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The postreinforcement pause and the blackout procedure: Are blackouts neutral stimuli?

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Three pigeons were trained to respond on a fixed-interval 300-sec schedule. Blackouts were introduced following each unreinforced response during either the first 180 sec or the last 120 sec of the interval. Blackouts reduced responding, with the greatest reduction occurring when they occurred during the last 120 sec of the interval. Only blackouts during the last 120 sec of the interval resulted in consistent decreases in pause length. These results are not consistent with the view that blackouts are neutral stimuli that simply function to reduce the number of interreinforcement responses.

In fixed-ratio (FR) and fixed-interval (FI) schedules, changes in the respective ratio or interval requirements result in changes in the length of the postreinforcement pause. Larger ratio (Felton & Lyon, 1966; Powell, 1968) or longer interval (Schneider, 1969; Shull, 1971) requirements produce longer postreinforcement pauses than do smaller ratios or shorter intervals. Changing the ratio requirement of an FR schedule or the interval requirement of an FI schedule changes both the number of interreinforcement responses and the length of the interreinforcement interval (IRI). Thus, the number of interreinforcement responses and the duration of the interreinforcement interval are confounded as variables controlling the length of the postreinforcement pause.

A number of attempts have been made to separate the length of the interreinforcement interval or other temporal factors from the number of interreinforcement responses as variables controlling pause length. Some investigators have concluded that pause length is solely related to temporal variables (Killeen, 1969; Neuringer & Schneider, 1968; Rider, 1980; Shull, 1970), but others have concluded that both response and temporal variables may be important (Alferink, Nunes, & Crossman, 1980; Capehart, Eckerman, Guilkey, & Shull, 1980; Crossman, Heaps, Nunes, & Alferink, 1974; Nunes, Alferink, & Crossman, 1979; Rider & Kametani, 1984; Shull, 1971).

The strongest evidence separating response and temporal variables as factors controlling pause length comes from studies done with a blackout procedure (Alferink et al., 1980; Barowsky & Mintz, 1978; Crossman et al., 1974; Neuringer & Schneider, 1968; Nunes et al., 1979). For example, Neuringer and Schneider (1968) interposed blackouts following each unreinforced response on FR or FI schedules. During blackouts, the chamber is dark and the response key is inoperative. Increasing the duration of the blackout on the FR schedule increased the duration of the interreinforcement interval without changing the number of interreinforcement responses. On the FI schedule, increasing blackout duration limited the number of interreinforcement responses without changing the duration of the interreinforcement interval. Since the length of the postreinforcement pause did not change on the FI schedule but increased on the FR schedule with increases in blackout duration, Neuringer and Schneider suggested that the postreinforcement pause was related to the length of the interreinforcement interval, but that it was independent of the number of interreinforcement responses.

In studies done with the blackout technique, it has been assumed that blackouts are neutral events that serve simply to control interreinforcement time while limiting interreinforcement responding. Yet the results may have been produced by the blackout technique rather than by the way in which blackouts affect either responses or time. Thus far, no one has attempted to determine whether blackouts affect pause length directly or whether the effects reported above were the indirect result of blackout duration's either restricting the number of interreinforcement responses or changing the duration of the interreinforcement interval.

Some studies suggest that blackouts may not be neutral events. For example, responding can be maintained when

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responses on an escape lever interrupt the schedule associated with a second lever and replace the stimuli associated with that schedule with a blackout (Thompson, 1964). Since schedule-induced escape responses occur during the postreinforcement pause (Falk, 1971), if these responses occur on the same key as have the food-reinforced responses, the effect would be to shorten pause length. It may be possible to circumvent this undesirable feature of the blackout technique by not programming blackouts during the postreinforcement period. Since FI schedules produce high rates of responding late in the interval, it would still be possible to produce large decreases in the number of responses by interposing blackouts during the later portion of the interval. In this way, it may be possible to determine whether blackouts are neutral stimuli that simply operate to reduce the number of interreinforcement responses.

METHOD

Subjects

Three experimentally naive adult homing pigeons obtained from a local supplier were maintained at 80% of their free-feeding weights. The sex of the birds was undetermined. Purina Pigeon Checkers were used as the reinforcer, as well as for all home cage feedings. Water was continuously available in the home cage for each subject.

Apparatus

The experiment was conducted in three 80-quart Coleman picnic coolers (Model 5256), which were converted into experimental chambers. The interior dimensions were 42×31×33 cm. The response keys, located on the intelligence panel, had a diameter of 2 cm and were arranged horizontally on a line 19.5 cm above the floor of the chamber. The distance between adjacent key centers was 9 cm, and an in-line projector was mounted behind each response key. The center key was transilluminated by a white light. The remaining two keys were not used and remained dark. A minimum force of about .15 N was required for operation of the key. White noise in the experimental room and exhaust fans attached to the chambers masked extraneous sounds. The reinforcer consisted of a 3-sec access to Purina Pigeon Checkers through a 6×5 cm hopper opening in the center panel. This hopper opening was located 7 cm above the chamber floor and was directly under the center key. When the food hopper was raised, the hopper light was illuminated and the key light was off. A houselight was located on the upper right corner of the intelligence panel, 1.5 cm from the top and 2 cm from the side of the chamber. The houselight was illuminated at all times during the experimental sessions, except during blackout periods. During blackouts, both the keylight and the houselight were turned off. The experiment was controlled and the data were recorded by a PDP-8E computer (DEC) located in a separate room.

Procedure

Each subject was magazine trained, and the keypeck response was shaped with the method of successive approximations. Keypecking was then reinforced for one session (approximately 50 reinforcers) on each of the following schedules: variable interval (VI) 15 sec, VI 30 sec, VI 60 sec, FI 60 sec, and FI 180 sec. An FI 300-sec schedule was then introduced; it remained in effect for 55 sessions.

After this training, a 10-sec response-produced blackout was added following each unreinforced response during specified portions of the FI 300-sec schedule. During each blackout, the keylights and the houselights were off and keypecks had no programmed consequences. Initially, these blackouts followed unreinforced responses only during the first 180-sec of the interval. If a blackout was initiated before the end of this 180-sec portion of the interval, it continued for its 10-sec duration even if the 180 sec had elapsed. A blackout then occurred, following unreinforced responses only during the last 120 sec of the FI 300-sec schedule. Subsequently, blackouts occurred only during the first 180 sec of the FI, and then blackouts did not occur (i.e., a simple FI 300-sec schedule).

Sessions terminated after 50 reinforcers had been delivered. Each condition remained in effect for 30 sessions, except for the initial FI 300-sec schedule, which continued for 55 sessions.

RESULTS

Figure 1 shows the mean number of responses per interval for each subject in each condition; the plotted data are from the last five sessions in each condition. The maximum number of responses occurred during the simple FI 300-sec schedule, on which no restrictions on responding occurred. When a blackout was introduced during the first 180 sec of the FI (BO 180 condition), the mean number of responses per interval decreased below that which occurred on the simple FI. When the blackout occurred during the last 120 sec of the interval (BO 120 condition), further decreases in the mean number of responses per

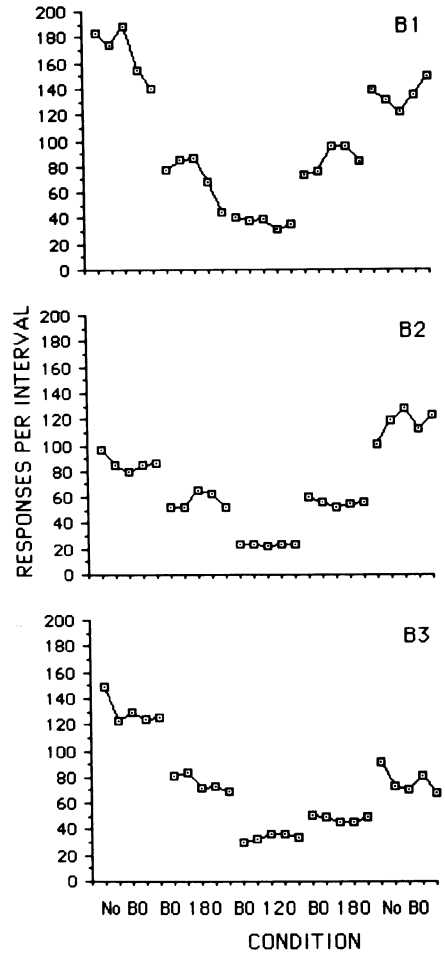

Figure 1. The mean number of responses per interval for the last five sessions for each subject in each condition. During No BO, no blackouts occurred; during BO 180, blackouts occurred during the first 180 sec of the interval; and during BO 120, blackouts occurred during the last 120 sec of the interval. (See text for details.)

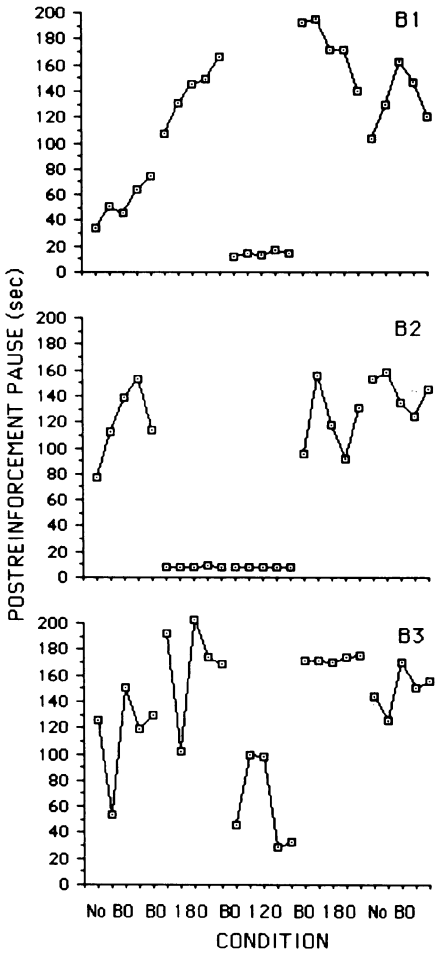

Figure 2. The median postreinforcement pause measured in seconds for the last five sessions for each subject in each condition. During No BO, no blackouts occurred; during BO 180, blackouts occurred during the first 180 sec of the interval; and during BO 120, blackouts occurred during the last 120 sec of the interval. (See text for details.)

interval occurred for all 3 subjects. Responding increased when the BO 180 condition was reinstated, and it increased further when the simple FI 300-sec schedule without any blackouts was reintroduced.

Figure 2 shows the length of the median postreinforcement pause for each subject in each condition. Data from the last five sessions in each condition are plotted. For subjects B1 and B3, pause length increased when a 10-sec blackout followed each response during the first 180 sec of the FI 300-sec schedule. When the blackout occurred during the last 120 sec of the interval, pause length decreased to its lowest level for both subjects. When blackouts again followed responses during the first 180 sec, pause length increased to approximately the level that existed previously in this condition. When the simple FI 300-sec schedule without any blackouts was introduced, pause length decreased slightly.

For Subject B2, pause length decreased when the 10-sec blackouts were introduced during the first 180 sec of the interval and remained short when the blackout occurred only during the last 120 sec of the interval. When blackouts again occurred during the first 180 sec of the interval, pause length increased and remained at this level when the condition was changed to the no-blackout condition.

DISCUSSION

Blackouts have been used as a means of separating the effects of the number of interreinforcement responses from the length of the interreinforcement interval. Athough blackouts do reduce the number of responses, it is possible that the effects of blackouts on pause length in these studies are due to some feature other than response reduction.

In the present study, blackouts were introduced following responding during different portions of an FI schedule. Blackouts decreased responding for all subjects, with the greatest reduction occurring when the blackouts were produced during the final 120 sec of the FI. In addition to effects on the number of responses per interval, the blackout procedure also affected the length of the postreinforcement pause. The shortest pauses occurred when blackouts followed responses only during the final 120 sec of the FI. For 2 of 3 subjects, presenting a blackout only during the first 180 sec of the interval increased pause length relative to the no-blackout condition. The primary effect of the blackout was determined by its occurrence and its placement in the interval. Blackouts early in the interval increased pause length, whereas blackouts late in the interval decreased pause length.

The present study does not support the use of the blackout technique to reduce responding. Blackouts are not neutral events that simply operate to restrict the number of interreinforcement responses. Instead, the effects of the blackout on pause length may depend on its placement in the interval rather than simply on the degree of response reduction. This means that the effects of the blackout procedure depend on a complex interaction of the blackout with pause length. As pauses shorten, more blackouts occur early in the interval; as pauses lengthen, the effects of blackouts later in the interval become more important. Since the primary support for the role of the number of interreinforcement responses in controlling pause length is based on the blackout technique, this support is questioned by the present study. When blackouts are used in other procedures to reduce or eliminate responding (see, e.g., Boelens, Kop, & Slangen, 1989), care should be taken in drawing conclusions about whether the effects are due to the blackout procedure or to the response reduction thereby obtained.

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