The effects of length of vacation on free operant avoidance*

ANNE CLAY-FINLEY
V.A. Hospital, Miami, Fla. 33125

Avoidance response rates increased and shock rates decreased following 1-, 2-, 3-, 4-, and 6-day vacations from daily scheduled 6-h free operant avoidance sessions. Vacations of 4 and 6 days were followed by more pronounced effects than 1-, 2-, or 3-day vacations. The increase in avoidance rate is attributed to a positive contrast effect arising from the scheduling of extra nonavoidance sessions.

When discriminated avoidance responding is temporarily interrupted prior to asymptote, subsequent avoidance behavior under the same conditions is disrupted. This decrement in discriminated avoidance responding has been well documented (Kamin, 1957; Denny & Thomas, 1960; Denny & Ditchman, 1962; Kamin, 1963; Brush, Myer, & Palmer, 1963, 1964). Intersession intervals (ISI), or vacations, ranging from 30 min to 20 days have all produced a decrease in the number of avoidance responses and an increase in the number of shocks during postvacation sessions.

Gabriel (1968) found that the decrement in discriminated avoidance was eliminated when overlearning trials were administered. Further, intertrial responses were positively related to length of ISI. These data suggest that the decrement following ISIs in discriminated avoidance may be a preasymptotic phenomenon specific to the discriminated avoidance paradigm. If the positive relation between intertrial responses and ISIs in discriminated avoidance holds in the free operant or nondiscriminated avoidance paradigm, where response rate is less restricted, an incremental, rather than decremental, function might be obtained.

This experiment investigated postvacation effects on response and shock rates in a maintained nondiscriminated avoidance paradigm.

SUBJECTS AND APPARATUS

Three naive male hooded rats, 150 days old at the beginning of the experiment, served as Ss.

Two identical experimental chambers of stainless steel, approximately 9 x 4¼ x 6½ in., were

housed inside a close-fitting wooden shell.

The floor was constructed of four 5/8-in. stainless steel bars spaced 1-3/8 in. apart center to center. Acoustic tile and white noise served to mask extraneous sounds.

Two response levers, 1/8 in. in diam, were mounted 2¼ in. from the grid floor and 3 in. apart. The levers extended into the chamber approximately 1-1/8 in. The ends were bent at a 90-deg angle to the front panel and extended 1¼ in. parallel to the panel.

Two perforated wall areas located directly above the response levers admitted diffused light from four 1½½-W 28-V bulbs. Luminance 3 in. from the perforated area was .25 fc.

The shock circuit consisted of a 1,100-V ac source in series with a variac, a 500,000-ohm variable resistor, and a relay-type scrambler (Hoffman & Fleshler, 1962). The walls and response levers were wired into the circuit. The shock amplitude and duration were, respectively, 2 mA and .5 sec.

Standard electromechanical programming equipment was located in an adjacent room.

PROCEDURE

All Ss were trained to press the right response lever. During the training phase, the SS interval was 2 sec and the RS interval, 20 sec. When the Ss avoided shocks consistently, the SS interval was gradually increased to 20 sec over eight sessions.

Each rat had at least 30 6-h sessions with these contingencies in effect. Each 6-h session was scheduled at the same time every day, 7 days a week, until the behavior was judged stable (a difference of less than .10 responses/min between any two out of three consecutive sessions).

Vacations of 1 to 6 days were interspersed within 25 6-h avoidance sessions. During baseline sessions, the rats had been immediately returned to their home cages and remained there for the usual 18-h intersession interval. When the vacations were scheduled, the rats were returned to their home

cages for the 18 h plus the scheduled vacation time. In this experiment, the vacations were 1, 2, 3, 4, or 6 days long. The length and schedule of vacations for each S are given in Table 1. There were six successive vacations, with each vacation duration occurring at least once for each S. The 2-day vacation was scheduled twice for R-1 and R-3, while the 4-day vacation was scheduled twice for R-2. R-1 and R-3 had a total of 18 days of vacations in addition to the usual 18-h intersession intervals, while R-3 had a total of 20 days.

RESULTS

Baseline response rates for R-1, R-2, and R-3 were 8.2, 10.6, and 9.3 responses/min. Each mean is a 3-day average. Shock rates for R-1, R-2, and R-3 were .76, .30, and .67/min, respectively.

The postvacation rates were compared to the rate during the session immediately preceding the vacation rather than to initial baseline rates. This measure provided an adjusting baseline against which to measure vacation effects. In almost all cases, the rates had returned to initial baseline prior to a vacation. These data are shown in Figs. 1 and 2. Each data point was obtained by subtracting the rate for the prevacation session from the postvacation session, dividing the difference by the prevacation rate, and converting to percentage.

Figure 1 shows that response rates increase following a vacation. The 4- and 6-day vacations were followed by the greatest increase in response rate for all Ss. The 1-, 2-, and 3-day vacations were also followed by increases in response rates, although the percent of increase is not systematically related to vacation length. The relation between response rate increase and vacation length was a systematic positive one for R-1, but not for R-2 and R-3. R-2 and R-3 show reversals in this relation at the 3- and 2-day vacations, respectively.

Figure 2 shows percent shock rate decrease following each vacation. The 4- and 6-day vacations had the most dramatic effect on shock rate. The 1-, 2-, and 3-day vacations were followed by decreases ranging from approximately 2% to 50%. The amount of decrease was not systematically related to vacation

Table 1
Order of Vacation Lengths in Days
for Each S

S	Vacation Order					
	1	2	3	4	5	6
R1	3	6	1	4	2	2
R2	3	6	4	4	1	2
R3	2	2	6	1	4	3

*This paper is based on a dissertation submitted to the Department of Psychology, University of Alabama, in partial fulfillment of the requirements for the PhD. The author is grateful for the assistance of Drs. P. S. Siegel, A. A. Baumeister, S. F. Bollinger, and R. C. Hall. Reprints may be obtained from the author, Psychology Research, V.A. Hospital, 1201 N.W. 16th Street, Miami, Fla. 33125.

Fig. 1. Percent response rate increase over prevacation rate as a function of vacation length for R-1, R-2, and R-3. The 2-day vacation is a mean value for two vacations for R-1 and R-3, and the 4-day vacation is a mean value for two vacations for R-2.

Fig. 2. Percent shock rate decrease from prevacation rate as a function of vacation length for R-1, R-2, and R-3. The 2-day vacation is a mean value for two vacations for R-1 and R-3, and the 4-day vacation is a mean value for two vacations for R-2.

length for 1- to 3-day vacations.

All Ss increased their avoidance responding following an increase in time away from the avoidance situation. Further, the behavior was more efficient in terms of percent of shocks avoided.

DISCUSSION

Following vacations of 1, 2, 3, 4, and 6 days from an avoidance schedule, free operant avoidance is facilitated, as evidenced by response rate increase and shock rate decrease. The post-ISI decrement in discriminated avoidance does not generalize to postasymptotic nondiscriminated free operant avoidance behavior. These data confirm Gabriel's (1968) findings that the effect is apparently specific to preasymptotic avoidance behavior. In addition, the postvacation increase in intertrial responding observed by Gabriel in the discriminated avoidance situation may be reflected in the free operant paradigm by the general increase in postvacation response rate. Had responding been unrestricted in his experiment, the incremental function observed in the present experiment might have been observed among Ss given overlearning trials.

Increases in frequency, duration, or intensity of shock (Sidman, 1966; Hayes & MacKinnon, 1968; Huff, Piantanida, & Morris, 1967) are followed by increases in avoidance response rates. The same functions between these variables and reinforcement obtain in the positive

reinforcement paradigm. Another variable found to produce increases in responding (or decreases if the response has a punishment history) in the latter paradigm is time out, or vacation from responding (Azrin & Holz, 1966). The present results show that this increase in responding following a vacation also holds for avoidance behavior.

Reynolds (1961) found that replacement of a VI component by a TO component in a Mult VI VI schedule resulted in increases in response rate in the remaining VI component (positive contrast). The present results can be analyzed in terms of contrast effects when the events over the entire 24-h period are considered. The 6-h avoidance sessions systematically alternated with an 18-h nonavoidance (home cage) session. The entire cycle could be considered a two-component multiple schedule, with 6 h of free operant avoidance comprising one leg and 18 h of nonavoidance, or vacation, comprising the other. Thus the schedule is best described as Mult $R_{\text{avoidance}} 6 \text{ h}$, $R_{\text{nonavoidance}} 18 \text{ h}$ (Mult Rav 6-Rnav 18). When vacations were programmed, the schedule was changed to Mult Rav 6-Rnav 18-Rnav 24, 48, 72, 96, or 144, thereby effectively replacing the next scheduled Rav 6 component, since the vacation component alternated with avoidance components, with Rnav components ranging from 24 to 144 h. The decrease in reinforcement, shock,

and avoidance response rates during the vacation component and concomitant increase in relative shock and reinforcement rates in the Rav component may comprise a condition for positive contrast in free operant avoidance.

The magnitude of positive contrast has been found to be a function of relative reinforcement frequency in the unchanged component (Reynolds, 1961) and response rate in the varied component (Reynolds & Limpo, 1968). In this experiment, response rate increases were positively related to vacation length and, hence, to relative shock and reinforcement rates in the avoidance component.

Several explanations (e.g., dissipation of inhibition, incubation of fear, weakening of incompatible responses, recovery from adaptation, etc.) have been offered for improvement in behavior with time out of the conditioning situation. While some of these interpretations could be useful in analysis of the present data, the contrast analysis appears to be more useful and more amenable to evaluation.

REFERENCES

- AZRIN, N. H., & HOLZ, W. C. Punishment. In W. K. Honig (Ed.), *Operant behavior: Areas of research and application*. New York: Appleton-Century-Crofts, 1966. P. 398.
- BRUSH, F. R., MYER, J. S., & PALMER, M. E. Effects of kind of prior training and intersession interval upon subsequent avoidance learning. *Journal of*

- Comparative & Physiological Psychology, 1963, 56, 539-551.
- BRUSH, F. R., MYER, J. S., & PALMER, M. E. Joint effects of intertrial and intersession interval upon avoidance learning. Psychological Reports, 1964, 14, 31-37.
- DENNY, M. R., & DITCHMAN, R. E. The locus of maximal "Kamin effect" in rats. Journal of Comparative & Physiological Psychology, 1962, 55, 1069-1070.
- DENNY, M. R., & THOMAS, J. O. Avoidance learning and relearning as a function of shuttle box dimensions. Science, 1960, 132, 620-621.
- GABRIEL, M. Effects of intersession delay and training level on avoidance extinction and intertrial behavior. Journal of Comparative & Physiological Psychology, 1968, 66, 412-416.
- HAYES, W. A., & MacKINNON, R. C. Two methods of increasing response rate in free operant avoidance conditioning. Psychonomic Science, 1968, 13, 274-276.
- HOFFMAN, H. S., & FLESHLER, M. A relay sequencing device for scrambling grid shock. Journal of the Experimental Analysis of Behavior, 1962, 4, 309-316.
- HUGG, F. W., PIANATANIDA, T. P., & MORRIS, G. L. Free operant avoidance responding as a function of serially presented variations of UCS intensity. Psychonomic Science, 1967, 8, 111-112.
- KAMIN, J. L. Retention of incompletely learned avoidance response: Some further analyses. Journal of Comparative & Physiological Psychology, 1963, 56, 713-718.
- KAMIN, J. L. The retention of an incompletely learned avoidance response. Journal of Comparative & Physiological Psychology, 1957, 50, 547-560.
- REYNOLDS, G. S. Behavioral contrast. Journal of the Experimental Analysis of Behavior, 1961, 4, 57-71.
- REYNOLDS, G. S., & LIMPO, A. J. On some causes of behavioral contrast. Journal of the Experimental Analysis of Behavior, 1968, 11, 543-547.
- SIDMAN, M. Avoidance behavior. In W. K. Honig (Ed.), *Operant behavior: Areas of research and application*. New York: Appleton-Century-Crofts, 1966. Pp. 448-498.

Exploratory behavior in response to the spatial rearrangement of familiar stimuli

KENNETH J. WILZ and RUTH L. BOLTON
Williams College, Williamstown, Mass. 01267

The effects of the spatial rearrangement of familiar stimuli on exploratory behavior were studied in the Mongolian gerbil. Using an open-field situation, Ss were exposed to one or a number of stimuli in a particular spatial relation to each other and to the walls of the container. A rearrangement of these stimuli (or stimulus) subsequently evoked considerably more exploration than did the control treatment. Total locomotion, the number of approaches to stimuli, and the total time spent investigating stimuli were all affected.

A considerable amount of research has been directed toward determining the role that external stimuli play in eliciting exploratory behavior. Results with rodents indicate that one of the primary determinants of exploratory behavior, either investigatory response or locomotor exploration (Berlyne, 1960), is the degree of visual novelty of the stimuli (Fowler, 1965). Recently, Corman & Shafer (1968), using an "open-field" situation, have given further confirmation of this generalization by demonstrating that rats direct an increasing amount of exploration toward that area of the open field in which change has been effected by either stimulus introduction or stimulus removal.

Shillito argues further that rodents on their home range possess a detailed knowledge of not only the general nature of stimuli, but also of the spatial organization of these objects. Yet the question of whether or not rodents are sensitive to the relational

properties of stimuli has received little experimental attention, with the exception of Dember (1956) (see also Tinbergen, 1951, for a summary of invertebrate findings). Dember used a Y-maze, and his rat Ss were first exposed at the choice point to white and black alternatives. Then, on a subsequent trial, they were permitted a choice with both alternatives now identical in brightness, and the results showed that the spatially novel stimulus was reliably chosen.

Shillito (1963) has recently taken a somewhat different approach. Concerned with the behavior of rodents (*Microtus agrestis*) in the natural environment, she has evidence that her Ss possess a very detailed knowledge of their home range. This familiarity is gained, she claims, by means of exploratory behavior and would certainly be highly adaptive, for instance, in finding the way back to the burrow in the shortest possible time when danger threatens.

The experiments discussed here were designed to test whether or not rodents also are sensitive to spatial cues in rather different experimental circumstances. They utilized the open-field situation, where mammalian Ss were exposed to a certain stimulus situation involving one or more objects and where the orientation of these objects was then changed to determine, in comparison with controls, the effects on exploratory activity. At least in the first experiment, we chose stimulus situations approximating the complexity of the natural environment. Furthermore, the experiments were designed so that both locomotion measures (grid crossing) and investigatory measures (approaches and total time) could be utilized as dependent variables. The Mongolian gerbil was selected as the S. This rodent species displays considerable activity in the open field and does not exhibit the wall-clinging behavior characteristic of many other rodents (Glickman & Hartz, 1964; Nauman, 1968).

METHODS

The Ss were young adult Mongolian gerbils, *Meriones unguiculatus*. They were maintained in groups of two to six in standard laboratory rodent cages, with food and water always available. Temperatures were kept around 22°C, and the animals were subjected to the natural midwinter light-dark cycle, with all tests being performed from mid to late morning. Only males were used.

The testing containers were constructed of Masonite and measured 77 x 178 cm, with a height of 57 cm. The floor of these containers was marked off into 24 units of equal size with white chalk. In introducing and removing animals from these testing chambers, a portable startbox was used (28 x 28 cm, open at the top). The Ss were placed into this box, always set at the same point in the testing apparatus, and then the box was lifted out of the arena. In capture, the animal was first confined in the smaller container and then removed. Feces were removed after the testing of each individual.

In Experiment 1, a number of stimuli were arranged in the testing container. The experiment was designed to determine whether overall activity in the open field would increase substantially with a spatial rearrangement of these same objects after a lengthy exposure to the initial configuration. The objects used included the following: six medicine bottles with rubber tubing tied to the top (height = 9 cm); four corks with a clothespin attached dorsally (height = 5 cm); five opaque jars (height = 22 cm, diam = 8 cm); one