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Effects of knowledge of results and amount of stimulus change on "resistance to extinction" on a perceptual motor task

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A previous study (Black & Black, 1970) demonstrated that schedule of knowledge of results (KR) affects "resistance to extinction (RE)" on a pursuit rotor in the same manner as partial reinforcement (PR) in instrumental conditioning. The present experiment sought to replicate this finding and to determine if the greater RE of Ss trained under PKR rather than CKR could be attributable simply to the discriminability of acquisition and extinction stimulus conditions. The present results did replicate those obtained earlier in showing an apparent PRE following PKR. However, merely introducing a novel stimulus (a buzzer) at the beginning of extinction failed to produce as large a reduction in RE. These results were interpreted as compatible with the frustration interpretation of PRE.

It is well known that knowledge of results (KR) is a potent determinant of performance in perceptual motor tasks. Thus, providing S with such informative feedback typically facilitates performance, while discontinuing KR tends to result in a progressive impairment of performance (e.g., Bilodeau & Bilodeau, 1961). Consequently, it is not difficult to recognize the apparent parallel between the effects of KR and those of reinforcement in instrumental conditioning in which the presentation of reward leads to the strengthening of the instrumental response, while its withdrawal leads to the extinction of that response.

Recently, Black & Black (1970) were apparently able to extend this parallel between the effects of KR and those of reinforcement by demonstrating that partial KR (PKR) leads to greater "resistance to extinction (RE)" than consistent KR (CKR) in performance on a pursuit-rotor task. Specifically, they reported that Ss were willing to perform longer on the task following the discontinuation of knowledge of time on target (TOT) if their initial training had involved PKR than if it had involved CKR. If such persistence in performing is considered a measure of RE, then an analogue of the "partial reinforcement-extinction effect (PRE-E)" had presumably occurred.

Reasoning further by analogy with the PRE in instrumental conditioning, Black & Black (1970) suggested that the frustration interpretation of this effect might also extend to the pursuit-rotor task. According to this view, as advanced by Amsel (1958) and Spence (1960), Ss trained under PR show greater RE than those trained under CR because, under the former condition, Ss have learned to continue performing in spite of the frustration resulting from nonreinforcement, while under the latter condition they have not. If failure to provide KR of TOT is frustrating in the pursuit-rotor task, then Ss initially trained with PKR might be expected to perform longer at that task following withdrawal of KR than Ss whose initial training involved CKR. This expectation is, of course, consistent with the results reported by Black and Black. On the other hand, an alternative explanation is provided by the "discrimination hypothesis" which was first described by Mowrer & Jones (1945). According to this view, RE is determined by the degree of similarity of the stimulus conditions prevailing during extinction as compared with those during acquisition. Any stimulus change at the outset of extinction which makes thy transition from acquisition to extinction abruptly and readily noticeable will contribute to rapid extinction. Thus, extinction following PR is more gradual than that following CR because Ss trained under PR have experienced nonreinforced trials during training, and the occurrence of such trials during extinction does not represent a novel event. On the other hand, nonreinforced trials do occur initially as a novel event in extinction for Ss trained under CR and thus, the transition from acquisition to extinction is readily discriminated by such Ss.

In the present experiment an attempt was made to manipulate both the effect of schedule of KR of TOT and the amount of change in stimulus conditions introduced at the beginning of extinction. RE was defined as the number of trials that S was willing to continue to perform the task, prior to indicating that he was "bored," etc. Under one condition Ss were asked to track the target while it was rotating and a buzzer was sounding, while under a second condition the buzzer was omitted. For half of the Ss, correct KR of TOT was provided following each of an initial series of 24 trials, while for the other half of the Ss KR was provided on only half of these trials. Following the initial series of 24 trials, "extinction" was instituted for all Ss—i.e., no further KR of TOT was provided. For all Ss during "extinction" the buzzer was sounded during each trial. Thus, the experiment was a 2 by 2 factorial design involving the status of the buzzer of the beginning of "extinction" (i.e., "familiar stimulus" or "novel stimulus") and the schedule of KR prior to the beginning of "extinction" (50% KR or 100% KR). If the greater RE of PKR than CKR Ss is simply the result of the introduction of a "novel stimulus" (i.e., no KR) at the beginning of "extinction" for the CKR Ss, then the introduction of another "novel stimulus" (the buzzer) should also produce at least as great a reduction in RE for those Ss who first are presented the buzzer at the beginning of extinction.

METHOD

The Ss were 60 male volunteers from the introductory course in

psychology at the University of South Carolina. The apparatus was a Marietta 5-6S pursuit rotor, Model D, which was equipped with automatic timers for both "test" and "rest" intervals and a clock which measured time on target in .01-sec units. The turntable was 12 in. in diam, while the target was a circle .75 in. in diam. The turntable revolved at 60 rpm. During the experiment S stood in front of the turntable, which was mounted on a table and separated from E by a wood screen. A simple buzzer was used to provide a sound during the test periods on the appropriate trials.

For all Ss 10-sec test periods alternated with 10-sec rest periods, time on target in .01-sec units. The turntable was 12 in. in diam, while the target was a circle .75 in. in diam. The turntable revolved at 60 rpm. During the experiment, S stood in front of the turntable which was mounted on a table and was separated from E by a wood screen. A simple buzzer was used to provide a sound during the test periods on the appropriate trials.

When S entered the experimental room, E played a tape in which were recorded a description of the experimental procedure and S's task. These instructions stated that on some, but not all, trials S would be correctly informed of his TOT for that trial and that on some, but not all, trials a buzzer would sound during the test period. The instructions further stated: "We will continue running trials until you become tired or disinterested in the task. So please tell me when you wish to stop. We will stop when you are tired or bored. You do us both a disservice if you continue after you think you would like to stop. Remember, you stop the experiment. We will stop when you tell me. However, you should continue until you lose interest."

The Ss were assigned randomly to one of four groups of 15 each designated in terms of the KR schedule employed on the initial 24 trials (50% or 100%) and the presence or absence of the buzzer on those trials. For those Ss who had been trained with the buzzer present during the initial 24 trials, the buzzer was said to be "familiar (F)" at the beginning of "extinction," while for the remaining Ss it was "novel (N)" at the beginning of extinction. Thus, the groups were: Group F-CKR received KR of TOT on each of these 24 trials and the buzzer had been sounded during each trial, while for Ss in Group F-PKR the buzzer was sounded on each of the first 24 trials but KR had been given randomly after only half these trials. For Ss in the former group, KR had been given on each of these trials, while for N-PKR Ss, KR had been given randomly on one-half of these trials.

For all Ss 10-sec test periods alternated with 10-sec rest periods, and S remained in the experiment until he indicated to E that he wished to stop performing. Note that following the initial 24 trials (i.e., in "extinction") all Ss were treated identically—i.e., the buzzer sounded during each test period and no further KR of TOT was given.

RESULTS

The mean number of trials performed by Ss in each of the four groups prior to their termination of the experiment were as follows: Group F-PKR, 125.0; Group N-PKR, 105.33; Group F-CKR, 98.00; Group N-CKR, 87.00 trials to termination. Thus, both KR schedule and the familiarity or novelty of the buzzer at the onset of "extinction" appeared to affect performance. Ignoring KR schedule, the average trials to termination (TTT) for Ss for whom the buzzer was familiar was 111.50, while TTT for Ss for whom it was novel was only 96.16—a difference of 15.34 trials. Ignoring the novelty-familiarity variable, the average TTT fro Ss trained under CKR was 92.5, while for PKR Ss it was 115.16—a difference of 22.66 trials. A two-way analysis of variance of these data indicated that the main effect of KR schedule was significant ($F = 4.00$, $df = 1/56$, $p < .05$). The main effect of familiarity-novelty, however, failed to prove reliable ($F = 1.36$, $df = 1/36$, $p > .05$). Similarly, the interaction of KR Schedule by Familiarity-Novelty also failed to prove significant ($F > 1.00$).

DISCUSSION

The present results confirmed those of Black & Black (1970) in demonstrating that Ss performed longer on a pursuit-rotor task when they had initially been trained with PKR than when KR had initially been administered consistently. A similar result was also obtained by Mandell (1969). Like Black & Black (1970), this E also reported that Ss who are always given KR perform longer than either PKR or CKR Ss. Presumably, such Ss terminate the experiment as the result of fatigue rather than as the result of "extinction" attributable to "nonreinforcement" (i.e., withdrawal of KR). In this connection, Mandell also reported that Ss who are *never* given KR terminated the experiment earlier than did any of the other groups. This result would also be expected if KR is considered to be a form of reinforcement. Taken together, then, the present results, those of Black & Black (1970), and those of Mandell (1969) all rather convincingly suggest that the role of schedule of KR in determining "RE" on a pursuit-rotor task is completely analogous to the role of schedule of reinforcement in instrumental conditioning.

A second purpose of the present experiment was to determine if the effect of schedule of KR on RE can be considered the result of a stimulus change at the outset of extinction trials. To test this possibility an overt and readily noticeable stimulus change (i.e., the sound of a buzzer) was introudced for half of the Ss at the time that KR of TOT was withdrawn. For the remaining Ss the buzzer was an already familiar one, having been present on each of the 24 trials prior to ',extinction." The results indicated that the introduction of a novel buzzer did somewhat reduce TOT. Thus, the greatest "RE" (125.0 trials) was shown by Ss in Group F-PKR who were trained with PKR and for whom the buzzer was familiar at the beginning of extinction. Similarly, the least "RE" (87.0 trials) was shown by Ss in Group N-CKR for whom both the buzzer and the occurrence of nnKR trials wer novel at the outset of extinction. It should be noted, however, that the schedule of KR effect was longer than that associated with the "novel vs familiar buzzer effect," and the latter, in fact, failed to prove significant. On the other hand, the present results seem completely compatible with a frustration interpretation of PRE. Thus, the effect of KR shcedule did prove significant, as would be expected under the assumption that the omission of KR results in frustration. Furthermore, a reduction in RE associated with the introduction of a novel and irrelevant stimulus (i.e., the buzzer) at the outset of extinction would also be predicted to occur simply as a generalization decrement.

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