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RESPONSE EFFORT AND THE FRUSTRATION HYPOTHESIS¹

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Partial reward and response effortfulness during acquisition have in common the effect of prolonging extinction. Dissonance theory has been used to explain this effect as well as the same effect of delayed reward. The present experiment was an attempt to see whether Amsel's frustration hypothesis, which handles the partial reward effect, could also account for response effort. Rats were run in a double runway, the standard test situation for the frustration effect (FE). While effort was effectively manipulated and reliable FEs were obtained, high response effort did not enhance an FE produced by nonreward. Thus, it does not appear that frustration theory can account for the effect of effort on resistance to extinction.

This experiment is an attempt to extend Amsel's frustration theory of extinction (1958, 1962), which accounts for partial reward, to handle the effect of another variable, namely, response effortfulness. Experiments reported by Lawrence and Festinger (1962) showed that increasing the effortfulness of the trained response led to an increase in resistance to extinction of the resulting habit. Along with the partial reinforcement effect and effects of delay of reward, these extinction results were interpreted in terms of the principle of dissonance reduction.

The gist of Amsel's theory is that *S* will resist extinction to the extent that it has experienced, and learned to continue responding to, frustrating events during training. Thus, the theory might account for the effect of effort upon extinction if it could be shown that effort is related to frustration. On intuitive grounds,

it is credible that frustration from nonreward would be greater the more effortful the response frustrated.

The standard method of assessing frustration effects is the double-runway procedure (Amsel, 1958) used in our experiment. The experiment investigated whether the magnitude of the frustrative effect of nonreward would vary with the effortfulness of the response frustrated.

METHOD

Subjects

Forty-five male rats, approximately 90 days old served as *Ss*. Thirty-nine were albinos, and six were hooded rats. One death occurred among the albinos.

Apparatus

A wooden, U shaped, enclosed double-runway was used. One arm of the U consisted of a start box (SB) leading into a runway (R1). A goal box (G1) joined the two parallel arms and led into the second runway (R2). A second goal box (G2) terminated R2. The SB, G1, and G2 were

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each 12 in. long; R1 was 5 ft. and R2, 6 ft. long. The entire apparatus was 4 in. deep, 3 in. wide, and covered with hardware cloth. The SB, R1, and G1 were painted white; R2 and G2 a flat black. Illumination was provided by two, 150-w. bulbs, one suspended 2 ft. above the middle portion of each runway.

A set of hinges permitted setting R1 at various slopes so *S*'s movement from SB to G1 could be made an effortful upward climb. The whole apparatus was elevated to permit a maximum R1 angle of 55°. Regardless of R1 angle, SB, G1, R2, and G2 were level at all times. The R1 floor was covered with hardware cloth to facilitate running in the effortful conditions.

Guillotine doors isolated SB, G1, and G2 from the runways. Running times in R1 were measured from the moment the SB door was opened until *S* stepped into G1, thereby closing a Micro-switch under the hinged floor and stopping the clock. Running times in R2 were measured over the middle 5-ft. portion of that runway by photocells operating a clock.

Procedure and Design

The *Ss* were kept in individual cages with free access to water. A daily diet of 12 gm. of lab checkers was maintained throughout the course of the experiment. Each *S* was handled, allowed to explore the runways, and eat in the goal boxes over a 5 day, preexperimental period; R1 was level during this time.

The *Ss* were randomly assigned to three groups, with the restriction that the hooded rats were equally distributed in these groups. The groups were differentiated by the effortfulness of the response in R1 during acquisition. The R1 runway was level for the low-effort (L) group, at 28° for the medium-effort (M) group, and at 55° for the high-effort (H) group. All *Ss* started in the low-effort condition at the beginning of training. The M and H groups were shifted to the M condition on the fourth day. After the fifth day, each group ran over the designated slope.

The acquisition phase of the experiment lasted for 96 trials: Two trials per day were run for the first 6 experimental days and three trials per day thereafter. Reward was available in each goal box on every trial for the first 3 days. Thence, an irregular partial (50%) reward schedule prevailed in G1 with continuous (100%) reward maintained in G2. A 6-day cyclical pattern of rewarded (r) and nonrewarded (n) trials in G1 took the following trial-by-trial form: rnn, rnm, nnr, nmr, nrm, nrr. Thus, on any 2 successive days, three of the six trials were rewarded in G1 and three were nonrewarded. Each reward consisted of three Noyes pellets. The *S* was confined in each goal box for 5-10 sec. At least 10 min. elapsed between each trial and between the last trial of the day and daily feeding. The *S* was returned to his home cage after each trial.

In the extinction phase all *Ss* ran under the

medium-effort condition, to G1 only and were never rewarded. This phase also consisted of three trials per day. An arbitrary response-failure criterion was set. If *S* did not enter G1 within 60 sec. after the SB door was opened, the trial was terminated and *S* was removed from the apparatus. Five such trials, not necessarily consecutive, for any *S*, terminated the experiment for that *S*, with the exception that all *Ss* were run for at least 36 trials.

RESULTS AND DISCUSSION

Acquisition

Figure 1 presents group average speeds in each runway during acquisition. Speeds in R1 were not directly comparable to those in R2 since the latter reflect running time only, while the former include both starting and running times.

It is apparent in the left panel of Figure 1 that the effort manipulation had an appropriate and large effect on R1 speeds. All group differences in R1 speeds were significant beyond the .01 level.

The right panel of Figure 1 shows R2 speeds for the three groups, separating trials preceded by reward in G1 from those which followed nonreward in G1. Analysis of the R2 data from Days 17-34 showed no significant differences among groups for speeds after reward nor for speeds after nonreward. ($F = 1.75$ and 3.06 , $df = 2/41$, both $p > .05$) A frustration effect (FE) is apparent for each group; that is, R2 speeds were faster following nonreward than following reward in G1. This FE was highly significant for each group considered separately. The primary question was whether the size of the FE would vary with effortfulness of the R1 condition. A negative answer was obtained.

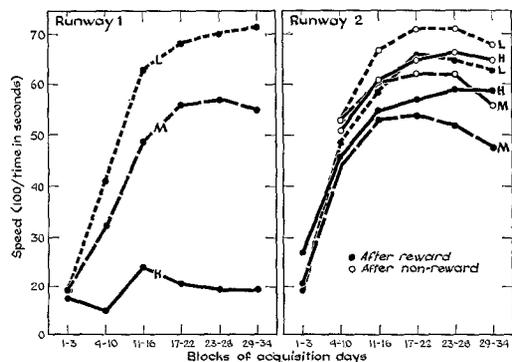


FIG. 1. Mean running speed in each of the two runways in 18 trial blocks, except for 6 trials only at the first data point.

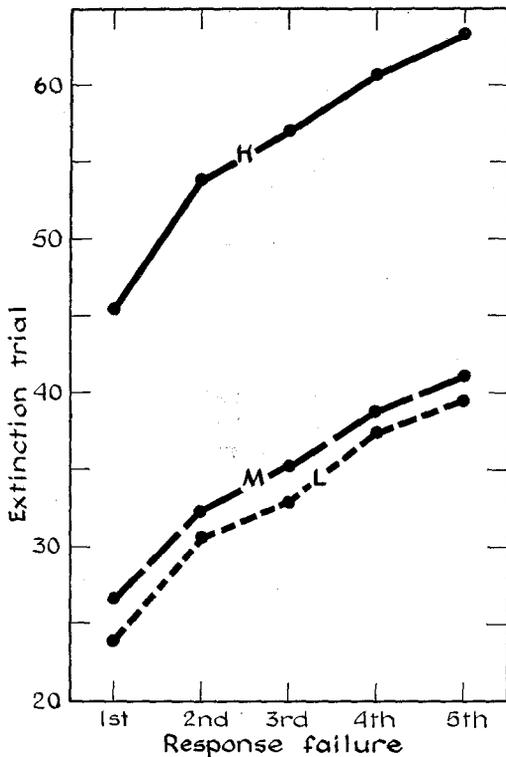


FIG. 2. Mean extinction trials reached on each of the five response failures, which together comprised the extinction criterion.

Over Days 17-34, the group mean FE scores (speed after nonreward minus speed after reward) were 7.1, 8.5, and 5.4 for Groups H, M, and L, respectively. These scores do not differ significantly ($F = 3.12$, $df = 2/41$, $p > .05$).

Since the effort variable was effectively manipulated and reliable FEs were obtained, the failure to find a relation between effort and FE magnitude was not a result of ineffective procedures. We conclude that the frustration hypothesis cannot be extended to explain the effect of effort. For this conclusion to be valid we must show that effort did prolong extinction.

Extinction in R1

When Group L was first shifted to the M condition, there was a sharp decrement in speed; Group H shifted to the M condition showed an increment in speed. After 36 trials, those Ss who had failed to respond five times were eliminated, while the remainder continued until this criterion was met. Throughout extinction, Ss in Group H continued running faster and for more trials than do Ss in Groups M and L. The latter two groups differed little.

Some of the results on resistance to extinction are shown in Figure 2, where the average trial number on which the first through fifth response failure occurred is presented. The curves are parallel with little difference between Groups L and M, while Group H persisted responding for many more trials than the other two groups. Separate comparisons of Group H with M, and of H with L, yielded t 's significant beyond the .01 level for trials to the fifth response failure. We have no explanation for why Group M was not significantly more persistent over Group L.

Using similar procedures and apparatus, Lawrence and Festinger's Experiment 14 showed the same effect of effort on persistence without a shift in effort between acquisition and extinction. We therefore conclude that higher effort prolongs resistance to extinction whether or not extinction involves effort changes. We conclude too that this increased resistance to extinction is not caused by differential frustrative factors since, by direct assessment, the FEs did not vary with response effortfulness.

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