*CONTROL OF CONCURRENT AVOIDANCE AND
APPETITIVE BEHAVIORS BY AN INDICATOR
OF SHOCK PROXIMITY¹*

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Two monkeys were exposed to concurrent schedules in which every fifth response on one lever had the dual consequences of delivering food and stepping a 20-step light counter upward; responses on a second lever stepped the light downward. By responding appropriately on each lever, a ration of food could be obtained without exposure to a brief shock that occurred when the counter reached the twentieth step. Behavioral patterns of light-counter control were analyzed when the monkeys were handicapped by several types of discontinuities in the 20-step counter: (1) different sets of four consecutive lights inoperative, (2) the upper or lower 10 steps inoperative, and (3) all lights inoperative. Generally, the monkeys maintained the light in the upper five steps of the 20-step light counter if the lights immediately preceding the shock position were functional. However, when these counter positions were inoperative, subjects maintained the counter around the highest operative position. With all positions of the light counter inoperative, no systematic pattern of responding on the food and avoidance levers occurred.

In some natural settings, the persistence of behavior that exposes the organism to a favorable aspect of the environment increases the likelihood of a noxious event. This general arrangement of environmental events can be viewed as an appetitive behavior being maintained by appropriate positive reinforcement with the onset of an aversive event dependent on the persistence of the appetitive behavior. If the aversive stimulus is scheduled as a punishment condition, the organism can avoid the aversive event only by terminating the positively reinforced behavior (Azrin and Holz, 1966). Alternatively, the environmental conditions can permit the organism to control the onset of the aversive stimulus by providing a means of avoiding this event while continuing to satisfy the requirements of positive reinforcement. Under these conditions, the adapting organism exhibits concurrent operants: one set of responses avoids an approaching aversive event, and another set produces the positive reinforcer. Generally, the efficiency of

any avoidance behavior is facilitated by the organism's capacity to detect any features of the environment that precede the aversive stimulus (Ulrich, Holz, and Azrin, 1964). These environmental events can acquire the function of conditioned aversive stimuli, thus controlling the response that postpones the primary aversive stimulus.

Those instances when the organism exhibits concurrent operants in an environment that exerts both appetitive and aversive control and that also provides information on proximity of the aversive event, illustrate a complex interaction of behavior and environmental influences, each modifying and controlling the other. Some of the components of this combination of controlling variables have been the subject of laboratory studies. For example, Field and Boren (1963) permitted rats to control their proximity to shock, which was indicated by an 11-step clock; Sidman (1958) analyzed factors controlling concurrent appetitive and avoidance behavior of monkeys, and Davison (1970) scheduled a second non-preferred operant that allowed pigeons to avoid the aversive stimulus correlated with positive reinforcement. A study by Dardano and Brady (1968) attempted an analysis of this class of complex behavior with an experimental procedure that incorporated both appetitive and aversive control and a counter correlated with shock proximity. Re-

¹Research supported by Grants NSG 189-61 and NGR 21-001-069 from the National Aeronautics and Space Administration. The author thanks E. Taylor and J. Wilson for assistance in conducting the study. Reprints may be obtained from the author, Division of Behavioral Biology, The Johns Hopkins University School of Medicine, The Traylor Building, 720 Rutland Avenue, Baltimore, Maryland 21205.

sponses on one lever resulted in food and also changed the position of the illuminated light in a 20-step light counter to the next higher position. A brief shock was delivered when the light reached the twentieth step. Responses on a second lever moved the light to the next lower position. Both primates responded in a manner that resulted in an adequate food ration and infrequent shocks. One prominent result was the persistent maintenance of the light in the upper quarter of the counter, proximate to the shock position.

The present study further investigated the properties of concurrent appetitive and discriminative avoidance behavior by introducing discontinuities in the environmental indicator of the proximity of the aversive stimulus. Procedurally, the 20-step shock counter continued to change in accordance with the pattern of responding on the two levers, but particular positions in the correlated 20-light counter were inoperative. Specific points of interest in the analysis included the effects on avoidance performance (1) when small segments of the light counter in various parts of the counter were inoperative, (2) when a larger segment of the light counter was inoperative, and (3) when an indication of shock proximity was not available at all.

METHOD

Subjects

Two adult rhesus monkeys (*Macaca mulatta*), a female (M-1) and a male (M-2), had taken part in an earlier study that used the same basic experimental procedure. In addition, the history of M-1 included exposure to a conditioned suppression procedure involving superimposition of clicker-shock pairings on a food-maintained performance. Both monkeys remained in their respective experimental chambers throughout the study except for a two-week period in an exercise cage midway through the investigation. Their primary diet consisted of commercial monkey pellets delivered during the experimental session. Water was continuously available. A post-session feeding of a portion of a fruit or a vegetable and a weekly vitamin supplement completed their diets.

Apparatus

Two commercial monkey compartments, consisting of an experimental chamber en-

closed within a wooden cubicle, housed the subjects. The experimental chamber was 28 in. high by 14 in. wide by 28 in. deep (70 by 35 by 70 cm). The floor and front of the chamber were stainless steel grids, and the remaining surfaces were stainless steel sheet panels. Two levers, a pilot light above each lever, and a food well were located on the left side of the chamber. Each effective response on a lever produced a brief flash of the pilot light above that lever. A red indicator light, $1\frac{1}{8}$ in. (27 mm) in diameter and located above and to the left of the pilot lights, was illuminated in sessions when the shock procedure was in effect. The levers were mounted 12 in. (30.5 cm) above the floor, were separated by 7 in. (17.8 cm), extended 1.5 in. (3.8 cm) inside the chamber, and required a 0.75 in. (1.9 cm) excursion for closure. General illumination was provided by a 7.5-w lamp above the center of the chamber. An exhaust fan on the roof of the wooden enclosure provided ventilation and masking noise.

The light counter was a vertical column of 20 pilot lights (GE 313) mounted on a black Bakelite strip set at the left-front corner of the chamber. Each light was mounted flush against a 0.3-in. (9-mm) hole in the Bakelite so only this illuminated area was seen by the monkey. The center-to-center separation of the lights was 0.75 in. (1.9 cm), the top light was 2.8 in. (6.4 cm) from the ceiling and the bottom light was 6.5 in. (16.5 cm) above the floor.

The positive reinforcer was one 0.8-g monkey pellet (Dietrich and Gambrill special monkey diet) delivered to the illuminated food well from a rotary pellet dispenser. The aversive stimulus was a 60-Hz electric shock with a duration of 200 msec and an intensity of 3 mA generated by a commercial shocker (Foringer, No. 1154) and delivered through a grid shock scrambler (Foringer, No. 1925). Shock intensity was measured across two grids electrified by scrambled output, and was set at the lowest level that elicited a vigorous reaction (leap and vocalization) from both subjects.

All scheduling and recording was accomplished automatically and remotely by a system of electromechanical relays, timers, and counters. The momentary position of the illuminated light in the 20-step counter was recorded with an Esterline-Angus 20-pen event recorder. Closed circuit television permitted remote observation of the subjects during the

session. With the exception of a red panel light, correlated with the presence of the shock condition in the present study, the apparatus was the same as that used in the earlier study (Dardano and Brady, 1968).

Procedure

Both subjects were exposed immediately to the following conditions, which were part of their behavioral histories. Five depressions of the left lever, referred to as the "food lever", resulted in the delivery of one food pellet: a fixed-ratio 5 (FR 5) positive reinforcement schedule. Whenever the FR 5 was completed on the food lever, the illuminated light in the 20-step light counter moved to the next higher position. Five responses on the left lever, referred to as the "avoidance lever", changed the illuminated light in the light counter to the next lower position. If the position of the light reached the twentieth step, a single shock was delivered and a 10-sec timeout period was initiated. During the timeout, all lights were turned off in the chamber, both levers were inoperative, and the light counter was reset to the first position. The subjects could respond on either or both levers at any time during the session. If the illuminated light in the counter occupied the first position, completion of the FR 5 on the avoidance lever had no effect on the light position. If the subjects switched to the other lever before completing the ratio of five responses, the partial count remained on the lever. The performances under these conditions, referred to as "all lights", provided the baseline for assessing the effects of the various experimental conditions.

Experimental conditions differed from the baseline condition only in the particular lights in the counter that were operative during the session. In the first part of the study, a set of four adjacent lights were inoperative: either 1 through 4, 5 through 8, 9 through 12, 13 through 16, or 17 through 20. For example, with light 1 through 4 inoperative, the counter would move through these four positions in accordance with the pattern of lever pressing, but the subject would not have information on the exact location of proximity of shock until the counter reached position five. A minimum of 10 sessions were scheduled under each set of inoperative lights, and additional sessions were scheduled until the performances appeared stable over 10 consecutive sessions. Stability

was judged from the absence of trends in the event and cumulative records. The set of four inoperative lights in the counter were scheduled in ascending order for both subjects. After the final session under a particular set of inoperative lights, one to four sessions were scheduled without the light-shock condition.

After completing the first part of the study, the subject was removed from the apparatus, maintained in an exercise cage, and placed on free-feeding for a two-week period. Then, subjects were exposed again to the "all-lights" condition until reaching a criterion of 10 sessions of stable performance.

In the second part of the study, the lower 10 lights of the counter were inoperative (no lights 1-10), and then the upper 10 lights of the counter were inoperative (no lights 11-20). All other experimental conditions were identical to those in Part 1. The subjects were exposed to each of these conditions until the performances satisfied the stability criterion. After each of these light conditions, several sessions under "all lights" and sessions without the light-shock condition were scheduled.

In the final part of the study, all lights in the counter were disconnected (no lights). The subjects were not provided with any information on the proximity of shock. The red indicator light correlated with the presence of the shock schedule was illuminated, and the 20-step shock counter continued to change in accordance with the subject's pattern of responding on the food and avoidance levers. This experimental condition was continued until the performances showed no general trends or novel patterns. After the final session under "no lights", the check sessions under "all lights" and sessions without the light-shock conditions were scheduled. The general experimental procedure is summarized in Table 1. The subjects were run daily and session duration was 2 hr. Sessions without light-shock or "all lights", which were scheduled after a modification of the light counter, are not listed.

RESULTS

Four Lights Inoperative

The pattern of avoidance responding changed markedly only when the final four lights of the counter, 17 through 20, were inoperative. A small but consistent effect re-

Table 1

Summary of experimental procedure showing number of sessions under each of the light-counter conditions and the order of presentation of these conditions. Test sessions after each light condition are not listed.

Light Condition	Number of Sessions	
	M-1	M-2
All Lights	35	35
1- 4 Off	12	12
5- 8 Off	12	21
9-12 Off	16	13
13-16 Off	24	37
17-20 Off	29	37
All Lights	13	33
1-10 Off	15	22
11-20 Off	40	23
No Lights	35	24

sulted from removal of lights 13 through 16. Elimination of each of the other sets of four lights produced only an initial transitory effect. Figure 1 shows the frequency distributions of the 20-light counter positions for each subject under the baseline condition in which all lights were operative (top row) and under the two light counter conditions that modified the baseline performance, "no lights 13-16" and "no lights 17-20" (middle and bottom rows). Each frequency distribution shows the proportion of times that the light occupied each of the 20 positions of the light counter. The proportions were calculated from the total frequencies over the final 10 sessions under each condition. The quartile values of the frequency distributions for each of these six light-counter conditions are listed in the upper section of Table 2.

Table 2

Quartile values of the frequency distribution of positions of the light in the 20-step counter under the different light-counter conditions. Values based on the total frequencies over the final 10 sessions under each condition.

Light Condition	M-1			M-2		
	Q-1	Q-2	Q-3	Q-1	Q-2	Q-3
All Lights	14.9	17.0	17.9	17.6	18.2	18.8
1- 4 Off	14.8	17.3	18.2	17.6	18.2	18.9
5- 8 Off	15.5	17.0	18.0	17.5	18.2	18.8
9-12 Off	15.1	17.0	18.0	17.7	18.3	18.9
13-16 Off	15.5	16.3	17.1	17.6	18.3	18.9
17-20 Off	11.1	13.6	14.9	13.6	14.5	15.4
All Lights	16.5	17.2	18.0	17.3	18.1	18.7
1-10 Off	15.8	16.9	17.6	17.6	18.2	18.9
11-20 Off	9.1	10.3	11.8	9.9	10.5	11.1
No Lights	4.4	7.5	11.5	6.6	10.2	14.5

With all light positions in the counter operative, both subjects maintained the light in the upper steps throughout the session by responding equally on the food and avoidance levers. When the light occupied the first position in the counter at the beginning of the session, and also after the delivery of shock, responding was confined almost exclusively to the food lever until the light had advanced to the upper steps of the counter. Characteristics between the monkeys under "all lights" persisted in all phases of the study: M-1 maintained the lights at a lower average position and over a wider area of the counter than M-2, and M-1 obtained less food during the session.

The slight effect of omitting lights 13 through 16 was different for each subject. M-1 maintained the lights at a slightly lower position, on the average, as reflected in the distribution by the shift of the most frequently used positions from 17 and 18 to 16 and 17. Note that this light-counter condition eliminated position 16, which was frequently used by M-1 when all lights were operative. With M-2, removal of lights 13 through 16 resulted in a series of alterations of the light positions between 12 and 13 that briefly interrupted the run of ratios on the food lever at the beginning of the session. This characteristic of the performance was responsible for the small peak at these two positions in the frequency distribution.

The marked and lasting change in the pattern of light control resulting from removal of lights 17 through 20 was similar in both subjects and extremely stable between sessions. The light was usually maintained in a position below the lowest inoperative light in the counter. Often, the light was alternated between the final operative position, 16, and the first inoperative position, 17. The frequency distribution of light changes under this condition for each subject in Fig. 1 exhibits a downward displacement of approximately four steps for each subject, an increase in variability, and a greater degree of symmetry.

Figure 2 shows the successive changes in the light position during a session when all lights were operative and for a session in which lights 17 through 20 were inoperative for both subjects. Each point in the graph represents the upward or downward movement of the light after completion of FR 5 on the food or the avoidance lever respectively. Sessions in which

Fig. 1. The proportion of times each position of the 20-step counter was occupied under "all lights", "no lights 13-16", and "no lights 17-20". Each distribution is based on the total frequencies from the final 10 sessions under that condition. Darkened bars indicate inoperative positions of the counter. The particular light-counter condition, noted inside the graph of M-1, also refers to the graph of M-2 on the right.

Fig. 2. The successive positions occupied in the 20-step counter as a function of completed ratios on the food and avoidance levers. A session with all lights functional and a session with lights 17-20 inoperative are shown for each monkey. Complete sessions are shown for M-1. In the deleted part of the records of M-2 at A and B, the light continued to alternate between the two positions shown before the deletion. In the graphs for "no lights 17-20", changes in the inoperative positions of the counter are shown as open circles.

the subject permitted the light to reach the top position were selected in order to show the performance after delivery of shock. The top graph of each subject showing the pattern of light changes with all lights functional illustrates the narrow range of the counter used by each subject. Note the precise control of the light position by M-2, which alternated the light between positions 18 and 19 throughout the session. A lower ceiling was adopted when the upper four positions failed to provide the monkey with information on shock proximity. The boundary of the last operative light and the initial operative light was often utilized by the subjects, as illustrated by the record of M-2. When the subjects were shocked under "no lights 17-20", movement of the light to the top position was usually preceded by a series of responses on the levers in the inoperative zone of the counter. The slight increase in the variability of light movement in the counter when lights 17-20 were inoperative can be noted by comparing the two graphs of a subject. All graphs show the run of responses on the food lever with the consequent movement of the lights into the upper counter positions, which always occurred at the beginning of the session and after a shock delivery.

A stable characteristic of the performances of both subjects under all light conditions was a difference in the delay associated with the shift from one lever to the other after the light reached the upper steps of the counter. Completion of the response requirement on the food lever was usually followed by a delay of at least several seconds before starting the ratio on the avoidance lever, whereas completion of the ratio on the avoidance lever was followed by a much shorter delay before starting to respond on the food lever. The records from the 20-pen event recorder included in Fig. 3 provide data illustrating this temporal relationship. Excerpts from a record during a session under "all lights" and during a session under "no lights 17-20" are shown for each subject. These were the same sessions used in Fig. 2. The longer delay preceding the start of responding on the avoidance lever after the ratio on the food lever is shown in these records by the longer time that the upper pen remained deflected when the pen deflections alternated between two positions.

The records in Fig. 3 also reveal a difference between the series of responses on the food

lever that occurred at the beginning of each session and after shocks in a session. These runs of responding on the food lever had a higher rate after shock than at the start of the session, hence a shock resulted in a more rapid movement of the light to the steps proximal to the shock position. This effect was most pronounced under the "all-lights" condition.

The overall pattern of responding on the levers was similar under all six of the light counter conditions. Figure 4 shows cumulative response records of food and avoidance lever responding in the final session under the "all-lights" condition for each subject. A cumulative record of food-lever responding during a session without the light-shock procedure, which was scheduled during a preliminary stage of the experiment, is also included. The pattern of M-1 under the light-shock procedure was to complete a few ratios on each lever, alternating with extended pauses throughout the session. The pattern of M-2 was extremely regular responding on the levers with brief pauses following reinforcements, then a cessation of responding. In approximately half of the sessions, M-2 again initiated responding shortly before the end of the session. Unlike M-1, the addition of the light-shock procedure did not greatly modify the food-lever response pattern of M-2. The only difference was less variation in pause duration after successive reinforcements when the light-shock procedure was present.

One-half of the Light Counter Inoperative

When the first 10 lights in the counter were inoperative, the final performances of both subjects were similar to the baseline or "all-lights" performances. In the initial sessions under "no lights 1-10", frequent avoidance responding occurred at the start of the session, but after the counter moved into the functional positions over several sessions, there was a rapid transition to the type of performance seen under "all lights".

The absence of lights in the upper 10 positions of the light counter produced an immediate and pronounced effect on the performances. Both subjects maintained the counter step around the position of the final functional light. M-2 usually alternated the active counter position between the final operative lamp and the first inoperative lamp; M-1 permitted the counter position to range more widely around

Fig. 3. Excerpts from the records of the 20-pen event recorder during a session under "all lights" and a session with lights 17-20 inoperative. The individual records read from right to left. Each of the 20 pen positions corresponds to a position in the 20-step counter. The pen deflected upward when the corresponding light was illuminated and remained deflected until the light was changed to the next higher or lower position. The area under the deflected pen was blackened to aid inspection. Paper speed was 1.9 cm/min.

the highest operative lamp. The upper graphs in Fig. 5 are the frequency distributions under "all lights", and the middle graphs are the distributions under "no lights 11-20". A comparison of these two sets of distributions reveals the extreme adjustment made by each subject to this light-counter condition. Descriptive measures of the distributions for "all lights", "no lights 1-10", and "no lights 11-20"

are presented in the middle section of Table 2. Under "no lights 11-20", the median light position was approximately seven steps lower for each monkey.

Figure 6 shows the sequential changes in the 20-step counter for each subject when lights 11-20 were inoperative. Two sessions are presented for each subject to illustrate the two general response patterns under this condition.

Fig. 4. Cumulative response records of the subject's responding on each lever during a 2-hr session with all lights operative and the cumulative record of food-lever responses during a session when the light-shock condition was absent. The pip on the food record denotes completion of the ratio resulting in delivery of food and movement of the light, if scheduled, to the next higher position, and the pip on the avoidance record denotes completion of the ratio resulting in movement of the light to the next lower position.

Shock usually followed an extended period of responding on both food and avoidance levers in the non-functional half of the counter, with a greater frequency of responses on the food lever producing a general drift toward the twentieth step.

All Lights Inoperative

Without any exteroceptive information on shock proximity, the pattern of avoidance re-

sponding failed to reflect the regularity found under the other light-counter conditions. Both subjects alternated responding on the avoidance and food levers shortly after the start of the session. Responses on the food lever usually became more frequent during the session, resulting in an upward drift of the active position of the 20-step counter through the higher counter positions. The patterns of food and avoidance responses in separate sessions

Fig. 5. The proportion of times that each position in the 20-step counter was operative under "all lights", "no lights 11-20", and "no lights". Each distribution is based on the total frequencies over the final 10 sessions under the particular light-counter condition. Darkened bars indicate inoperative light positions in the counter. The particular light-counter condition, noted within the graph of M-1, also refers to the graph of M-2 on the right.

Fig. 6. The successive positions occupied in the 20-step counter as a function of completed ratios on the food and avoidance levers under "no lights 11-20". Two complete sessions are shown for each subject. Open circles denote positions of the counter in which the lights were inoperative.

were extremely variable. The frequency distributions of the counter positions used by each subject under this condition are the two lower distributions in Fig. 5. Descriptive data for these distributions are shown in the bottom line of Table 2. In contrast to the frequency distributions for the other light-counter conditions, these distributions have no pronounced

peak. No single step in the counter was used more than 10% of the time and most steps were used 3% to 7% of the time.

The sequential changes in positions of the 20-step counter during a session under "no lights" are illustrated in Fig. 7. A typical performance was not available from this condition, and the graphs in Fig. 7 show most of the

Fig. 7. Successive changes in the 20-step counter as a function of completed ratios on the food and avoidance levers during sessions with all lights inoperative. Occurrence of shock is noted in the graph. Two sessions are shown for M-1 and a single session for M-2.

local response patterns of each subject that appeared in the separate sessions. The only instances of any discriminative control over the performances were the higher frequency of responses on the food lever following shock and a brief run of ratios on the food lever at the beginning of the session.

Regarding the performances under all the light-counter conditions used, the average number of shocks and also the average number of pellets in a session under the different light-counter conditions did not reveal any marked differences common to both subjects. The number of shocks never averaged more than one shock per session under any of the light-counter conditions.

DISCUSSION

Under the "all-lights" condition, the behavioral control exerted by the 20-step counter correlated with shock proximity was limited to the later steps of the counter. These results replicate those of Dardano and Brady (1968). There was not a continuous gradient of increasing aversiveness extending from the first step of the counter to the shock position. Rather, the counter appeared dichotimized into a "safe area", comprising the lower three-quarters of the counter, and a "danger area" that included the upper quarter of the counter. The upper steps of the counter exerted strong control over avoidance responding, and the subjects, in turn, displayed a precise and consistent mode of manipulating the lights in these counter positions.

A question might be raised about the monkeys' strategy of maintaining the light in the positions immediately preceding the shock step, since this exposed the subject to unnecessarily advanced light positions throughout the session. The same amount of food could have been obtained and the shock kept maximally distant by initiating avoidance responding at the beginning of the session. This immediate alternation on both levers would have increased by only 90 the total responses in the session. The apparently more stressful alternative adopted by the subjects can be interpreted as the absence of any reinforcing consequence by reducing the position of the light when it occupied lower positions of the counter. The inconsequential nature of changes in the lower light positions for avoidance responding is

supported by the results under "no lights 1-10", which also failed to show avoidance responding during the inoperative steps. The light changes in the first half of the counter can be considered functionally equivalent to absence of lights in the lower half, since both conditions generated the same type of performance. The stimulus conditions present under each of these two conditions when the counter occupied the initial 10 steps could function as discriminative stimuli for responding on the food lever without aversive consequences.

The performances under the various experimental conditions provided the general finding that the part of the light counter significant to the subjects was dependent on the highest light position that indicated shock proximity. Lower light positions of the counter that had not been utilized frequently by the subjects developed control over avoidance responding if all higher light positions were inoperative. For example, lights 13 through 16 were not associated with frequent avoidance responding when lights 17-20 were operative, but lights 13-16 were the occasion for frequent avoidance responding when the following four lights were not functional. The performances under "no lights 11-20" provided a more striking example of the acquisition of control by particular light positions when all later counter positions were inoperative. In addition, the overall results showed that the location of the ambiguous segment in the counter was a more critical determinant of the performances than size of this segment.

The maintenance of the light around the point of the highest operative position implies a conditioned aversive property associated with responding on the food lever in the segment of inoperative lights. The absence of a light in the counter acting as a pre-aversive stimulus would be based on the conditions preceding the delivery of shock; namely, responses on the food lever without illumination of any counter light. When a large number of counter steps intervened between the last illuminated position and the shock position, frequent responding on the food lever could occur in the inoperative positions without shock, which should weaken the aversive control exerted by absence of an illuminated light in the counter. In accordance with this view, the performances under "no lights 11-20"

showed more frequent use of the first inoperative counter position than the performances under "no lights 17-20". Also, a gradient of aversiveness over the inoperative segment under "no lights 17-20" and "no lights 11-20" is suggested by the declining frequencies in the successive inoperative steps.

The performances of the subjects without the benefit of the light counter permitted a determination of other possible sources of discriminative control over avoidance responses. The short series of consecutive ratios completed on the food lever at the start of the session and after delivery of a shock indicated that these two occasions were associated with maximum removal of shock. Another discrete event setting the occasion for avoidance responding during the session was the delivery of food that had been correlated with increased proximity to shock in earlier parts of the experiment.

Regarding the "no-lights" experimental condition, the absence of the light counter necessarily eliminated two events that were functions of the downward movement of the light to the next lower position. First, there was no longer any immediate environmental event indicating that a ratio on the avoidance lever had lengthened the proximity to shock. The effectiveness of responding on the avoidance lever under "no lights" was discriminable only from long-term response sequences in which frequent responding on the avoidance lever was associated with absence of shock and infrequent avoidance responses resulted in

shock. Second, there was no stimulus change correlated with completion of the required number of responses on the avoidance lever. Consequently, the ratio on the avoidance lever would be characterized by an excessive or deficient number of responses. The gradual upward movement of the counter during most of the sessions under "no lights" indicated insufficient responding on the avoidance lever. Informal observation revealed that the subjects failed to complete many of the ratios on the avoidance lever.

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Received 22 June 1970.