Self-Presentation and Self-Termination of a Conflict-Producing Stimulus

Abstract. *Rats could press a lever to initiate or terminate a stimulus that was associated with intermittent rewards and punishments. Subjects spent time in both the stimulus-on and stimulus-off condition and oscillated frequently between the two conditions. This method provides continuous, quantitative records of oscillatory behavior and is sensitive to manipulations of shock intensity and food deprivation as well as the relative frequency of reward and punishment.*

Since intense conflict is a predominant feature of human psychopathology, the experimental study of conflict behavior in animals has frequently supplied worthwhile leads for the analysis of abnormal behavior in humans (*1*). In one of the most powerful types of conflict a stimulus is correlated with both reward and punishment. In this condition, often labeled an approach-avoidance conflict, subjects typically show considerable ambivalence toward the stimulus and oscillate between approaching it and retreating from it.

Although hesitation and oscillation in the face of conflict have often been described qualitatively in the experimental literature, quantitative estimations of these aspects of conflict have usually proved difficult. In this report we describe a method which seems to provide continuous, quantifiable records of such behavioral vacillation. The method differs from some previous ones by permitting subjects not only to terminate but also to initiate a stimulus which serves as a signal for both reward and punishment.

The subjects were five naive male albino rats, maintained at 75 percent of their normal weights. A telegraph-key lever, which the subjects could press, was mounted on one wall of the experimental chamber. Rewards during the 90-minute daily sessions consisted of access for 3 seconds to a dipper containing 0.1 ml of condensed milk. Electric shocks (0.4-second duration) to the grid floor of the chamber were used as punishments. Additional details of the apparatus were described elsewhere (*2*).

After some preliminary sessions, in which rewards only were presented, the subjects were exposed to a procedure which included both reward and punishment. During the stimulus condition S^D (a clicking sound for two of the subjects and a period of silence for the other three subjects), milk rewards were given according to a 1-minute variable interval schedule (variable-interval 1) and punishments occurred on a 4-minute variable interval schedule (variable-interval 4). These rewards and punishments were delivered regardless of the subject's behavior. However, if the subject pressed the lever once, S^D was terminated, and a time out (TO) from reward and punishment occurred.

During TO the other stimulus condition (silence or clicking sound) was in effect. A single press of the lever during TO restored S^D and the possibility of intermittent rewards and punishments. The punched tape programmers which controlled the separate schedules of reward and shock were independent of each other and operated only during S^D. Sessions always began with an S^D period; if the subject never depressed the lever, S^D remained on for the entire session. Once the subject had produced TO, further failure to respond meant that the subject would remain in TO for the rest of the session and would never receive rewards or punishments (*3*).

During training, different subjects required different amounts of shock and different amounts of exposure to the procedure. However, all subjects eventually learned to press the lever, which produced onsets and offsets of S^D.

After lever-pressing had been acquired by all the subjects, we investigated the influence of some factors that have been the focus of study in traditional experiments concerning conflict behavior. These factors were (i) the intensity of shock, (ii) the degree of hunger, and (iii) the relative frequency of reward and punishment. A 1-minute variable interval for food and a 4-minute variable interval for shock were maintained in (i) and (ii), whereas the separate, variable interval schedules were systematically varied in (iii). Animals were usually kept on a particular procedure for at least ten consecutive sessions to permit behavior to stabilize under the new conditions. Data from the last five sessions of this period were used as the measure of stabilized performance.

In the first series of experiments variations in shock intensity were studied. We found that when shock intensity was either very high or very low, oscillations (as defined by the number of times that subjects completed a single onset-offset sequence) occurred less frequently than at intermediate shock intensities. All individual subjects exhibited their maximum number of oscillations at one of the intermediate shock intensities. This relationship could be interpreted to mean that at very high or very low shock intensities the approach and avoidance tendencies were not in "equilibrium," and therefore subjects did not vacillate very much between the TO and the S^D conditions. At these two extremes of shock intensity, subjects would be expected to overwhelmingly favor either the TO or S^D condition. This turned out to be the case: with the highest shock (0.8 ma) subjects spent an average of about 85 percent of the session in TO, whereas with the mildest shock (0.2 ma) or no shock they averaged more than 90 percent of the session in S^D. On the other hand, at intermediate shock in-

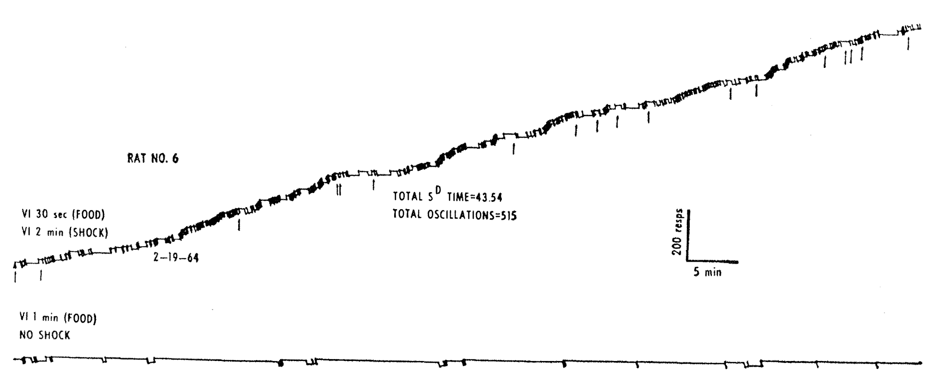

Fig. 1. Cumulative response curves for rat No. 6 under two different combinations of food and shock frequency. Downward deflections in the records indicate S^D offsets and upward deflections indicate S^D onsets. Shocks are shown by vertical arrows. The records were obtained on the last day of a test phase with the indicated procedure (VI, variable interval).

Table 1. Effects of satiation on mean time spent in the stimulus-on condition (S^D) and mean number of oscillations. Maximum possible time in S^D was 90 minutes.

Subject No.	Time in S^D (min)		No. of oscillations	
	Hungry	Satiated	Hungry	Satiated
1	67.91	42.98	21.7	2.0
2	65.92	41.84	36.0	3.7
4	18.83	10.95	19.3	1.7
5	17.47	8.13	29.7	3.0
6	59.36	16.64	70.0	2.3
Group mean	45.90	24.11	35.3	2.5

tensities (for example, 0.4 to 0.5 ma) subjects generally spent between 25 and 75 percent of the session in S^D. These group results were representative of shock-intensity effects for all the individual subjects.

After several shock intensities had been tested, an "intermediate" shock value (either 0.4 or 0.5 ma) was selected for each subject—one which, on the basis of the earlier results, was considered likely to produce a fairly good balance between the positive and negative tendencies in the situation. The values in the "hungry" column at the left of Table 1 show that at the selected shock intensities individual subjects averaged from 20 to 75 percent of the session in S^D, with a group mean of approximately 50 percent. During the remainder of the experiment, shock intensity was kept constant at intermediate values.

To study the effects of variations in the hunger drive we satiated the subjects with condensed milk a few minutes before the start of three experimental sessions, according to a procedure described in (*2*). The three satiation sessions were compared with sessions under the usual "hungry" conditions—that is, the three experimental days that immediately preceded days on which satiation tests occurred.

Table 1 shows that food satiation reduced (i) the mean amount of time spent by each subject in S^D and (ii) the number of oscillations between S^D and TO. An analysis of variance revealed that the "time in S^D" differences were significant beyond the .02 level, whereas the differences in "number of oscillations" were significant beyond the .001 level. By decreasing the power of the appetitive factors in the situation, satiation apparently brought about an increase in the net effect exerted by the aversive factors (*4*).

Our current work with the new technique is focused on the study of variations in the relative frequency of reward and punishment with shock intensity and hunger drive held constant. Figure 1 illustrates for a single subject some typical results that occurred as a result of changes in these frequencies. When only food was possible during S^D (lower curve) the subject spent most of the session in S^D and rarely oscillated between S^D and TO. On the other hand, when both food and shock (0.4 ma) occurred relatively frequently (upper curve), the subject spent about half the time in each condition and displayed pronounced oscillation from one condition to the other. It might be added that when no food but only shocks were possible in S^D, the subject invariably terminated S^D at the beginning of the session and rarely turned it back on. Although differing among themselves in absolute rate of oscillation and in variability of performance, the other subjects exhibited qualitatively similar effects. Oscillations were most frequent at intermediate relative frequencies of reward and punishment (*5*).

The principal difference between this procedure and some earlier methods of studying conflict lies in the provision that subjects can initiate as well as terminate the conflict situation. This provision makes the procedure similar in some important respects to procedures used in several recent studies (*6*), in which subjects could control the onset as well as the offset of a particular set of experimental conditions. Unlike the present experiment, however, those studies did not explicitly program any punishment during the "on" condition. Even so, subjects in those experiments still produced onsets and offsets—a result which suggests that certain events which seemingly involve only positive reinforcement may also have aversive properties. Therefore, findings from studies which permit subjects to control both the presentation and the termination of a given stimulus condition may eventually necessitate a revision of the traditional criteria used to distinguish conflict behavior from other types of behavior.

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References and Notes

1. See, for example, E. R. Guthrie, *The Psychology of Human Conflicts* (Harper, New York, 1938); N. E. Miller, in *Personality and Behavior Disorders*, J. McV. Hunt, Ed. (Ronald, New York, 1944), vol. 1, p. 431; P. L. Broadhurst, in *Handbook of Abnormal Psychology*, H. Eysenck, Ed. (Basic Books, New York, 1961), p. 726.
2. E. Hearst, *J. Comp. Physiol. Psychol.* **56**, 1027 (1963).
3. In the study cited in (*2*) subjects could only terminate S^D; following a termination, S^D came on again after a fixed time interval (5 minutes) no matter what the subject did.
4. A prior experiment (*2*) seems to eliminate as an explanation the possibility that a food-associated stimulus may itself become strongly aversive for satiated subjects, as well as the possibility that the results are primarily due to a reduction in general activity following satiation.
5. Subjects have generally displayed relatively infrequent oscillation between S^D and TO when no shocks were possible. For example, rat No. 6 averaged fewer than ten oscillations per session when neither food nor shock was possible in S^D; this result can be compared with the records for this subject shown in Fig. 1. Such findings suggest that subjects were not pressing the lever because mere stimulus change was reinforcing or because the stimulus accompanying S^D or TO was inherently aversive. N. E. Miller, however, has proposed that conflict may have a marked potentiating effect on pressing for mere stimulus change, an explanation that cannot be ruled out at the present time.
6. A. G. Hundt and D. Premack, *Science* **142**, 1087 (1963); N. H. Azrin, *ibid.* **133**, 382 (1961); J. B. Appel, *J. Exptl. Anal. Behav.* **6**, 423 (1963).

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Hominid Bipedalism: Independent Evidence for the Food-Carrying Theory

Abstract. *Habitual food carrying has been suggested as a possible major factor in making bipedal locomotion biologically advantageous so that it was selected for in early hominid evolution. This speculation, supported by slight observations of captive macaques, has now acquired greater plausibility from four recent independent reports of wild and semi-feral bipedal, food-carrying apes and monkeys from the Congo, Tanganyika, Japan, and a Puerto Rican monkey colony. The most striking evidence of the relationship between food-transport and bipedal walking comes from a troop of Japanese monkeys where the locomotor habit emerged as part of a chain of new behaviors initiated with a changed food supply.*

In 1961 I suggested that hominid bipedalism might have arisen initially in connection with carrying of food from one place to another, perhaps when a primate living in the open country began to depend on scavenged