Three-choice probability learning: Effect of varying information level

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To explore further variables determining the finding of "matching" in probability learning paradigms, Ss were asked to predict which one of three stimuli would be "correct" for each trial of a series. IVs were two levels of information feedback, three levels of verbal reinforcement, and three levels of instruction concerning game strategy. Ss responded to stimuli representing ps selected for maximum discriminability. Both complete and partial feedback Ss closely matched actual ps under all conditions. "Partial" Ss achieved "match" levels more slowly, however, indicating eventual asymptote at levels comparable to the "complete" group.

Within the literature already accumulated in the area of probability learning (PL), a number of studies in humans (e.g., Humphreys, 1939; Grant, Hake, & Hornscth, 1951; Gardner, 1961) and in other species (e.g., Behrend & Bitterman, 1961; Bullock & Bitterman, 1962; Bitterman, 1965) have demonstrated the puzzling phenomenon of probability matching. This is the tendency for S to asymptotically match response probability to reinforcement probability in a multiple-choice learning task. In typical PL, S is asked to predict which of two or more alternatives will be "correct" for each trial in a series. Hilgard (1956), reviewing this research, states that the matching found in these studies is not the strategy which would be expected from a "rational" decision maker, as implied by game theory. Rather than maximizing "hits" by guessing the most frequent event, as the professional gambler would do, Ss in these studies tended to match the p values with their guesses, a finding which poses an important problem for learning theory.

A variable of considerable importance is the number of choices available to S. Stochastic models, such as those developed by Estes and by Bush and Mostellar, while demonstrating their ability to predict two-choice behavior, have failed to cope adequately with paradigms using more than two alternatives. Research, then, appears to point, not in the direction of a general probability matching theory, but to the presence of multiple contributing variables. The purpose of this study was to investigate the effects of varying level of information feedback (IF) on strategies employed in playing a three-choice guessing game.

Method

A stimulus display box, measuring 18 in. high by 18 in. wide, by 14 in. deep was used. Three stimulus cards, containing a triangle, square, or circle, respectively, were located in separate slots. During each trial, S pressed one of three switches, each electrically con-

nected to an isolated light behind the panel. If he pressed the "correct" switch, the light came on; if he responded "incorrectly," the light remained off. O could monitor information independently by remotely activating the "correct" light.

A total of 270 students, balanced within groups for sex composition and recruited from sections of Introductory Psychology at UC, were subdivided into groups of 90 Ss for each of three experiments. In this study two levels of IF, complete (CF) and partial (PF), three levels of instruction regarding use of strategy, three probabilities of payoff (60:30:10), and three levels of verbal reinforcement (Experiment I only) were used.

Experiment I. Each of 90 Ss was told to press the switch on each trial which would light the "correct" stimulus on the display panel. Instructions were limited to telling S that this was an experiment in "educated" guessing, that there was an optimal strategy rather than a random guessing procedure involved in playing the game effectively, and that the task was to illuminate the "correct" panel as often as possible during the game. For CF Ss only, corrections were made by O immediately following an incorrect choice. Sixty, 30, and 10 percent payoff levels were randomly distributed through the series in ten-trial blocks for triangle, square, and circle, respectively. Regardless of actual performance, all subgroups were given verbal "praise," "reproof," or "neutral" (neither "praise" nor "reproof") comments periodically during testing.

Experiment II. The procedure in this experiment was identical to that above except that two of the verbal reinforcement conditions ("reproof" and "neutral"), found in Experiment I to have no measurable effect, were discontinued and all Ss were periodically encouraged to give their best performance, regardless of the actual levels achieved. In addition to the basic instructions described above, Ss were told to use a "probability" strategy. This concept was defined and standardized questions asked to insure uniform understanding of the task.

Experiment III. The procedures used here were identical to those used above except that, in addition to previous information, the actual probabilities were revealed without stipulating which discriminanda were associated with them.

Results and Conclusions

Outcomes were similar under all experimental conditions; regardless of type of instruction or IF levels Ss tended to match ps of each corresponding stimulus rather than to maximize the highest p in the triad. A

Fig. 1. $\bar{M}$ percentage of choices by CF and PF Ss of the alternative ps (60:30:10) of payoff as a function of successive trials. Experiment I.

Trend test failed to indicate significant differences in slope between CF and PF groups for any of the p values considered in this study. Figure 1 shows the close degree of matching under the "strategy" condition (Experiment I) for CF and PF groups. Excluding the fact that groups receiving more instructional information tended more rapidly to approach asymptotic levels of performance, corresponding slopes and levels attained for all conditions (Experiments I through III) were remarkably similar for each p level. From initially chance levels (33-1/3) for approximately the first 20 trials, improved discrimination in both CF and PF groups rapidly ensued,

Fig. 2. $\bar{M}$ percentage of choices by "high," "medium," and "low" PF Ss of the alternative ps (60:30:10) of payoff as a function of successive trials. Experiment I.

with corresponding p values being closely approximated by Trial 180. Inspection of Fig. 1 still leaves open the question of whether asymptotic levels had been achieved in the 60 and 10 percent levels; however, interrogation of randomly selected CF Ss, immediately following testing, confirmed the fact that Ss were generally aware of the true p values by Trial 200.

Since PF curves showed a consistent tendency to lag slightly behind CF curves, a further analysis was made on the PF data to see what level of feedback is required for efficient matching to occur. The PF data were accordingly divided into "high" (25-25 percent IF), "medium" (36-40 percent IF), and "low" (41-50 percent IF) categories. Figure 2 shows the result of this manipulation. It can be seen that only the "high" IF condition approximates the true p values as closely as do the CF levels. Interestingly, however, although the various PF groups show a progressive drop in p levels attained with decrease in IF, except for the p 30 condition, none of the curves for "medium" and "low" feedback conditions appear to have reached asymptote, suggesting that matching levels would have been reached eventually if sufficient trials had been run on these Ss.

Evidence clearly establishes the presence of matching by adults in a three-choice probability learning situation. The present study indicated that IF levels ranging from 100 to 50 percent failed to impair effective matching of the p values used. Further, at the "low" end of the IF range (25 to 35 percent), response curves for the 60 and 10 percent p values appeared to be slowly approaching these levels. Clearly suggested for further studies in this area are considerations of (1) What happens to PL performance when the level of discriminability among p levels is systematically varied, and (2) How is PL affected as level of IF is varied?

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