedure. The following additional instructions were given before each demonstration to the demonstration Ss and were omitted for the no demonstration Ss:

"Before you begin, I will demonstrate the correct path through the maze."

The interval between demonstrations was the same as that between trials, and *E* timed these with a stop watch. During this interval *E* recorded the time for the demonstration or trial. During S's performances, *E* stood to his left rear and recorded errors.

Results

Three response measures were obtained; time, number of trials, and number of errors. If time or trials are used as the dependent measure, a reasonable correction to apply in order to compare with trial and error performance is to add the time spent in demonstrating or the number of demonstration trials to the respective performance totals. When this is done the effect of demonstration all but disappears. The time correction is also dependent on the speed of the demonstration, and there is no evidence available as to the effect of this variable. More important, an inspection of the data revealed that many Ss continued to make only one or two errors for extended trials. This phenomenon is hidden when considering the time, trials, or total errors measures. An errors per trial measure reflects an early advantage most clearly, and the results of this measure are presented here.

The mean errors per trial and standard deviations for each of the 4 groups are presented in Table 1.

Table 1. Mean Error per Trial and Standard Deviations for Each of 4 Groups of Subjects.

Group	Mean	Standard Deviation
ND	3.096[a]	.684
D1	2.362[b]	.679
D2	1.405[c]	.488
D3	1.041[c]	.628

Note: Means with a letter in common are not significantly different from each other.

A simple analysis of variance was performed, and the obtained F-Value of 19.77 was significant beyond the .01 level. The "critical difference" (Lindquist, 1953, p. 93) was computed. The D1 group did significantly better than the ND group, and the D2 group did significantly better than the D1 group. Three demonstrations failed to yield significantly fewer errors per trial than two demonstrations.

The results show that 1, 2, or 3 demonstrations, when compared with the trial and error learning of a no demonstration condition, have a significant effect on the acquisition of a simple task. Increase in demonstrations beyond 2 did not produce any significant decrement in errors per trial. If the trend indicated by these results continues, it appears that the effect of additional demonstrations beyond two would progressively diminish. It is conceivable that a large number of demonstrations would result in a near errorless performance by S on his first trial. However, further research may establish that point at which the increment in performance produced by additional demonstrations would not be commensurate with the time and effort expended on these demonstrations. This optimum number of demonstrations would necessarily be dependent upon the complexity of the task and the purposes of the educator.

EXPERIMENT II

Procedure

The subjects were 30 male and 30 female undergraduates from a course in elementary psychology.

The apparatus was identical with that used in Experiment I, except that the maze path consisted of 36 stops and a green light indicated correct responses while a red light indicated errors.

Ten male and ten female Ss were randomly assigned to each of these three groups: 2 demonstrations with errors (E2), 3 demonstrations with errors (E3), and 3 skilled demonstrations (S3).

In the error demonstrations, *E* made errors at 9 stops. These stops were selected on the basis of the locations of the most frequent errors committed by Ss in an essentially similar study employing a 36 stop maze path. Nine errors were used to equate the total number of responses in the E2 and S3 conditions. Each error involved 2 additional responses—one off the path and one back to the path, giving a total of 54 responses in error demonstrations. Thus, 108 responses occurred in both the E2 and S3 demonstrations. The E3 and S3 conditions were equated with respect to number of demonstrations.

In this experiment, S was instructed that in addition to the green light on correct contacts, a red light at the top of the board would light up if he made an incorrect contact. The S was not informed that errors would be made in the demonstrations. The remainder of the instructions and the procedure were identical with those in Experiment I.

Results

The mean errors per trial and standard deviations for each of the 3 groups are presented in Table 2.

Table 2. Mean Errors per Trial and Standard Deviations for Each of 3 Groups of Subjects

Group	Mean	Standard Deviation
E2	3.15[a]	1.305
E3	2.52[b]	1.066
S3	2.10[b]	.711

See note below Table 1.

An analysis of variance was performed and the effect of treatment was found to be significant at the .05 level. There was no significant effect of sex. The "critical difference" was computed. The E3 and S3 groups both did significantly better than the

E2 group. Three skilled demonstrations did not yield significantly fewer errors per trial than 3 demonstrations with errors.

The hypothesis that demonstration with errors, when compared with skilled demonstrations, would produce superior learning, was not confirmed.

The present results agree with those of Klopfer obtained with birds, and disagree with those obtained by Herbert & Harsh with cats. The studies cited by McGeoch & Irion found that performance of inaccurate responses facilitated maze learning in humans. One relevant respect in which many of these latter studies differed from the present one is that the Ss actually performed and repeated errors and did not merely observe the performance of inaccurate responses.

Such discrepancies in findings can be only be resolved by the further study of the specific conditions under which demonstration with errors is superior to skilled demonstration. Differential instruction may prove to be one of these specific, important variables. A replication of the present experiment with an additional condition in which the S is instructed to avoid the errors he observes in the demonstration may produce results imilar to those found when the S actually performed inaccurate responses. Such a study is now being conducted in the Iowa Laboratories.

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