penalized in the scoring procedure of the present study. Further substantiation for this notion comes from the fact that the frequency of CR's are more similar for the two studies during the earlier trials than during the later trials. In the earlier trials *S* would not have learned adequately the cue value of the warning signal. Therefore, voluntary or guessing responses as a function of the signal would be less expected here than during the later trials.

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SUPPLEMENTARY REPORT: DISCRIMINATION LEARNING WITH PROBABILISTIC REINFORCEMENT SCHEDULES[1]

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This study deals with discrimination learning in a verbal conditioning situation and is an extension of research reported by Popper and Atkinson (1958). The study differs from theirs in that a new set of parameter values and a more rigorously controlled experimental procedure were employed. Two stimuli, T_1 and T_2, were used and two responses, A_1 and A_2, were available to *S*. Each trial began by the presentation, with equal probability, of either T_1 or T_2. On a T_1 trial, A_1 was correct with the probability π_1 and A_2 was correct with probability $1 - \pi_1$. For a T_2 trial, π_2 was identically defined.

Method.—Five groups were used. For all groups $\pi_1 = .9$. The groups differed with respect to the π_2 parameter which assumed the values of .9 (G-I), .7 (G-II), .5 (G-III), .3 (G-IV) and .1 (G-V). The *S*s were given 400 trials. However, on the first 40 trials all groups were given $\pi_1 = \pi_2 = .5$. The *S*s were 180 undergraduates, 36 per group. The experimental design was identical to that of Popper and Atkinson (1958) except that *S*s were run in subgroups of three, each *S* placed in a private booth after instructions. The apparatus, viewed from within *S*'s booth, consisted of two keys attached to the base of a panel, upon the panel were mounted four small lights. Two lights were in a column centered above the keys and served as the T_1 and T_2 stimuli. Each of the two remaining lights (the reinforcing signals) was mounted directly above one of the keys. On all trials the signal light (T_1 or T_2) was lighted for 1.5 sec.; the signal light went off simultaneously with the onset of a reinforcing light. The reinforcing light remained on for 1.8 sec., and was followed by an intertrial

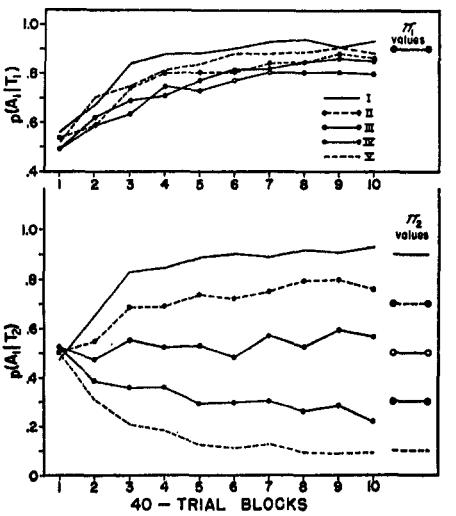

FIG. 1. Observed mean values of $p(A_1|T_1)$ and $p(A_1|T_2)$ in successive blocks of 40 trials. Each point is based on approximately 20 observations per *S*.

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interval of 4 sec. Trials were run without interruption and S made his response while the signal light was on. Instructions were similar to those presented in Atkinson and Suppes (1958) except that they were modified to describe the T_1 and T_2 stimuli as in Popper and Atkinson (1958).

Results.—Figure 1 presents mean response curves over all trials of the experiment. In this figure the proportion of A_1's made on T_1 trials, $p(A_1|T_1)$, and the proportion of A_1's made on T_2 trials, $p(A_1|T_2)$, are plotted in successive 40-trial blocks. The corresponding π values are indicated on the far right. The asymptotic and pre-asymptotic characteristics of these curves are identical to those found by Popper and Atkinson (1958). One aspect of these results to be emphasized is the relation between the observed $p_\infty(A_1|T_1)$ and π_2. A convex function was found by Popper and Atkinson when π_2 varied from .85 to .15 (for a fixed $\pi_1 = .85$) and the same relation holds for this study. Specifically, if the proportions computed over the last 120 trials are used as estimates of $p_\infty(A_1|T_1)$, the obtained values are .930, .867, .808, .856, and .895 for Groups I to V, respectively. The convexity was found significant by evaluation of the quadratic component of the treatment sum of squares, $F = 18.2$.

The significance of these findings with regard to stochastic theories of discrimination learning is discussed by Atkinson (1958). In particular, the demonstrated convex relation between π_2 and $p_\infty(A_1|T_1)$ suggests that the Burke and Estes (1957) component model for discrimination learning is not applicable in this type of situation.

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