Probability matching and the overlearning reversal effect

JAMES F. JUOLA AND B. R. HERGENHANN
HAMLINE UNIVERSITY

Sixty Ss were divided into two groups to be criterion trained or overtrained on a probability matching problem. The probabilities used were 90:10, 80:20, and 70:30. After the training period these were reversed to become 10:90, 20:80, and 30:70 for the occurrence of the same objects. The overlearning reversal effect was demonstrated in that overtrained groups reversed significantly faster than criterion groups.

In two-choice learning situations it has been demonstrated that there is a tendency for Ss to choose in such a way as to make the percentages of their predictions of an item match the percentages of occurrence of that item (Hake, 1955). The percentages of occurrence have been altered (Estes & Straughan, 1954; Parducci, 1957) or reversed (Brown, 1966), but Ss soon change their prediction patterns to probability match once again.

Most probability learning situations represent a type of discrimination task in which S is on a partial reinforcement schedule. In discrimination learning it has been found that prolonged training decreases resistance to extinction and facilitates the learning of the reversal of the original discrimination, e.g., Capaldi (1963). This phenomenon is known as the overlearning reversal effect.

The present study was designed to investigate the effects on prediction behavior when the initial probability of two mutually exclusive events was reversed. It was hypothesized that if S received overtraining on the initial probability, the learning of the probability reversal would be facilitated.

Method

The Ss were 60 undergraduate students from Hamline University.

Two 3 x 5 in. index cards were used, each with outline figures of either a 1 in. square or circle attached. A 3 x 1 ft pressed wood shield was used so that S could not see the cards before they were presented.

The Ss were instructed to predict whether a square or a circle would be presented in each succeeding trial. After each prediction, S was shown one of the cards according to a series randomized in blocks of 10. The criterion trained Ss received 25 trials, and the overtrained Ss received 50 trials on the initial problem. Within these two groups 10 Ss each were assigned the probabilities of 90:10, 80:20, and 70:30. After the training period the probability ratio of square to circle was inverted, and both groups received the same series of 100 trials for the respective probability ratios.

Results

The data for the first 60 trials after reversal were analyzed since both groups probability matched equally well through the last 40 trials. The measure of the dependent variable used was the absolute deviation score for each of the 10 Ss in the six subgroups. The formula used for determining the absolute deviation was:

$$d_n = \frac{\sum_{i=1}^n |(\pi_i - q)|}{n}$$

where:

d_n = The absolute deviation from exact probability matching.

i = Any of the successive trial blocks being analyzed.

n = The number of trial blocks.

π_i = The actual number of occurrences of one of the two objects in the trial block.

q = The number of times that object was predicted by S in the same trial block.

The data were analyzed in blocks of 10 ($n=6$) by using a 2 by 3 factorial design. This analysis showed both main effects to be significant (training level: $F=13.43$, $df=1/54$, $p<.001$; probability magnitude: $F=12.68$, $df=2/54$, $p<.001$). The interaction was not significant ($F=2.27$, $df=2/54$, $p<.20$). The results are shown in Fig. 1.

The Duncan Multiple Range Test (Duncan, 1955) was

Fig. 1. Mean absolute deviation as a function of probability magnitude and level of training.

used to further analyze sources of variance. The results showed that there was a significant difference ($p < .05$ in all cases) between the performance of over-trained and criterion trained groups on 70:30 and 80:20 probability schedules, but not in the 90:10 groups. In addition, all differences between the three groups in the criterion trained half were significant, but no significant differences were found between the over-trained groups.

Discussion

The results of this experiment supported the hypothesis that the overlearning reversal effect would occur in a probability matching situation. Ss who were subjected to overtraining on the original probability learned the reversal significantly faster than Ss in the criterion trained group.

That this effect was significant in groups on 70:30 and 80:20 schedules but not in the 90:10 group was probably due to the fact that Ss in the 90:10 group learned the probability more quickly than those in the other groups. Thus both criterion trained Ss and overtrained Ss may have "overlearned" the original probability and therefore learned the reversal more quickly. This hypothesis is supported by Restle (1957), who states, in essence, that Ss receiving a high percentage of reinforcement learn a discrimination faster than Ss on a lower percentage of reinforcement. In a probability matching problem, schedule of reinforcement and therefore rate of learning both increase with an increase in probability magnitude.

This would also explain the significant difference

between the performance of the three groups of criterion trained Ss. The poorer performance by Ss as probability ratio decreases also indicates that learning rate is a function of probability magnitude.

The design of this experiment served to point out that rate of learning is not the same for different ratios of occurrence of two objects in a probability matching situation. It also demonstrated that the overlearning reversal effect is observable in this situation. Refinements of the definitions of criterion training and overtraining, perhaps with the use of Restle's (1957) theory, would put these measures into closer proximity with actual learning and overlearning and thus improve the sensitivity of the experiment in demonstrating the overlearning reversal effect.

References

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