Two-choice discrimination with alternating trial types*

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One hundred and twenty Ss were required to predict which of two events would occur on each of 510 trials. Two signals to respond were alternated, and different events probabilities were associated with each signal. Combinations of the two event probabilities were varied over groups. Contrary to Brody's (1958) earlier finding, response probability to one signal was influenced by the event probability to the other signal, as well as by the immediately preceding response and event occurrence.

In the two-choice discrimination task, the S is required to predict which of two events, E_1 or E_2 , will occur on each trial. There are two types of trials, T_1 and T_2 , differing with respect to the event probabilities on the trial. The probabilities of E_1 on T_1 and T_2 trials are referred to as π_1 and π_2 , while the probabilities of predicting E_1 on T_1 and T_2 trials are referred to as $P(A_1 | T_1)$ and $P(A_1 | T_2)$.

With one exception (Brody, 1958), investigations of probabilistic two-choice discrimination have indicated that Ss have difficulty in responding independently to the two sets of events (e.g., Popper & Atkinson, 1958; Schaffer, 1963). Contrary to the usual findings, Brody (1958), who used an alternating sequence of trial types rather than the random sequence used in all other studies in this area, concluded that responses on the two trial types were independent. Brody's results have an important implication for sequential decision tasks; an individual can monitor two channels of information if he alternately samples from each. There are, however, two procedural weaknesses in the Brody experiment. First, only 100 trials of each type were run, and the response probability curves appeared to be still rising at the end of the session. Second, since only one value of π_1 , and two values of π_2 , 30% apart, were used, it is possible that Brody's conclusions would not hold over a wider range of values. The experiment reported in this paper uses Brody's procedure with more trials and more values of π_1 and π_2 .

PROCEDURE

Each S was assigned randomly to one of the six combinations of the independent variables, π_1 and π_2 (.85/.85, .85/.50, .85/.15, .60/.85, .60/.50, .60/.15) with a

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total of 20 Ss in each experimental group. At the beginning of the experiment, the Ss were read instructions that explained that following the occurrence of one of two signal lights they were to predict which of two event lights would occur and that they were to try to predict correctly as often as possible. The Ss were not told specifically that there was a different event probability associated with each signal. The temporal sequence of signal and event lights and intertrial interval was identical to that used by Brody. Following eight practice trials, the 510-trial experimental sequence was presented without interruptions. Each of the 510 trials represents two predictions, one for T_1 and one for T_2 . A detailed description of the apparatus appears in Myers & Cruse (1968).

RESULTS AND DISCUSSION

Only those results directly relevant to the major purpose of the present experiment will be discussed; all other results will be presented without comment.

The probabilities of predicting E_1 on T_1 and T_2 trials, $P(A_1 | T_1)$ and $P(A_1 | T_2)$, are plotted as a function of successive

102-trial blocks in Fig. 1. Probability learning is evidenced by a trial-blocks effect for both the T_1 ($p < .001$) and T_2 ($p < .01$) data. A direct reinforcement effect of π_1 ($p < .001$) and π_2 ($p < .001$) is clearly seen in the lefthand and righthand panels, respectively.

Contrary to Brody's (1958) results, Fig. 1 indicates the presence of generalization effects ($p < .01$) due to π_2 (lefthand panel) and an effect due to π_1 (righthand panel), although the latter falls short of statistical significance. In addition to the analysis of variance, a series of chi-square values were calculated for the last trial block in order to provide a test of the independence of responses on adjacent trials as well as a direct comparison with the Brody results. All chi-square values were significant at the .02 level or better except for the .60/.50 group. These statistics conflict with Brody's finding that the chi-square values were not significant. Chi squares were also computed to determine if the response to a T_1 signal was independent of the response following the same signal on its last presentation. Again all values were significant at the .02 level or better. Thus the S's response on any T_1 trial depends both on his preceding response to the other signal as well as on his preceding response to the same signal. Finally, as may be seen in Table 1, responses are also contingent upon both the event and response of the preceding trial.

The data reported in this paper do not support Brody's conclusion that responses on two types of discrimination trials are independent when the trials are alternated. The discrepancy between these results and Brody's are probably due to the use of more trials and a wider range of values of π_2 .

Fig. 1. Probabilities of predicting E_1 on T_1 (left panel) and on T_2 (right panel) trials plotted as a function of π_1 and π_2 over trial blocks.

Fig. 2. Probabilities of predicting E_1 on T_1 and T_2 trials plotted as a function of π_1 and π_2 for the last trial block.

A final comparison of interest may be made between those groups for which π_1 is .85 and similar groups in the Popper & Atkinson (1958) experiment in which the primary concern was the shape of the function relating $P(A_1 | T_1)$ to π_2 . The relevant data are shown in Fig. 2.

The major difference in the functions obtained in the two studies is the data obtained in the .85/.15 condition. Popper and Atkinson found $P(A_1 | T_1)$ and $P(A_1 | T_2)$ to slightly overshoot π_1 and to undershoot π_2 . The values obtained with the alternating sequence in the present experiment are at .75 and .25 after a comparable number of trials. It is possible that the same stimulus-generalization mechanism usually postulated for these data can account for the discrepancy; some

stimulus component common to both trial types is available for conditioning (Burke & Estes, 1957; Atkinson, 1958) and is a stronger factor with the alternating than with the random sequence. However, if it were, the .85/.50 data sets for the two studies should differ more.

The explanation for the .85/.15 and .60/.15 groups would seem to lie in the fact that there is necessarily a strong event alternation pattern inherent in the overall event sequence. The S adopts a response-alternation strategy, generally making A_1 responses on Type 1 trials and A_2 responses on Type 2 trials. Occasionally, he forgets the previous event or response and slips out of phase for some number of trials. This explanation is consistent with the $P(A_1 | T_1)$ and $P(A_1 | T_2)$ data. More compelling is the manner in which it accounts for the effects of preceding response-event combinations. Ss alternate responses more after having been correct than after having been wrong, a result completely inconsistent with most mathematical models for binary prediction, but perfectly reasonable if it is assumed that the alternation strategy rather than any single prediction is reinforced on each

trial. Furthermore, Ss alternate more after having made an A_1 response on T_1 or an A_2 response on T_2 , and they also alternate most in the .85/.15 condition, next in the .60/.50 condition (particularly on Type 2 trials), and next in the .60/.50 condition. These results also follow if it is assumed that the probability of response alternation is a direct function of the probability that such a strategy will be correct.

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Stimulus meaningfulness and similarity, recall direction and rate of recall test*

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In a previous study, decreases in stimulus meaningfulness and similarity produced increases in the differences between forward and backward recall following paired-associate (PA) acquisition. This experiment indicated that these relationships were not a result of the long recall test interval used. Although the overall level of recall was reduced under a faster test rate, the meaningfulness-similarity recall direction relationships were independent of test rate.

Nelson, Rowe, Engel, Wheeler, & Garland (1970) found that the relative differences between forward and backward recall increased as stimulus meaningfulness and similarity were decreased. These results were interpreted as being consistent with the assumption that decreasing

meaningfulness and similarity increased the likelihood of partial stimulus coding processes, reducing nominal stimulus availability at recall. However, a relatively slow 8-sec recall test rate was used, with the retrieval cue remaining on the screen for the entire interval. As Ekstrand (1966) has suggested, this long interval might have allowed Ss to "run through" all the stimuli

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Table 1
Probability of an A_1 Response Conditional on the Outcome of the Preceding Trial*

Group	Outcome of Preceding Trial			
	A_1E_1	A_2E_1	A_1E_2	A_2E_2
.85/.85	.951	.691	.864	.571
	.946	.692	.917	.500
.85/.50	.796	.714	.804	.702
	.613	.534	.638	.571
.85/.15	.300	.694	.311	.934
	.074	.658	.195	.727
.60/.50	.770	.510	.763	.546
	.884	.624	.877	.783
.60/.50	.437	.506	.586	.620
	.440	.559	.491	.683
.60/.15	.359	.413	.400	.612
	.139	.273	.215	.311

*The first line for each group presents response probabilities on T_1 trials following the outcomes of T_2 trials. The second line for each group presents response probabilities on T_2 trials following the outcomes of T_1 trials.