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CHILDREN'S RESPONSE SPEEDS FOLLOWING FAILURE AND SUCCESS AS A FUNCTION OF INTERRESPONSE INTERVAL AND INSTRUCTIONAL SET

by

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ABSTRACT

On each of 20 trials, 108 second- and third-grade children performed a light-switching game followed by a lever pulling response. Half the Ss (self-blame group) were told that winning the light-switch game depended on their playing the game "right", and the other Ss (other-blame group) were told that E controlled winning and losing. Success was under E's control and all Ss were allowed to succeed on the first task on half the trials and were failed on the other trials. The self-blame and other-blame groups were each divided into three subgroups differing in the duration of the interval between the two responses. Each S received a constant 0-, 4-, or 8-sec. IRI. Analysis of the lever pulling start speeds indicated that failure on the switch game resulted in slower start speeds than did success. This difference was greater for the self-blame Ss than it was for the other-blame Ss. In the 0-sec. IRI condition this difference was greater than it was in the 4-sec. or 8-sec. conditions.

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INTRODUCTION

Many investigators have recognized the importance of frustration as a determinant of behavior. Freud (1952) considered the frustration of needs to be at the root of most cognitive activity. Frustration produced by the interruption of ongoing activity or the withholding of a reward was viewed as a cause of aggression (Dollard et al., 1939) and as a cause of regression (Barker et al., 1943). Zeigarnik (see Baldwin, 1968) found that people would remember a task that was interrupted better than they would remember a task which they were allowed to complete. The so-called "Zeigarnik effect" was interpreted in Kurt Lewin's (see Baldwin, 1968) theory as evidence that frustration produces a state of tension, often resulting in overt or covert behaviour associated with the satisfaction of the frustrated need. More recently, researchers (e.g., Amsel, 1958) have investigated the effects of a frustrating stimulus event on the strength of a simple response following that event.

The Frustration Effect and its Interpretation. The most influential theory of the effects of nonreward on behaviour was proposed by Amsel (1958) in an attempt to incorporate the role of frustrating events into the Hull-Spence theory of behaviour. Amsel defines a frustrating event as nonreward for a response that has been previously rewarded. The theory states that once anticipatory goal responses, or reward expectancy, has developed in a learning situation, nonreward produces an aversive emotional state, frustration, which contributes to drive level. This increase in drive is measured by the vigor of a continuously rewarded response which follows the frustrating event; the increase in vigor of a response following frustration is called the Frustration Effect (FE). After a number of nonreward trials, components of the frustration response may be classically conditioned to stimuli present in the situation. These components, when elicited prior to the goal response, are called anticipatory frustration responses. The notion of anticipatory frustration is a useful concept in accounting for the Partial Reinforcement Acquisition Effect and the Partial Reinforcement Extinction Effect.

The first experiment designed to test Amsel's theory of frustration (Amsel and Roussel, 1952) employed an apparatus consisting of two straight runways and two goal boxes which were connected in such a way that a rat could be released from the goal box at the end of one runway directly into the second runway. Albino rats were trained to traverse the two runways in sequence in order to receive a food reward in each of the two goal boxes. When stable performance was reached 36 test trials were administered. On 18 of the test trials the rats were rewarded in the first goal box (R_1 + trials), and on the other trials there was no reward in the first goal box (R_1 - trials). There was always a reward in the second goal box. Analysis of running times in the second runway revealed that following nonreward in the first goal box the rats ran faster than they did following reward in the first goal box. The results were interpreted as supporting Amsel's theory that nonreward produces an increment in drive.

An alternative explanation of Amsel's findings that does not require a motivational assumption has been suggested by Brown (1961) and others. If the animal has learned prior to the experiment to increase the vigor of an instrumental response following nonreward for that response, this learning might generalize from runway 1 to runway 2 resulting in increased speeds in runway 2 on R_1 - trials.

This associative explanation is most convincing when the stimulus conditions for both responses are highly similar, as in the case of the Amsel and Roussel study. Levine and Loesch (1967) carried out an experiment in which the stimulus conditions for the two responses were very dissimilar. A rat was trained to press a bar for food reward, and then to pull a chain for a water reward. When stable performance was reached a partial reinforcement schedule was introduced for the first response. The results showed that on R_1 - trials the rats pulled on the chain harder than they pulled on R_1 + trials. The findings were interpreted as supporting Amsel's theory. An associative explanation of this seems unlikely as the specific motivations (hunger and thirst), the stimuli, and the nature of the two responses for each task were dissimilar.

Child Studies of Nonreward and Blocking. The studies that have examined the FE in children have involved a simple first response (e.g., pulling a lever). On R_1 + trials the S was given a marble that counted for a prize. After an interresponse interval (IRI) of at least 5-sec. a visual stimulus was presented as the cue to perform a second simple response that was always rewarded by a marble.

The first study of nonreward-produced frustration in children was reported by Penney (1960). Penney used a double lever apparatus. Eighty-eight kindergarten children were divided into four groups: control and experimental Hi-Habit groups, and control and experimental Lo-Habit groups. Initially all Ss received four trials in which both the first lever pull (R_1) and the second lever pull (R_2) were reinforced (R_1 + trials). Then Ss in the Hi-Habit groups were administered ten R_1+ trials with R_2 omitted. The Ss in the Lo-Habit groups were administered one R_1+ trial with R_2 omitted. Following two more R_1+ trials eighteen test trials were administered to all Ss. For Ss in the control groups all test trials were R_1+ while for Ss in the experimental groups there were six R_1+ trials and twelve R_1- trials. Analysis of the R_2 movement speeds on test trials revealed that for Ss in the experimental Hi-Habit group R_2 speeds on four of the twelve R_1- trials were greater than R_2 speeds on comparable trials in the Hi-Habit control group. In addition, on R_1- trials in the experimental Hi-Habit group, R_2 speeds were greater than R_2 speeds on R_1+ trials. The finding of a FE in the Hi-Habit group only is consistent with Amsel's contention that the FE is a function of the development of anticipatory goal responses.

Ryan (1965) administered 20 trials on two single lever apparati to 100 kindergarten children who were divided into an experimental group and a control group. All trials for the control Ss were R_1+, while half the trials were R_1+ and half R_1- for the Ss in the experimental group. Analysis of the R_2 start speeds revealed that on R_1- trials the experimental Ss responded faster than they did on R_1+

trials. The experimental Ss responded faster than control Ss on both types of trial. The results were interpreted as being consistent with Amsel's theory of frustration.

Davidson and Fitzgerald (1970) investigated the effects of recency and summation of frustrative nonreward on a simple response. Kindergarten children were trained under 100% reinforcement to operate three levers in succession with 5-sec. IRI's. Three different partial reinforcement patterns were introduced for the first two lever responses while the third lever response was always reinforced. Analysis of the start latencies on the third response indicated that when nonreward preceded the third response the FE was greater than when nonreward was separated from the third response by reward on the second response. Nonreward on both the first two responses was found to summate producing a greater FE than the FE following nonreward on only one of the first two responses. These results were interpreted as supporting Amsel's theory.

A second group of investigators have investigated the effects of blocking an ongoing response chain on the vigor of a second response. Haner and Brown (1955) instructed second, third, and fourth grade children to fill 36 holes in a board with marbles. At any point in this task E could cause all the marbles to fall out of the holes. This terminated the task, and a buzzer sounded simultaneously. The S was required to push a plunger to stop the buzzer, and the amplitude of the S's response was recorded. The Ss were allowed to succeed at the marble game on two trials, and were blocked at various stages of the game on the other trials. The results revealed that the closer the S had been to completion when blocked, the greater was the amplitude of plunger pushing. There was no difference between response amplitudes on success and failure trials.

Ford (1963) instructed fifth grade children to complete a form-board puzzle as quickly as possible. A buzzer terminated the task at various stages of completion and S had to push a plunger to stop the buzzer. On the trials when S was allowed to complete the puzzle, R_2 speeds were faster than they were on trials when the S was blocked.

Subjects in an experiment by Endsley (1966) were required to pull a carriage up a 48-inch tower without allowing a steel ball to fall off the carriage. Failure and success were experimenter-controlled and a buzzer was used as the cue to terminate the carriage task. Following success on the first task Ss responded faster to push a plunger than they did following failure.

The nonreward and blocking studies discussed above have yielded diametrically opposite results. Nonreward for a response results in increased vigor on a second response (the FE) while blocking an ongoing response chain results in a decrement in the vigor of a second response. This decrease in the vigor of a response following blocking will be called the Blocking Effect (BE).

There are a considerable number of procedural differences between the nonreward and blocking studies reviewed above. The Ss in the nonreward studies were kindergarten or grade one children while Ss in the blocking studies were children in grades one through six. The ratio of reinforcement for the first task on test trials was usually 50% in nonreward studies and averaged 30% in blocking studies. Ryan and Watson (1968) have pointed out that the blocking studies have usually used fewer trials than the nonreward studies. The first task in blocking procedures was always more "complex" and of a longer duration than the first response in nonreward procedures. The cue for S to perform the second response was always visual in nonreward studies and always auditory in blocking studies. The instructions relating to the performance of the first task implied that the task was a test of speed or skill in blocking studies, while in nonreward studies the instructions made no such implication. The IRI in blocking studies was always 0-sec., while in nonreward studies IRI varied from 5-sec. to 20-sec.

Since the first task in the blocking studies has involved a chain of highly similar responses, Hull-Spence theory would predict that anticipatory goal responses would generalize to all the responses in the chain. Blocking this chain constitutes nonreward for responses which are associated with anticipatory goal responses and should therefore elicit the primary emotional reaction which Amsel called frustration. According to Amsel's theory blocking a response should produce an increment in drive which would be evidenced by increased response speeds following blocking as compared to speeds following success. The fact that the results of the blocking studies are diametrically opposed to the results of nonreward studies and frustration theory has led to the development of two accounts which attempt to explain the differences produced by the two types of experimental procedures.

First, Ford (1963) and Endsley (1966) speculate that failure in the blocking situation elicits a feeling of self-blame which inhibits ongoing behaviour. According to this hypothesis, the frustrating event is aversive and produces mild aggression which is normally evidenced in the FE. However, whereas cultural norms allow mild aggression in response to the failure of a mechanical device, the failure of oneself to perform adequately on a task is less acceptable as justification for aggression, and hence the aggression is inhibited in self-blame situations. It is likely that a S in a typical nonreward experiment would see little reason to blame himself for nonreward, whereas a S who was asked to perform a task as quickly as possible in a blocking experiment would respond to failure with feelings of self-blame for the failure. If this is the case, the self-blame hypothesis predicts a BE in blocking studies and a FE in nonreward studies.

The self-blame explanation of the BE was examined by Pederson and McEwan (1970). Second and third grade children received 32 trials; on each trial they performed a marble maze task and then made a lever pulling response. Half the Ss (self-blame group) were told that guiding the marble through the maze was a test of skill, and the remaining Ss (other-blame group) were told that it was a matter of chance whether or not the marble negotiated the maze successfully. Subjects in both groups could manipulate the plane of the maze, supposedly to guide the ball through the maze. Success was under E's control, and Ss were blocked at various stages of the maze or allowed to succeed. A buzzer terminated the task and served as the cue for the lever pulling response. The reciprocals of the time scores were obtained for the latency from buzzer onset to the start of the lever response to yield start speed scores. In both instructional conditions the R_2 start speeds were greater following success than following failure, the typical blocking effect. In addition, the R_2 start speeds following success were faster in the self-blame group than in the other-blame group. This evidence suggests that the self-blame variable is insufficient to account for the different results of the nonreward and blocking studies. The evidence also indicated that degree of self-blame affected R_2 speeds on success trials but not on failure trials, in contradiction to the Ford and Endsley hypothesis. A limitation of the Pederson and McEwan study, suggested by the authors in their report, is that Ss in the other-blame group could manipulate the maze, and may thus have assumed some responsibility for failure on the marble maze task. As a result, the amount of self-blame may not have differed greatly between the two instructional conditions.

The second explanation proposed to account for the different results of nonreward and blocking studies was offered by Ryan and Watson (1968) in a review of the research. They suggested that both nonreward and blocking events elicit interfering responses that hide the FE during the first few trials. In a reanalysis of Watson and Ryan's (1966) study they found that nonreward produced a BE on the early trials of the experiment. Since the blocking studies have used relatively few trials (e.g., Haner and Brown used 12) there may not have been a sufficient number of trials for a FE to appear. The findings of the Pederson and McEwan (1970) study contradict two aspects of this proposition. First, Pederson and McEwan used 32 trials, more than most of the nonreward studies, and obtained a consistent BE. Second, start speeds on success trials increased over trials while start speeds on failure trials remained constant over trial blocks. If interfering responses elicited by failure are assumed to dissipate over trials, one would expect that the start speeds on failure trials would increase across trial blocks, while the start speeds on success trials would remain constant.

Interresponse Interval Effects on the FE and the BE. A variable which has received little attention as a possible factor involved in the divergent results of nonreward and blocking studies is IRI. Since the nonreward and blocking studies have consistently employed different IRIs, the time course of the FE and the BE merits examination.

In their original study Amsel and Roussel (1952) hypothesized that the motivational increment produced by nonreward would decrease monotonically during the interval between the two responses. On test trials the rats were divided into three groups according to the length of time they were retained in goal box 1 on R_1- trials (5-, 10-, or 30-sec.). On R_1+ trials IRI was 30-sec. for all Ss. Analysis of the R_2 running times and latencies revealed no reliable differences amongst the magnitudes of the FE at the three levels of IRI.

McKinnon and Amsel (1964) replicated the Amsel and Roussel study using IRIs of 5-, 15-, and 90-sec. on R_1- trials. On R_1+ trials the

IRI was 15-sec. for all Ss. They found that the magnitude of the FE following 5-sec and 15-sec. IRIs was greater than the magnitude of the FE following the 90sec. IRI. The results of this study, as regards the time course of the FE, are unfortunately impossible to interpret due to shortcomings in the experimental design. Since IRI was held constant for all groups on R_1+ trials, but varied between groups on R_1- trials, a comparison of the magnitude of the FE at different IRI's would require the assumption that R_2 vigor on R_1+ trials does not vary as a function of IRI, an assumption which is very likely unsound.

Robinson and Clayton (1963) attempted to overcome the procedural shortcoming of the Amsel and Roussel study and the MacKinnon and Amsel study. The training of the rats in the double runway apparatus involved the same procedure as the Amsel and Roussel experiment. During the test trials one group of rats was retained in goal box 1 for .5-sec. on all trials, whereas a second group was retained in goal box 1 for 5-sec. on all trials. Analysis of the running times in the second runway indicated that the rats given the .5-sec. IRI showed a typical FE, whereas the rats receiving a 5-sec. IRI did not show an FE. These results suggest that the motivational increment produced by nonreward decreases over time.

Watson and Ryan (1966) examined the effect of IRI on the FE with children. Using a nonreward procedure similar to that of Ryan's (1965) experiment, they employed IRI's of 5-, 10-, and 20-sec., varied within-Ss. They obtained an FE at the 5-sec. IRI but not at the 10- or 20-sec. IRI's. The results were interpreted as supporting Amsel and

Roussel's hypothesis that the motivational increment produced by frustration decreases monotonically over IRI.

Pederson (1970) investigated the relationship between IRI and the BE, using a within-Ss manipulation of IRI. Children received 36 trials on a ball-tower apparatus similar to that of Endsley (1966). On half of the trials S was allowed to succeed on the first task and on the other trials S was blocked at various stages of the task. Six failure trials and six success trials were followed by each of three IRIs, .5-, 1-, and 5-sec. The sequence of IRI's was a restricted random order. The IRI preceded a buzzer which was the cue to perform a lever pulling response. Analysis of the start speeds indicated that a large BE was obtained on the .5-sec. IRI trials, a significantly smaller BE was obtained on 1-sec. IRI trials and on 5-sec. IRI trials no BE was obtained. Start speeds on success trials did not vary across IRI but speeds on failure trials increased as IRI was increased. The results were interpreted as indicating that failure elicits interfering responses but that these responses dissipate over time.

A potentially important aspect of any investigation of IRI in a frustration paradigm is whether IRI is varied within-Ss or between-Ss. In a situation involving a random sequence of IRIs, the development and dissipation of interfering responses and/or motivational changes could be quite different from a situation in which IRI is constant. Varying IRI within-Ss would correspond to the first situation while varying IRI between-Ss would correspond to the second situation. In a study of reaction times, Elliot (1970) found that when the duration of a preparatory interval was varied irregularly, response speeds of 8 to 10 year-old children increased as the interval varied from 1- to 2- to 4-sec. and decreased as the interval increased from 4- to 16-sec. But when the preparatory interval was varied in a regular manner the response speeds of these children decreased as the interval varied from 1- through 16-sec. If the IRI in frustration and blocking studies corresponds to a preparatory interval for the second response to some extent, the distinction between constant and variable IRIs may be of importance. Furthermore, a comparison of blocking and nonreward studies involves a confounding of constant IRIs and suggests that a between-Ss manipulation of IRI would provide the most appropriate test of the effects of IRI relevant to the differences between these procedures.

The Experiment. This study involved a blocking procedure. The variables manipulated between-Ss were instructional set (self-blame (SB) *vs*. other-blame (OB)) and IRI (0-, 4-, and 8-sec.). The first task involved a light-switch panel. The S was instructed to try and turn on all the lights on the panel in order to win the game. The game ended when all the lights went out. This task allowed for a more realistic manipulation of the self-blame variable than did the apparatus used in the Pederson and McEwan (1970) blocking procedure. In Pederson and McEwan's procedure the S in the other-blame condition could manipulate the maze, and receive positive feedback for his efforts on half the trials, thus making it unlikely that he would believe that success was a matter of pure chance. In addition, a S might not guess that a ball in a maze could be controlled by other means than those under his own control. In the present study the S should have readily believed that the E could have complete control over a set of electric lights, thus facilitating the induction of an other-blame set. Half the Ss were told that task 1 was a test of skill (SB group) and the other Ss were told that E controlled success and failure (OB group). By making E's control explicit it was hoped to maximize the effects of the self-blame variable.

The three levels of IRI (0-, 4-, and 8-sec.) were chosen to cover the range of IRI's which have been conducive to producing the BE (0- to 1-sec.: Ford, 1963; Pederson, 1970) and the FE (5- to 10-sec.: Watson and Ryan, 1966; Penney, 1960). IRI was manipulated between-Ss to maintain a constant IRI for each S.

The evidence of previous blocking studies (Endsley, 1966;Ford, 1963; Pederson and McEwan, 1970; Pederson, 1970) indicate that a BE should be obtained in the 0-sec. IRI condition. Pederson's (1970) study suggests that in the 4-and 8-sec. IRI conditions the BE should be either considerably smaller than the BE in the 0-sec. condition or non-existent. Self-blame instructions should result in a larger BE, or smaller FE than would result from other-blame instructions. Pederson and McEwan's (1970) study suggests that instructional set should affect R_2 speeds on success trials more than on failure trials.

METHOD

Subjects

The Ss were 50 male and 58 female children (mean CA = 103.5 months, range 91 - 119 months) in grades 2 and 3 of an elementary public school. Three additional Ss were discarded because of equipment failure.

Apparatus

The basic apparatus consisted of a switch box, a lever box, picture projection equipment, and timing and control circuitry. The arrangement of the apparatus is shown in Figure 1. The switch box was 18 x 10 x 9 inches and its gray front panel sloped away from Ss at a 50^{o} angle. Eight toggle switches were placed 2 inches apart on a centered horizontal row along the panel and a 120-V, .06-W. red neon light was located 2½-inches above each switch. A matching panel was located in the control room and was interconnected with the S's switch box such that when S reversed the position of a switch the corresponding lights on both panels were illuminated. By throwing a switch on the control panel, E could turn off all the lights on S's panel. A 12-V door chime placed near the door of the control room was used as the signal for S to begin the switching task.

The lever box was similar in design to those described by Ryan (1965), and consisted of a 14- x 16- x 16-inch steel-blue box with a front panel that sloped away from S at a 45^{o} angle. There was a 10- x 3/4-inch slot in the front panel of the lever box to allow passage of

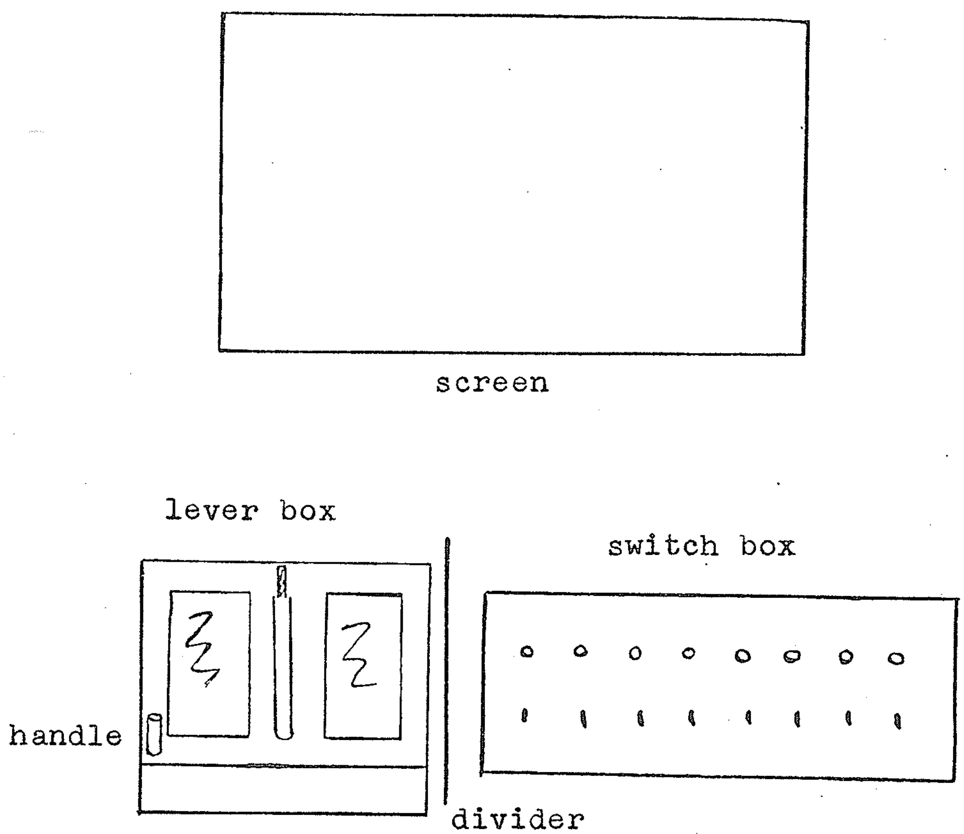

Fig. 1. The arrangement of the apparatus.

a $\frac{1}{2}$-inch diameter aluminum lever that extended 5 inches above the front panel. The lever was held at the top of the slot by a spring when S was not responding. A round vertical handle 1 inch in diameter and 4 inches high was attached to the lower left corner of the lever box to serve as a start position for the lever response, and a 6-V buzzer was located inside the lever box. The lever box was separated from the switch box by a 12- x 16-inch vertical partition to prevent S from making both the switching responses and the lever response with the same hand. The lever box was located on the S's left of the switch box and all Ss were required to operate the switches with their right hand and the lever with their left hand.

A Kodak Carousel 800 projector, located in the control room, projected 35 mm slides through a one-way mirror, located behind and above Ss, onto a 4- x 4-ft. screen placed about 10 ft. in front of S. The slides consisted of coloured pictures of animals and coloured drawings from children's books. The durations of the IRI's were controlled by the use of Hunter decade timers. Two .01-sec. Standard Electric Clocks were used to obtain the response latency measures.

Procedure

Eighteen Ss were randomly assigned to each of the six groups formed by the factorial combinations of the two instructional sets (SB and OB) and the three IRIs (0-sec., 4-sec., and 8-sec.). Male and female Ss were assigned randomly to the groups.

The children were brought individually to the trailer laboratory by E, where they were seated in front of the switch and lever boxes and read the appropriate instructions for the group to which they had been assigned. A complete transcript of the instructions appears in Appendix A. Subjects in all groups were told that to "win" the switching game they must turn on all the red lights on the panel by operating each toggle switch beginning with the first switch on the left and working to the right. The game ended when the lights went out; hence, if the lights went out before they managed to turn on all the lights they "lost" the game. Each S in the SB condition was told that, "If you play the game right you can turn on all the lights and win the game." Each S in the OB condition was told that, "Sometimes I will let you turn on all the lights and you will win the game. Other times I will turn off the lights before you can turn them all on and you will lose the game". All Ss were told that they would win a prize if they "win the game many times." The Ss were told to hold the handle on the lever box with their left hand during the switching game and to release the handle and pull down the lever as soon as the buzzer sounded, "Soon after the lights go off on the light-switch game".

Each trial commenced when E sounded the door chime to initiate the light-switch game. On the nonblocking (NB) trials the S was allowed to turn on all the lights before E switched off the lights, whereas on blocking (B) trials E switched off the lights when S had turned on 5, 6 or 7 of the eight lights. When E switched off the lights, the IRI was automatically initiated and following the 0-sec., 4-sec., or 8-sec. IRI, depending upon which group the S was in, the buzzer in the lever box came on and the start clock began timing. When the lever was moved from its resting position at the top of the slot the start clock stopped, the buzzer was turned off, and the movement clock began timing. When the lever had been pulled 9 inches from its resting position the movement clock stopped and the projector advanced to present a picture. The picture served as the reward for the lever response and was exposed for the duration of the 30-sec. intertrial interval. During the intertrial interval E recorded the start and movement latencies from the start clock and movement clock, respectively. Following B trials E also recorded whether or not any switching responses were made by S after the offset of the lights on S's panel (perseveration responses). These switching responses continued to turn on lights on E's panel, but not on S's panel, thus providing a record of perseveration behaviour. At the end of the 30-sec. picture presentation the projector advanced to a solid black slide and E initiated the next trial.

Each S received 24 trials including four practice trials. Two of the practice trials were B trials and two were NB trials, with the order of B and NB trials randomly assigned for each S. The 20 remaining trials were divided into two blocks of ten trials, each block containing five B and five NB trials. Ten random orders of five B and 5 NB trials were constructed with the restriction that no more than three consecutive B or NB trials could appear in an order. A second set of ten random orders was obtained by reversing the orders in the first set. Nine of the 18 Ss in a group were assigned two of the first set of random orders, and the remaining Ss in the group were assigned two of the second set of reversed random orders. No two Ss in one group were assigned an identical sequence of trials and each random order was used only twice in each group. The number of lights S was allowed to turn on prior to termination of the switching game on B trials (5, 6, or 7) was randomly assigned for each S and for each B trial. At the end of the game each S was given two pencils as a prize and asked not to tell the other children in his class about the game.

RESULTS

The start and movement latencies were converted to start speeds and movement speeds by the formula 1/time. For each response measure, the mean of each S's five speed scores on NB trials and the mean of each S's five speed scores on B trials were obtained for each of the two trial blocks. Overall mixed analyses of variance were computed separately for blocked start speeds and blocked movement speeds. In each analysis of variance there were two between-Ss variables, instructional set (SB vs. OB) and interresponse interval (IRI), and two within-Ss variables, type of trial (NB vs. B) and trial blocks.

Blocked start speeds. The blocked start speed means for each of the treatment combinations are presented in Table 1, Appendix B, and the analysis of variance for blocked start speeds is summarized in Table 4, Appendix C. Significant main effects were obtained for type of trial ($F = 47.735$, $df = 1/102$, $p < .001$) and trial blocks ($F = 24.900$, $df = 1/102$, $p < .001$). There were significant two-way interactions between instructional set and type of trial ($F = 5.383$, $df = 1/102$, $p < .025$), IRI and type of trial ($F = 33.721$, $df = 2/102$, $p < .001$), IRI and trial blocks ($F = 12.491$, $df = 2/102$, $p < .001$), and type of trial and trial blocks ($F = 8.790$, $df = 1/102$, $p < .005$). A triple interaction was obtained amongst IRI, type of trial, and trial blocks ($F = 7.258$, $df = 2/102$, $p < .01$). No other main effects or interactions were significant.

The means for the instructional set x type of trial interaction appear in Figure 2. The pairwise combinations of means were tested by

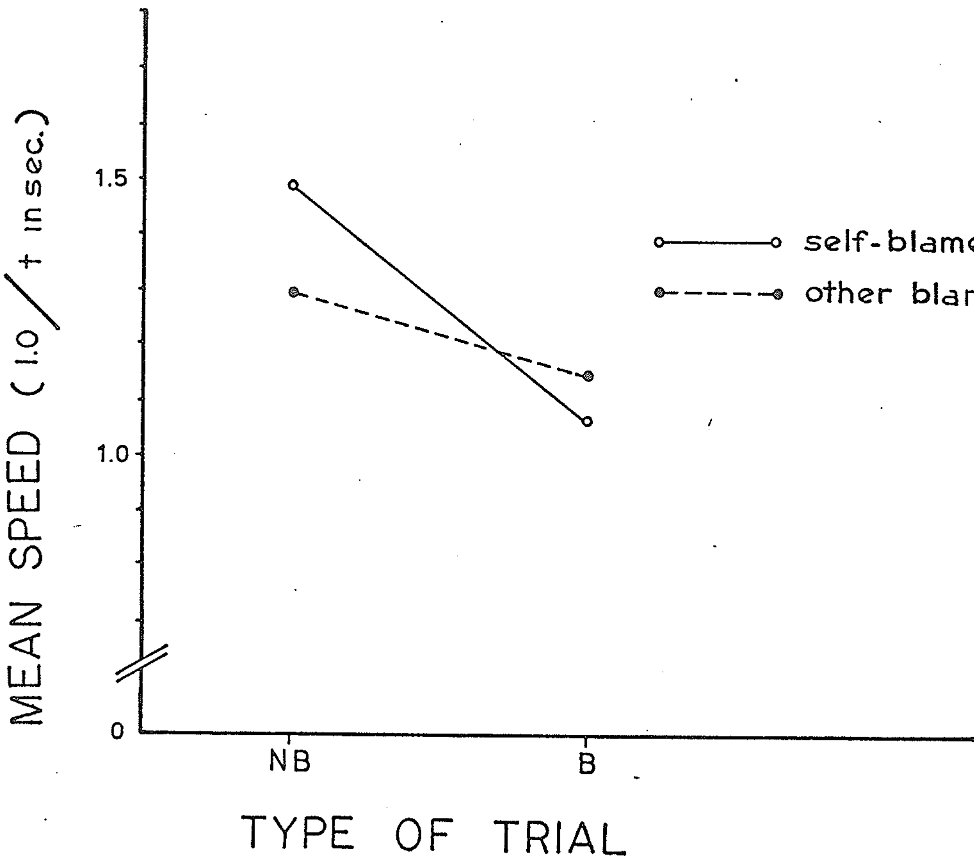

Fig. 2. Mean start speeds of self-blame and other-blame <u>S</u>s on NB and B trials.

Tukey's "honestly significant difference" (HSD) technique (see Kirk, 1968) and all differences were found to be significant ($p < .05$). Start speeds on NB trials were faster than start speeds on B trials for both the SB and OB Ss. In addition, on NB trials the SB S's start speeds were faster than the OB Ss' start speeds, whereas on B trials the SB Ss' start speeds were slower than the OB Ss' start speeds.

Two types of follow-up analyses were carried out to examine the IRI x type of trial x trial block interaction. The first set of analyses were conducted to compare the magnitude of the BE over levels of IRI and trial blocks. The means involved in the triple interaction, arranged appropriately for the first set of analyses, appear in Figure 3. Three analyses of variance were carried out involving the three pairs of IRI levels. The between-Ss variable in these analyses were IRI (two levels) and the within-Ss variables were type of trial and trial blocks.

The analysis of variance involving 0-sec. and 4-sec. IRI data is summarized in Table 5, Appendix C. Significant main effects for type of trial ($F = 41.450$, $df = 1/70$, $p < .001$) and trial blocks ($F = 26.051$, $df = 1/70$, $p < .001$), and double interactions between IRI and type of trial ($F = 31.603$, $df = 1/70$, $p < .001$), IRI and trial blocks ($F = 17.622$, $df = 1/70$, $p < .001$) and type of trial and trial blocks ($F = 8.540$, $df = 1/70$, $p < .01$) were obtained. The triple interaction among IRI, type of trial, and trial blocks was also significant ($F = 9.022$, $df = 1/70$, $p < .01$). The triple interaction in the 0-sec. vs. 4-sec. IRI analysis was examined by conducting separate analyses of variance on the 0-sec. and 4-sec. data. The within-Ss variables in these

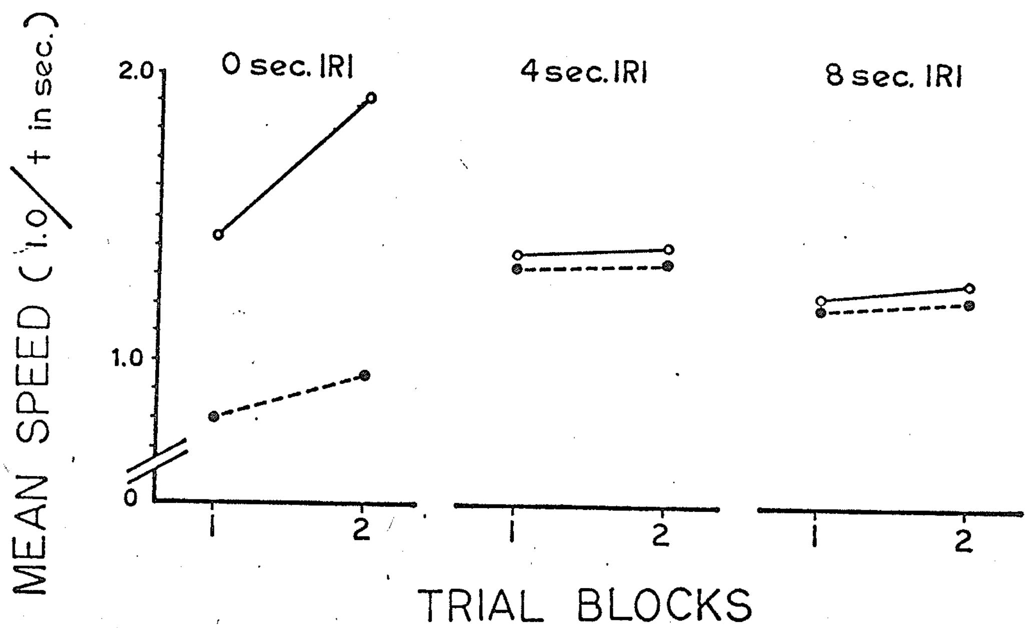

Fig. 3. Mean start speeds for each IRI level on NB (solid line) and B (broken line) trials at trial blocks 1 and 2.

analyses were type of trial and trial blocks. The analyses (see Tables 8 and 9, Appendix C) indicated that a significant type of trial main effect was present in both sets of data ($F = 75.281$, $df = 1/35$, $p < .001$, and $F = 9.821$, $df = 1/35$, $p < .001$ for the 0-sec. and 4-sec. data, respectively). An interaction between type of trial and trial blocks was also obtained in the 0-sec. data ($F = 24.463$, $df = 1/35$, $p < .001$). Tukey HSD comparisons amongst the 0-sec. means indicated that a reliable BE was obtained at both trial block 1 and trial block 2 ($p < .05$) and that speeds increased significantly from trial block 1 to trial block 2 on both NB and B trials ($p < .05$). The interaction indicates that the BE was greater on trial block 2 as compared with the BE on trial block 1 in the 0-sec. IRI condition. In addition, the triple interaction obtained in the 0-sec. vs. 4-sec. analysis was examined by conducting two separate analyses of variance on trial block 1 and trial block 2 data with IRI as the between-Ss variable and type of trial at the within-Ss variable. Both analyses of variance (see Tables 11 and 13, Appendix C) revealed significant main effects for type of trial ($F = 39.350$, $df = 1/70$, $p < .001$, and $F = 37.198$, $df = 1/70$, $p < .001$ for trial block 1 and trial block 2 data, respectively) and significant double interactions between IRI and type of trial ($F = 28.044$, $df = 1/70$, $p < .001$, and $F = 29.747$, $df = 1/70$, $p < .001$ for trial block 1 and trial block 2 data, respectively). The interactions indicate that the BE at 0-sec. IRI was greater than the BE at 4-sec. IRI in both trial blocks.

The analysis of variance involving the 0-sec. and 8-sec. IRI data is summarized in Table 6, Appendix C. Significant main effects were obtained for type of trial (F = 40.501, df = 1/70, p < .001) and trial blocks (F = 27.719, df = 1/70, p < .001). Double interactions involving IRI and type of trial (F = 32.969, df = 1/70, p < .001) IRI and trial blocks (F = 14.903, df = 1/70, p < .001) and type of trial and trial blocks (F = 11.995, df = 1/70, p < .002) were also obtained. Finally, the triple interaction involving IRI, type of trial and trial blocks (F = 8.666, df 1/70, p < .01) was found to be reliable. An analysis of variance (see Table 10, Appendix C) of the 8-sec. data revealed only a significant main effect for type of trial (F = 7.291, df = 1/70, p < .05). Separate analyses of variance were also carried out on trial block 1 and trial block 2 data. Both analyses of variance (see Tables 12 and 14, Appendix C) revealed significant main effects for type of trial (F = 38.257, df = 1/70, p < .001 and F = 37.611, df = 1/70, p < .001 for trial block 1 and trial block 2 data, respectively) and significant double interactions between IRI and type of trial (F = 31.890, df = 1/70, p < .001 and F = 30.102, df = 1/70, p < .001 for trial block 1 and trial block 2 data, respectively). The interactions indicate that the BE at 0-sec. IRI was greater than the BE at 8-sec. IRI in both trial blocks.

The third analysis of variance (see Table 7, Appendix C) involving the 4-sec. and 8-sec. IRI data revealed a main effect for type of trial (F = 8.544, df = 1/70, p < .01), but no interactions were significant.

In summary, the BE was found at each level of IRI but the effect at 0-sec. was greater than the effect at 4-sec. or 8-sec. No difference between the BEs in the latter two IRI conditions was found. Within the 0-sec. condition the BE on trial block 2 was greater than the BE on trial block 1.

The second set of follow-up analyses examined whether IRI affected response speeds following nonblocking, response speeds following blocking, or response speeds on both types of trial. The means of the triple interaction amongst IRI, type of trial and trial blocks, arranged appropriately for these analyses, appear in Figure 4. Two analyses of variance were conducted, one on NB data and the other on B data. The between-Ss variable in these analyses was IRI and the within-Ss variable was trial blocks.

The analysis of variance using data from NB trials (see Table 15, Appendix C) revealed significant main effects for IRI ($F = 7.228$, $df = 2/105$, $p < .01$) and trial blocks ($F = 24.698$, $df = 1/105$, $p < .001$), and a significant double interaction between IRI and trial blocks ($F = 14.675$, $df = 2/105$, $p < .001$). Pairwise comparisons of the means involved in the double interaction, using Tukey's HSD procedure ($p < .05$), revealed that for both trial block 1 and trial block 2, start speeds on NB trials were significantly faster following the 0-sec. IRI as compared with start speeds following the 4-sec. or 8-sec. IRIs, whereas speeds did not differ between 4-sec. and 8-sec. IRI conditions.

The analysis of variance of data from B trials (see Table 16, Appendix C) revealed significant main effects for IRI ($F = 30.427$, $df = 2/105$, $p < .001$) and trial blocks ($F = 7.400$, $df = 1/105$, $p < .01$).

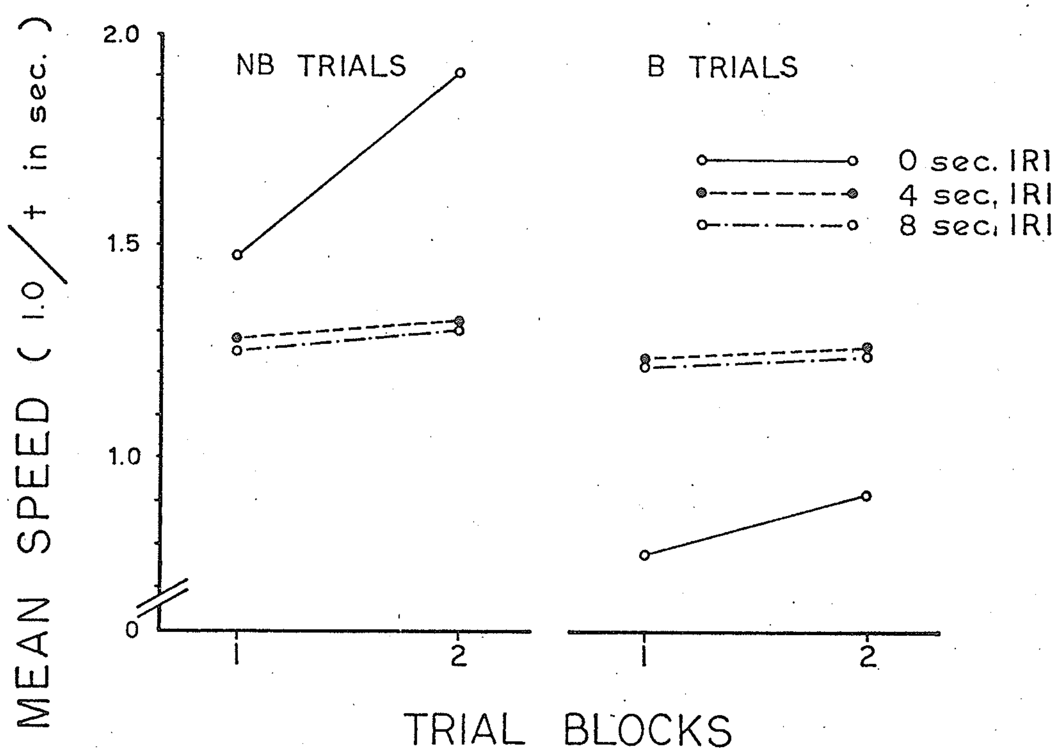

Fig. 4. Mean start speeds for each IRI level on NB and B trials at trial blocks 1 and 2.

Pairwise comparisons of the means, using Tukey's HSD procedure ($p <$ .05), indicated that start speeds on B trials in the 0-sec. IRI condition were significantly slower than start speeds in the 4-sec. or 8-sec. IRI conditions. Speeds did not differ between the latter conditions.

Blocked movement speeds. The blocked movement speed means for each of the treatment conditions are presented in Table 2, Appendix B, and the analysis of variance for blocked movement speeds is summarized in Table 17, Appendix C). The analysis of variance revealed a significant main effect for trial blocks ($F = 27.924$, $df = 1/102$, $p < .001$) and a triple interaction amongst instructional set, type of trial and trial blocks ($F = 5.354$, $df = 1/102$, $p < .025$). The means involved in the triple interaction appear in Figure 5. Pairwise comparisons of the means, using Tukey's HSD procedure ($p < .05$), revealed that for both NB trials and B trials, in both instructional conditions, movement speeds increased significantly from trial block 1 to trial block 2. In addition, there was a significant BE at trial block 1 in the SB instructional condition, but no other reliable differences between NB and B trials were obtained.

Perseveration responses. The median number of perseveration responses made by Ss on B trials in each experimental condition and in each trial block appear in Table 3. A median test (Siegel, 1956) indicated that the number of perseveration responses made by Ss in the SB condition was significantly greater than the number of perseveration responses made by Ss in the OB condition ($X^2 = 7.27$, $p < .01$). A

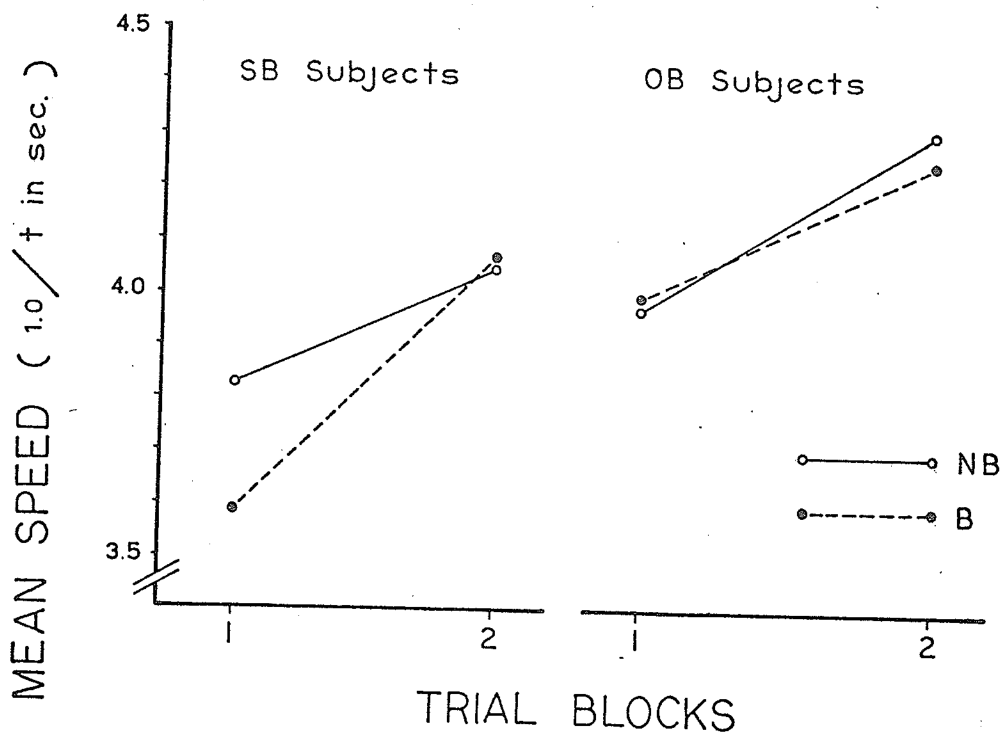

Fig. 5. Mean movement speeds of self-blame and other-blame Ss on NB and B trials at trial blocks 1 and 2.

second median test revealed no significant differences in the numbers of perseveration responses amongst the three levels of IRI. A sign test (Siegel, 1956) revealed that the number of perseveration responses on trial block 1 was greater than the number of perseveration responses on trial block 2 ($Z = 3.48$, $p < .001$).

DISCUSSION

The BE obtained in the start speed data substantiates the typical findings of previous blocking studies (Ford, 1963; Endsley, 1966; Pederson and McEwan, 1970; Pederson, 1970).

Effects of IRI on the BE. The results of the start speed data support Pederson's (1970) finding that the BE is a function of IRI. The BE was found at each level of IRI but the effect at the 0-sec. IRI was greater than the effects at 4-sec. and 8-sec. No difference was found between the latter two conditions. Changes in response speeds over IRI on both NB and B trials contributed to the decrease in the magnitude of the BE as IRI was increased from 0-sec. to 4-sec. Start speeds on NB trials at 0-sec. IRI were faster than start speeds at 4-sec. IRI whereas start speeds on B trials at 0-sec. IRI were slower than speeds at 4-sec.

The changes in start speeds on NB trials as a function of IRI are contrary to the results of Pederson (1970) who did not find changes in start speeds on NB trials over IRI. This discrepancy may be a result of varying IRI between-Ss in the present study as opposed to Pederson's procedure of varying IRI within-Ss. A S in a between-Ss procedure in a 4-sec. or 8-sec. IRI condition would not expect the cue for the second response immediately after the first response and might make responses during the IRI which interfere with the second response. For example, the S might look about the room or examine the apparatus rather than prepare himself for the second response. Thus, increasing IRI would have the effect of decreasing response speeds. On the other hand, a S in a within-Ss procedure might inhibit such interfering responses and be more attentive to the second task since he would not know when to expect the cue for the second response. Thus, the S receiving a variable IRI should have consistent response speeds over IRI, as was found by Pederson (1970).

The finding that start speeds on B trials increased as IRI increased from 0-sec. to 4-sec. is in agreement with Pederson's results and supports the hypothesis that failure produces interfering responses which dissipate over time (Ryan and Watson, 1968; Pederson, 1970). In the present experiment perseveration responses occurred on 28% of B trials; this evidence provides support for Pederson's suggestion that on B trials Ss were unprepared to response on task 2 immediately following blocking on task 1.

Effects of Instructional Set on the BE. The hypothesis that self-blame produces a greater BE than other-blame was supported by the finding that the BE was greater in the former condition than in the latter condition and also by the fact that a BE was obtained in the trial block 1 data of the movement speeds for SB Ss but not for OB Ss. In the present experiment instructional set affected start speeds on both NB and B trials. On B trials the SB Ss responded more slowly than the OB Ss suggesting that self-blame increases the amount of interference produced by failure relative to other-blame. The fact that SB Ss emitted more perseveration responses than OB Ss also supports the hypothesis that interfering responses are more prevalent for SB Ss as compared with OB Ss.

The results indicated that on NB trials SB Ss start speeds were faster than OB Ss' start speeds. This finding could be the result of SB instructions producing a higher general drive level as compared with OB instructions. This hypothesis is supported by evidence from a study of partial reinforcement. Ryan and Strawbridge (1969) examined start and movement speeds on a simple lever device under conditions of 50% and 100% reinforcement, using SB and OB instructions. They found that the start and movement speeds of SB Ss were faster than the speeds of OB Ss under both 50% and 100% reinforcement. Pederson and McEwan (1970) also obtained faster start speeds on NB trials with SB instructions than with OB instructions. In the present study the finding that SB Ss emitted more perseveration responses than did OB Ss might also be accounted for by a difference in general drive level between the two instructional conditions.

Effects of Trial Blocks on the BE. The start speed data indicate that the BE is not a transitory effect. In the 0-sec. IRI condition, the BE in trial block 2 was greater than the BE in trial block 1, and in the 4-sec. and 8-sec. conditions there was no difference in the magnitude of the BE over trial blocks. On the other hand, there was evidence supporting Ryan and Watson's (1968) hypothesis that failure-produced interference decreases over trials. The finding that perseveration responses were more frequent in trial block 1 than trial block 2, and the finding of the BE in the SB Ss' movement speeds in trial block 1 but not in trial block 2 suggest a decrease in interference over trial blocks. In the 0-sec. condition start speeds increased from trial block 1 to trial block 2 on B trials; however, on NB trials the increase in speeds was greater than the increase on B trials. Based on the assumption that practice effects on NB trials were equal to practice effects on B trials, one would expect an equal increase in speeds on B trials as compared with the increase on NB trials if failure-produced interference remained unchanged over trials. Thus the fact that speeds on B trials increased less over trial blocks than speeds on NB trials suggest that failure-produced interference does not decrease over trial blocks, in the 0-sec. condition.

Implications for Further Research. The present study manipulated two variables, IRI and instructional set, which have been confounded between nonreward and blocking studies, in the hope of accounting for the different effects of the nonreward and blocking procedures. There was no indication that a FE can be obtained within the blocking paradigm by manipulating self-blame vs. other-blame instructional set. The findings of the present study and previous blocking studies also indicate that the blocking procedure is unlikely to yield a FE within a reasonable number of trials or within the range of IRI which is conducive to producing a FE in nonreward procedures.

The self-blame variable and IRI have important effects on the magnitude of the BE but an account of the different effects of blocking and nonreward procedures will require investigations of other variables which have been confounded with the two procedures. There are four other variables which have differed in nonreward and blocking studies that merit further research: the age of the Ss; the use of a visual cue for the second response vs. the use of an auditory cue; the complexity and duration of the first task; and the effects of blocking a response vs. withholding a reward for a response.

Since the blocking procedures are more complex than the nonreward procedures, researchers using blocking procedures have used older Ss. Age may influence the Ss' reaction to nonreward and blocking. For example, because a younger S has had a briefer history of reinforcement for completing tasks, he may have acquired fewer interfering responses to nonreward and blocking than would an older S.

The use of a visual cue for the second response in nonreward studies requires the S to attend to the apparatus visually during the IRI, whereas the use of an auditory cue in blocking studies might allow the S to acquire interfering responses more readily since he would not have to attend to the apparatus. If interference produced by failure is largely eliminated when the S is required to look at the apparatus for the second response, the motivational increment produced by blocking could be manifested.

In blocking studies the first task has been more complex and of greater duration than the lever response used in nonreward studies. The more complex task may facilitate the acquisition of interfering responses to failure. Following failure a S might be distracted by analyzing his unsuccessful strategy or planning a new strategy for his next attempt on the first task. A simple lever response leaves little to the imagination of a strategist.

Despite their common properties, nonreward and blocking are different events and may have qualitatively different behavioural effects. For example, not being allowed to finish a task may have a depressant effect on drive level relative to the effect of "winning" the game, whereas nonreward may increase drive. On the other hand, nonreward can be viewed as the blocking of a response chain just prior to the overt or covert consummatory responses and hence be qualitatively the same as blocking in its behavioural effects but different from blocking in the magnitude of the motivational change produced. Thus the differences between nonreward and blocking may be either qualitative or quantitative in nature. The importance of this variable might be determined by a direct comparison of nonreward and blocking using comparable experimental procedures.

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APPENDIX A

INSTRUCTIONS

The following instructions were read to Ss in the other-blame condition:

"We're going to play two games. One is a light-switching game, (E points to the light-switch panel) and the other is a picture-looking game (E points to the lever box and the screen).

This is how you play the light-switch game. When you hear this bell (E sounds the start bell)...start switching these light-switches with your right hand, like this (E switches the first two lights on). Always use your right hand and start at this end of the board (E points to the left end of the panel). To win the game you have to turn on all the lights before the lights go off again. Sometimes I will let you turn on all the lights and you will win the game. Other times I will turn off the lights before you can turn them all on and you will lose the game. If you win the game many times you will win a prize at the end of the games. Remember, I will be the one who lets you win or lose the game.

When you are playing the light-switch game, hold on to this handle (E points to the handle in front of the lever box) with your left hand. Soon after the lights go off on the light-switch game, a buzzer will go on. As soon as you hear the buzzer take your left hand off the handle and pull this lever all the way down and then let go, like this (E domonstrates the lever box). When you do this a picture will go on here (E points the the screen).

After a while the picture will go off. When you hear the bell you start playing the light-switch game again."

The following instructions were read to Ss in the self-blame condition:

"We're going to play two games. One is a light-switching game (E points to the light-switch panel) and the other is a picture-looking game (E points to the lever box and screen).

This is how you play the light-switch game. When you hear this bell (E sounds the start bell) start switching these switches with your right hand, like this (E switches the first two lights on). Always use your right hand and start at this end of the board (E points to left end of the panel). To win the game you have to turn on all the lights before they go off again. If you play the game right you can turn on all the lights and win the game. If you do not play the game right, the lights will go off before you can turn them all on and you will lose the game. If you win the game many times you will win a prize at the end of the games. Remember, it is how you play the game that lets you win or lose.

When you are playing the light-switch game, hold on to this handle (E points to the handle in front of the lever box) with your left hand. Soon after the lights go off on the light-switch game, a buzzer will go on. As soon as you hear the buzzer take your left hand off the handle and pull this lever all the way down and then let it go (E demonstrates the lever box) like this. When you do this a picture will go on here (E points to the screen).

After a while the picture will go off. When you hear the bell, you start playing the light-switch game again.

After reading the instructions, E asked S the following questions:

1. What will you do when you hear the bell?

2. How do you win the game?

3. How do you lose the game?

4. What do you do when the buzzer comes on?

APPENDIX B

MEAN START SPEEDS, MEAN MOVEMENT SPEEDS, AND MEDIAN NUMBER OF TRIALS ON WHICH Ss MADE PERSEVERATION RESPONSES

TABLE 1

Mean Start Speeds

Between-Ss Variables		Within-Ss Variables			
Instructions	IRI	Type of Trial	Trial Block	N	Mean Speed (1/t)
SB	0-sec.	NB	1	18	1.689
			2		2.098
		B	1		.682
			2		.872
	4-sec.	NB	1	18	1.372
			2		1.327
		B	1		1.237
			2		1.255
	8-sec.	NB	1	18	1.188
			2		1.235
		B	1		1.117
			2		1.189
OB	0-sec.	NB	1	18	1.274
			2		1.708
		B	1		.861
			2		.932
	4-sec.	NB	1	18	1.182
			2		1.276
		B	1		1.197
			2		1.237
	8-sec.	NB	1	18	1.300
			2		1.356
		B	1		1.307
			2		1.291

TABLE 2

Mean Movement Speeds

Between-Ss Variables		Within-Ss Variables			
Instructions	IRI	Type of Trial	Trial Block	N	Mean Speed (1/t)
SB	0-sec.	NB	1	18	3.718
			2		3.891
		B	1		3.395
			2		3.723
	4-sec.	NB	1	18	3.986
			2		4.271
		B	1		3.802
			2		4.474
	8-sec.	NB	1	18	3.775
			2		3.993
		B	1		3.587
			2		4.006
OB	0-sec.	NB	1	18	3.532
			2		3.851
		B	1		3.489
			2		3.677
	4-sec.	NB	1	18	4.409
			2		4.712
		B	1		4.429
			2		4.693
	8-sec.	NB	1	18	4.025
			2		4.368
		B	1		4.082
			2		4.413

TABLE 3

Median Number of B Trials on which Ss Made

Perseveration Responses

IRI	0-sec.		4-sec.		8-sec.	
Trial Blocks	1	2	1	2	1	2
SB	1.7	1.5	2.0	.9	1.5	1.5
OB	.7	.5	1.0	.8	.6	.4

APPENDIX C

ANALYSIS OF VARIANCE SUMMARY TABLES

TABLE 4

Analysis of Variance: Start Speeds

Source	df	MS	F	p
Instructions (A)	1	.088	.201	
IRI (B)	2	.011	.025	
A x B	2	.726	1.659	
Error 1	102	.438		
Type of Trial (C)	1	10.997	47.735	.001
A x C	1	1.240	5.383	.025
B x C	2	7.769	33.721	.001
A x B x C	2	.646	2.804	
Error 2	102	.230		
Trial Blocks (D)	1	1.410	24.900	.001
A x D	1	0.0	0.0	
B x D	2	.707	12.491	.001
A x B x D	2	.046	.806	
Error 3	102	.057		
C x D	1	.290	8.790	.005
A x C x D	1	.096	2.915	
B x C x D	2	.239	7.258	.01
A x B x C x D	2	.001	.031	
Error 4	102	.033		
Total	431			

TABLE 5

Analysis of Variance: Start Speeds

(0-sec. and 4-sec. IRI Data Only)

Source	df	MS	F	p
IRI (A)	1	.002	.004	
Error 1	70	.552		
Type of Trial (B)	1	15.016	41.450	.001
A x B	1	11.449	31.603	.001
Error 2	70	.362		
Trial Blocks (C)	1	1.651	26.051	.001
A x C	1	1.117	17.622	.001
Error 3	70	.063		
B x C	1	.371	8.540	.01
A x B x C	1	.392	9.022	.01
Error 4	70	.043		
Total	287			

TABLE 6

Analysis of Variance: Start Speed

(0-sec. and 8-sec. IRI Data Only)

Source	df	MS	F	p
IRI (A)	1	.020	.041	
Error 1	70	.494		
Type of Trial (B)	1	14.561	40.501	.001
A x B	1	11.583	32.969	.001
Error 2	70	.359		
Trial Blocks (C)	1	1.797	26.719	.001
A x C	1	1.003	14.903	.001
Error 3	70	.067		
B x C	1	.446	11.995	.001
A x B x C	1	.322	8.666	.01
Error 4	70	.037		
Total	287			

TABLE 7

Analysis of Variance: Start Speed

(4-sec. and 8-sec. IRI Data Only)

Source	df	MS	F	p
IRI (A)	1	.011	.042	
Error 1	70	.272		
Type of Trial (B)	1	.187	8.544	.01
A x B	1	.036	.164	
Error 2	70	.022		
Trial Blocks (C)	1	.081	2.192	
A x C	1	.003	.083	
Error 3	70	.037		
B x C	1	.001	.077	
A x B x C	1	.003	.162	
Error 4	70	.018		
Total	287			

TABLE 8

Analysis of Variance: Start Speed (0-sec. IRI Data Only)

Source	*df*	*MS*	*F*	*p*
Type of Trial (A)	1	26.344	75.281	.001
Error 1	35	.350		
Trial Blocks (B)	1	27.419	58.564	.001
Error 2	35	.047		
A x B	1	.764	24.463	.001
Error 3	35	.062		
Total	108			

TABLE 9

Analysis of Variance: Start Speed (4-sec. IRI Data Only)

Source	df	MS	F	p
Type of Trial (A)	1	.242	9.821	.01
Error 1	35	.025		
Trial Blocks (B)	1	.053	1.593	
Error 2	35	.033		
A x B	1	.000	.010	
Error 3	35	.024		
Total	108			

TABLE 10

Analysis of Variance: Start Speeds

(8-sec. IRI Data Only)

Source	df	MS	F	p
Type of Trial (A)	1	.140	7.291	.05
Error 1	35	.019		
Trial Blocks (B)	1	.116	2.825	
Error 2	35	.041		
A x B	1	.010	.823	
Error 3	35	.012		
Total	108			

TABLE 11

Analysis of Variance: Start Speeds

(Trial Block 1, 0-sec. and 4-sec. IRI Data Only)

Source	df	MS	F	p
IRI (A)	1	.521	2.339	
Error 1	70	.222		
Type of Trial (B)	1	5.332	39.350	.001
A x B	1	3.800	28.044	.001
Error 2	70	.135		
Total	143			

TABLE 12

Analysis of Variance: Start Speeds

(Trial Block 1, 0-sec. and 8-sec. IRI Data Only)

Source	df	MS	F	p
IRI (A)	1	.370	1.886	
Error 1	70	.196		
Type of Trial (B)	1	4.955	38.257	.001
A x B	1	4.131	31.890	.001
Error 2	70	.130		
Total	143			

TABLE 13

Analysis of Variance: Start Speeds

(Trial Block 2, 0-sec. and 4-sec. IRI Data Only)

Source	df	MS	F	p
IRI (A)	1	.598	1.523	
Error 1	70	.392		
Type of Trial (B)	1	10.056	37.198	.001
A x B	1	8.041	29.747	.001
Error 2	70	.270		
Total	143			

TABLE 14

Analysis of Variance: Start Speeds

(Trial Block 2, 0-sec. and 8-sec. IRI Data Only)

Source	*df*	*MS*	*F*	*p*
IRI (A)	1	.653	1.783	
Error 1	70	.366		
Type of Trial (B)	1	10.052	37.611	.001
A x B	1	8.045	30.102	.001
Error 2	70	.267		
Total	143			

TABLE 15

Analysis of Variance: Start Speeds (Nonblocking Trial Data Only)

Source	*df*	*MS*	*F*	*p*
IRI (A)	2	4.095	7.228	.01
Error 1	105	.566		
Trial Blocks (B)	1	1.490	24.698	.001
A x B	2	.885	14.675	.001
Error 2	105	.060		
Total	215			

TABLE 16

Analysis of Variance: Start Speeds (Blocking Trial Data Only)

Source	df	MS	F	p
IRI (A)	2	3.685	30.427	.001
Error 1	105	.121		
Trial Blocks (B)	1	.211	7.400	.01
A x B	2	.062	2.162	
Error 2	105	.029		
Total	215			

TABLE 17

Analysis of Variance: Movement Speeds

Source	df	MS	F	p
Instructions (A)	1	7.050	1.458	
IRI (B)	2	17.070	3.530	
A x B	2	2.415	.499	
Error 1	102	4.836		
Type of Trial (C)	1	.474	3.107	
A x C	1	.170	1.116	
B x C	2	.332	2.172	
A x B x C	22	.085	.558	
Error 2	102	.153		
Trial Blocks (D)	1	11.178	27.924	.001
A x D	1	.041	.104	
B x D	2	.127	.318	
A x B x D	2	.150	.375	
Error 3	102	.399		
C x D	1	.189	1.463	
A x C x D	1	.691	5.354	.025
B x C x D	2	.081	.625	
A x B x C x D	2	.005	.036	
Error 4	102	.129		
Total	431			