The "frustration effect" in operant studies: A necessary control procedure¹

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Reinforcements were randomly eliminated from one segment of a multiple chained schedule. The ensuing response facilitation was found to be no greater than the facilitation produced by chronic nonreinforcement, i.e., what is commonly observed as contrast effects. This finding differs from those found in discrete trial situations and suggests that caution should be exercised in using frustration theory to account for operant phenomena.

The frustration effect (FE) refers to the increase of response speed following nonreinforcement of a previously reinforced response (Amsel & Roussel, 1952). Wagner (1959) devised a technique to allow comparison of the response facilitation produced by frustrative nonreinforcement with facilitation produced by chronic nonreinforcement, i.e., that facilitation commonly called contrast effects (e.g., Nevin & Shettleworth, 1965). The need for including procedures that can distinguish between these effects is well documented (Ludvigson & McHose, 1967). Unfortunately, some recent operant studies directed to the FE have not included control conditions which would allow comparison of the obtained frustration produced response facilitation with response facilitation that results from chronic nonreinforcement, i.e., contrast effects (Davenport & Thompson, 1965; Davenport, Flaherty, & Dyrud, 1966; Staddon & Innis, 1966). These studies compared responding following frustrative nonreinforcement with responding following reinforcement. In each study response rate was higher and/or response latency was shorter following frustrative nonreinforcement. The question remains as to whether the observed facilitation could be accounted for by frustrative nonreinforcement or by chronic nonreinforcement, i.e., contrast effects.

The purpose of the present study was to employ control procedures to determine if frustrative nonreinforcement will produce a momentary response facilitation in a free operant situation that is greater than facilitation obtained after chronic nonreinforcement, i.e., is greater than that observed as contrast effects.

Procedure

Seven male white King pigeons served as Ss. Each was maintained at 80% of its free feeding weight and run daily in a standard, one key experimental chamber. Each was magazine trained, shaped to peck a white key, and then exposed to a four segment multiple chain schedule. The 50th response in each segment produced reinforcement, and the next segment. Reinforcement

consisted of a 5 sec access to grain in Segments 1, 2, and 4. In the third segment, reinforcement consisted of a .5 sec presentation of stimuli associated with grain (magazine sound, magazine light, extinguished house and key lights). A solenoid operated plastic shutter remained in place over the magazine opening on nonfood reinforcements to prevent accidental food presentation (Leckrone, Zimmerman, & Hanford, 1966). Segments 1, 2, 3, and 4 (S_1 , S_2 , S_3 , S_4) were associated with green, white, red, and white key colors, respectively, for four birds, while S_1 and S_3 colors were reversed for counterbalancing purposes with the remaining birds.

Fifteen repeating cycles of the four component schedule constituted a daily session. The training phase of the experiment (at least 15 days) ended when responding had stabilized (two days of no marked changes). During each of six subsequent test days, one-fourth of the food reinforcements in S_1 were randomly eliminated and replaced with the .5 sec presentation of the magazine stimuli. These latter presentations are defined as frustrative nonreinforcements. During both training and test phases of the experiment, two response measures were taken in each segment. These were: (1) the number of responses in a 5 sec interval after the first response (initial rate), and (2) the latency of the first response. During test days, initial rates and latencies occurring after frustrative nonreinforcement (F trials) were recorded separately from those occurring after reinforcements (R trials) in S_1 .

Results and Discussion

Results are reported for initial rates only, since the latency data were similar and therefore redundant. Figure 1 presents initial response rates for each S averaged across all six test sessions in each of the conditions listed on the abscissa as: (S_1), initial rate in the first segment; (R), rate in S_2 after reinforced trials in S_1 ; (F) rates in S_2 after frustrative nonreinforcement in S_1 ; and (N) rate in S_4 , i.e., after chronic nonreinforcement in S_3 .

Three results deserve special attention. First, initial response rates in S_4 , i.e., following chronic nonreinforcement in S_3 (N) are higher than initial rates in S_2 , i.e., following reinforcement (R) in S_1 . These differences are typically referred to as contrast effects. Second, initial response rates following F trials (F) were higher than initial rates following R trials (R). It is these differences that are typically called the

Fig. 1. The mean initial rate across the six test sessions in each of the relevant segments for each bird. Letters on the abscissa refer to condition, i.e., rate in 1st segment (S₁), in 2nd segment after a reinforced trial in the 1st segment (R) and after a frustrative nonreinforced trial in the 1st segment (F), and in the 4th segment, i.e., after the chronically nonreinforced 3rd segment (N).

frustration effect. Finally, only in the case of one bird (17) is the initial rate following F trials higher than the initial rate following N.

These data indicate that the facilitation obtained from frustrative nonreinforcement (F) is not greater than that produced by chronic nonreinforcement (N), i.e., the facilitation observed as contrast effects. The increase in initial rates obtained on F trials above those rates observed following R trials is in agreement with previous operant studies investigating the FE (Davenport & Thompson, 1965; Davenport, Flaherty, & Dyrud, 1966; Staddon & Innis, 1966). However, interpreting the present differences as resulting from frustrative nonreinforcement as has been done in previous operant studies is not warranted, since the rate increases following frustrative nonreinforcement may be accounted for by contrast effects.

It might be argued that the present study failed to obtain evidence of frustrative facilitation because of the consequences that occur at the end of the various components. For example, responding in S₂ always resulted in food reinforcement and the onset of S₃ where food reinforcement never occurred. Thus, responding in S₂ may have been suppressed by the imminent production of the nonfood reinforced S₃. Thus responding after a frustrative nonreinforcement would also have been suppressed and less likely to reach a level above those obtained after the nonreinforced component (S₃). Evidence against such a possibility is suggested by comparing rates in S₂ on R trials with those occurring in S₁. Figure 1 shows that Birds 22, 20, and 18 displayed rates in S₁ below those on R trials of S₂. Birds 17, 16, 15, and 21 show the reverse effect, i.e., evidence for suppression of responding in S₂. There appears to be no relationship between presence or absence of suppression of S₂ in relation to S₁ and the amount of frustrative facilitation. While Fig. 1 shows these relationships for test sessions only, the same relationships were found in pretest data.

The present results are consistent with previous data (Hamm, 1967) which indicated that when several

reinforcements are received within a chain of discrete responses or within a short time interval, elimination of one reinforcement will not produce response facilitation when corrected for chronic nonreinforcement effects, i.e., behavioral contrast. In free responding situations, as in the present study, where many reinforcements may be obtained in a session, elimination of a few reinforcements may not produce facilitating effects as great as those produced in the discrete runway situation.

The present results do not preclude the occurrence of frustrative nonreinforcement produced facilitation in operant situations involving other reinforcement schedules or stimulus conditions, but they do indicate the need for caution in using frustration theory rather than contrast effects as an explanation for various operant phenomena.

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