The relative effects of nonreward and response thwarting on the frustration effect¹

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Studies of the frustration effect (FE) have confounded the facilitative effect of frustrative nonreward on R_2 performance with the possible energizing effect of response blocking in G_1 . To separate these two effects two groups of 11 rats were run in a double-runway to continuous reinforcement in G_1 and G_2 , and were then shifted to partial reinforcement in G_1 . One group was confined in G_1 on nonrewarded trials; the other group was never confined. Facilitation of R_2 performance was affected jointly by frustrative nonreward and response blocking in G_1 .

The term "frustration effect" (FE) refers to an increment in vigor of the responses which occur soon after a frustrating event. It has been reliably demonstrated in a double runway apparatus consisting of start box (SB), first runway (R_1), first goal box (G_1), second runway (R_2), and second goal box (G_2). Typically (e.g., Amsel, 1958), Ss receive continuous reinforcement in G_2 but are given nonrewarded trials interspersed with, or following, rewarded trials in G_1 . The increased vigor of responding in R_2 on nonrewarded trials has been attributed (Amsel, 1958) to an increment in drive level contributed by frustration resulting from nonreward in G_1 .

Results similar to those described in the foregoing have been observed in several studies (e.g., Holder, Marx, Holder, & Collier, 1957) in which the running response in a single runway was blocked for a few seconds before the S reached the goal box. The increment in vigor of the postdelay performance has been attributed (Brown & Farber, 1951) to frustration arising from the thwarting of the ongoing instrumental approach response.

In FE experiments, on rewarded trials Ss are released from G_1 as soon as the reward is consumed; on nonrewarded trials, however, they are confined in G_1 for a few seconds and then released. Clearly, the effects of thwarting and nonreward on performance in R_2 are confounded: The increased vigor of responding in R_2 could be explicable in terms of thwarting, nonreward, or both these factors.

That nonreward per se has energizing properties for the responses that follow may be surmised from a study by Wagner (1959) who found that a control group never rewarded in G_1 ran slower in R_2 than an experimental group following nonreward in G_1 . The two groups presumably experienced similar thwarting on the relevant trials, thus allowing a demonstration of the energizing effect of frustrative nonreward. These results, however, have been queried in a study comparable to Wagner's (McHose, 1963) where no significant differences were found in R_2 performance between the two relevant groups.

What is needed is an answer to the question: Does

frustrative nonreward have energizing properties independently of thwarting? And, if it does, what are the relative contributions of thwarting and nonreward on the observed increment in the vigor of responding in R_2 following frustrative nonreward in G_1 ?

In the study reported here, two groups were run to continuous reward in both G_1 and G_2 and were then shifted to partial reinforcement in G_1 . For one group, the doors in G_1 were always open, thus avoiding any possibility of response blocking. The relative contributions of thwarting and nonreward could then be assessed by comparing the performance of the two groups in R_2 following nonreward in G_1 .

Method

Subjects. The Ss were 22 male albino rats from the colony maintained at the University of Western Australia. They were housed four to a cage and were approximately 120 days old at the beginning of the experiment.

Apparatus. The Ss were run in a double runway made from 1/2 in. plywood. The internal dimensions were: overall length, 13 ft; height, 4 in.; width, 2-5/8 in. The overall length was made up of start box (SB) 12 in., first runway (R_1) 5 ft, first goal box (G_1) 12 in., second runway (R_2) 5 ft, and second goal box (G_2) 12 in. Clear Perspex doors, which opened downward, controlled access to the runways from SB and G_1 . Similar retrace doors closed automatically in both G_1 and G_2 when the S broke a photobeam 1/2 in. above the food cups. These consisted of a square metal dish 3/4 in. wide x 1/4 in. deep attached to a metal stand 1-1/8 in. off the floor so that the approaching animals could not see the food. One food cup was placed in the far left-hand corner of G_1 and G_2 . Photocells and lamps with infrared filters were installed in R_2 11 in. past G_1 and 1 in. before G_2 . The interruption of these light beams caused signals to be placed on a magnetic sound tape moving at constant speed. Running times were recovered, with a resolution of 20 msec, when the tapes were played through an interface into a DEC PDP-6 computer.

Procedure. Ten days before the beginning of training Ss were placed on a 23 h food deprivation schedule with water available at all times. For the last five days, Ss were handled together for 30 min daily on a large metal tray covered with sawdust. After handling, food was available for 1 h. Ss were assigned at random to two groups of 11 Ss each. During Acquisition, all Ss were continuously reinforced with four 20 mg Noyes pellets in both G_1 and G_2 . The Ss in Group NB (not blocked) were never confined in G_1 , both start and retrace doors in G_1 being always open; the Ss in Group B (blocked) were confined in G_1 until they had eaten and then faced the start door. One trial was run on each of the first

Fig. 1. Mean log running time (ft/sec) in R_2 . See text for further description.

two days of Acquisition, two on the third day, then four trials a day for the next 12 days, making a total of 52 Acquisition trials. The Ss were run in rotation with an intertrial interval of approximately 15 min; water was always available in the holding boxes. On Trial 53 all Ss were shifted to 50% reinforcement in G_1 for 40 further trials at four trials per day. The sequence of rewards was a recycling of the following schedule: RNRN, NRNR, NRRN, RNNR, NNRR, RRNN, where R represents rewarded trials and N nonrewarded trials in G_1 . On rewarded trials the treatment for each group was the same as during Acquisition. On nonrewarded trials, Ss from Group B were confined in G_1 for 5 sec and then released; the Ss in Group NB were never confined. Continuous reinforcement was maintained in G_2 throughout the experiment. One S in Group NB died, thus leaving 11 Ss in Group B and 10 in Group NB.

Results and Discussion

The running time in R_2 of each S on each trial was transformed logarithmically and then averaged for each group over blocks of trials to give the measure of performance shown in Fig. 1. Blocks of four trials and two trials were plotted for Acquisition and Shift, respectively. During Shift, the mean of the two daily trials on which Ss were rewarded in G_1 (R) and the two daily trials on which they received no reward (N) were plotted separately.

During Acquisition the effects of Trials was significant ($F=99.10$, $df=12/228$, $p<.001$), as was the Groups by Trials interaction ($F=4.65$, $df=12/228$, $p<.001$). No other effects reached significance.

The divergence of the performance curves of the two groups during Acquisition may be the result of a short period of confinement which the Ss in Group B experienced in G_1 between the time they finished eating and the time they were actually released into R_2 . This interpretation is consonant with the observation that the effect developed over trials and is in accordance with the results reported by Holder et al (1957). All FE experiments possibly have contained this effect, but it went undetected since the nonblocked controls were missing.

During Shift the significant effects were those of

Trials ($F=2.51$, $df=9/171$, $p<.01$), Groups ($F=5.84$, $df=1/19$, $p<.05$), and Reward vs Nonreward in G_1 ($F=40.93$, $df=1/19$, $p<.001$). No other effects, notably the interaction between Groups and reward conditions in G_1 ($F=0.64$) were significant.

The energizing effects of frustrative nonreward on performance in R_2 was obtained in both groups; its magnitude, however, was not related to response blocking in G_1 . Given that the superior performance of Group B over Group NB on rewarded trials stemmed from response blocking as discussed in the foregoing, nonreward appears to act in conjunction with thwarting in energizing the R_2 performance of Group B. On this basis, the difference in the postshift performance of Groups B(R) and NB(R) represents the effect of response thwarting, and the difference between Groups B(R) and NB(N) represents the joint effects of thwarting and nonreward. Results entirely consistent with this interpretation have recently been reported by Blanchard (1967) who obtained faster running speed under conditions of frustrative nonreward plus response blocking than under frustrative nonreward alone.

It is clear that in all the earlier FE experiments the effect of frustrative nonreward on performance in R_2 was confounded with other sources of response facilitation—notably, response thwarting. The confounding did not, however, lead to serious misinterpretation of the data since frustrative nonreward per se appears to have an effect of approximately the same magnitude whether or not there is also an effect due to response blocking in G_1 . If, however, the effect of frustrative nonreward is to be studied independently of other sources of response facilitation, the experiment must be carried out without doors in G_1 .

Recent studies (Hamm, 1967) have shown that differences in postshift performance are due to a decrement in speed in R_2 following R trials as well as to an increment in speed following N trials. It is not possible to determine from the present study whether either or both of these phenomena are affected by response thwarting in G_1 .

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Note

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