The effects of forced-choice trials upon free-choice behavior

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Abstract

Three groups of rats were run on a two-choice problem involving both forced-choice and free-choice trials; the groups differed in that 50, 75, or 100% of the forced-choice trials were to one of the two responses. During Phases 1 and 3 the response-availability cues were highly discriminable, while during Phase 2 the saliency of these cues was diminished. The free-choice response probability for each of the three groups was equal to .50 during Phases 1 and 3. In Phase 2 there was an instantaneous shift in response probability to a level that was linearly related to the forcing percentage.

Problem

An important issue in many current theories of learning deals with the effect of reinforced forced-choice trials on subsequent free-choice behavior. According to the analysis presented by Spence (1956), if in a two-choice problem the A_1 response is made to occur more frequently than A_2 (by means of forced-choice trials), then initially S should show a preference for A_1 . However, over trials the excitatory potentials of the two responses both will approach the same upper limits, and hence asymptotically the probability of A_1 should be .50. In the present study, these predictions were examined for three schedules of forced-choice trials. Also, to evaluate the effects of manipulating stimulus conditions, the discriminability of the response-availability cues was varied.

Method

The S s were 72 male Long-Evans rats run on a 36-hr. food deprivation schedule. The apparatus, which is described in detail in Atkinson and Calfee (1964), consisted of eight animal compartments, plus an automated programming and recording system. Each compartment was 36 in long and 15 in wide. The compartment was divided into two chambers by a gate; one chamber served as both a start and goal box, while the other compartment contained the response panel. The response units were two circular wire screens 1 in in diameter; the units were 8 in apart. Behind each unit was an S-6 lamp. When a response unit was available, the lamp was turned on and the unit was connected to a low amperage relay driver. The S made a response simply by touching the screen.

A trial began with a 2-sec. tone, which ended as the gate was raised, and one response unit, or the other, or both were turned on. Following S 's response, all of the units were turned off and a pellet was dispensed at the opposite end of the compartment. When S approached the pellet cup, the gate was lowered by a photoelectric

relay. Each S received 75 trials (spaced at 50-sec. intervals) every second day. The first three trials were always free-choice trials, as were a randomly chosen 24 of the 72; the other 48 trials were forced-choice. For Groups 50, 75, and 100, 50%, 75%, and 100%, respectively, of the forced-choice trials were to the A_1 response. For half of the S s, A_1 was the right unit, and for the remaining S s it was the left unit.

There were three phases to the experiment, each of 10 runs or 750 trials. During Phase 1 and 3, the response lamps were in series with a 50-ohm resistor, and during Phase 2, the lights were dimmed by using a 200-ohm resistor. Thus, each S was run through an initial phase in which the response lights were relatively bright, a second phase when the lights were dim, and a final phase in which the lights were again bright. The changes in intensity were designed to affect the discriminability of the three trial types (A_1 -forced, A_2 -forced, and free).

Results

For each S the A_1 probability on free-choice trials, $P(A_1)$, was obtained for each run, and these probabilities were averaged over S s (Fig. 1). An analysis of variance of the proportions (arcsine transformation) was performed for each phase of the experiment. There were no differences among groups during Phases 1 or 3 ($F_{2,69} = .003$, $F_{2,69} = .017$, respectively); while in Phase 2 the differences were highly significant ($F_{2,69} = 7.100$). Moreover, the shifts in $P(A_1)$ during Phase 2 are well accounted for by a linear combination of the forcing percentage π and a regression factor of one-half. Thus, if $P(A_1)$ is expressed as $\alpha/2 + (1 - \alpha)\pi$,

Fig. 1 Mean free-choice response probability over days for $\pi = .50, .75, 1.00$. $N = 24$ in each group.

Fig. 2. First-order sequential statistics, Phases 1, 2, and 3.

then a value of α equal to .37 leads to predicted response levels of .50, .65, and .82 for π 's of .50, .75, and 1.0, respectively. These predictions may be compared with the observed means of .51, .64, and .82. Analysis of the time scores shows that response speed was consistently higher on free than on forced trials throughout the experiment. During Phase 2, the difference between free and forced speeds was inversely related to π , and the free-choice speeds were higher during this phase than during Phases 1 and 3.

The detailed structure of the response protocols was analyzed by examining the first-order sequential statistics. The probability of a free-choice A_1 response, conditionalized on each of the four possible events on the preceding trial was obtained for each S. In order

to minimize perseverative tendencies resulting from position biases of individual animals, each group of Ss was divided into three subgroups on the basis of $P(A_1)$ during Phase 1; one subgroup consisted of the 8 Ss that had the highest proportions during Phase 1, another 8 having the lowest proportions, while the 8 remaining Ss constituted a medium subgroup. The mean conditional probabilities for these subgroups are presented in Fig. 2, where A_1 and A_2 denote free-choice responses, and F_1 and F_2 denote forced-choice responses. The data indicate that (1) following a free-choice trial, S tends to persevere, and (2) in Phase 1 and 3, S tends to alternate following forced-choice trials, while in Phase 2 the alternation washes out.

The data from Phases 1 and 3 support Spence's asymptotic prediction of equiprobable responding, but there is no apparent preference for the more frequently reinforced response during the early trials of the experiment. The instantaneous shift in $P(A_1)$ during Phase 2 indicates that stimulus conditions are an important variable. Apparently the reinforcement contingencies are learned during Phase 1, even though not reflected in S's behavior, since when the stimulus conditions are changed, $P(A_1)$ immediately changes to a level correlated with π .

The tendency to alternate following forced-choice trials is not predicted by the Hull-Spence Theory, nor by any other simple reinforcement model. Analysis of response probabilities conditionalized on forced-choice runs of varying lengths indicates that the alternation effect is one-trial dependent, i. e., as $P(A_1)$ is conditionalized on longer and longer runs of forced-choice trials to a given response, the tendency to alternate remains relatively constant.

References

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