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VICARIOUS CONDITIONED ACCELERATION: SUCCESSFUL OBSERVATIONAL LEARNING OF AN AVERSIVE PAVLOVIAN STIMULUS CONTINGENCY[1]

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Five rats (observers) were trained to avoid unsignalled shocks in a shuttlebox and then habituated to brief light presentations. They were next confined on an observation platform while another rat (model) received light-shock pairings in the opposite compartment. The observers were exposed only to the sight and sound of the model during classical conditioning and were not shocked themselves. Test presentations of the light during subsequent avoidance sessions produced response rate increases (vicarious conditioned acceleration) comparable to those obtained in other studies where the avoidance animals were used in classical conditioning. Following sessions in which the model was not shocked after the light, the light presentations during avoidance eventually failed to elicit any response increases in the observers. When the model was again shocked, immediate recovery of avoidance acceleration occurred in the observers during the light.

Observational learning may be defined as any behavioral change in an organism that occurs as a function of simple exposure to another member of the same species (model), which would not have occurred otherwise or would have occurred more slowly in the absence of such exposure. Bandura's (1969) review showed that exposure to models can produce both respondent and operant learning in both human and infrahuman observers. Infrahuman studies of observational learning can be classified loosely according to whether the vicarious learning involves acquiring a response for a reinforcement (appetitive paradigms), or involves some type of relationship between the observer organism and a noxious event (aversive paradigms). In the former category, Danson and Creed (1970) showed that specific rates of responding by a demonstrator monkey can serve as discriminative stimuli for observer monkeys in ways analogous to the control of operant rates by conventional stimuli (lights, tones, *etc.*). Myers (1970) showed that monkeys given the opportunity to observe a model later acquire the specific appetitive response patterns appropriate to extinction, fixed-ratio, and variable-interval reinforcement schedules more quickly than control monkeys without any opportunity to observe a model.

In the aversive paradigms, a substantial body of evidence attests to the effectiveness of observational learning in attenuating fear responses. For example, Davitz and Mason (1955) showed that the presence of a second rat in the experimental chamber reduced the amount of freezing behavior in observer rats during a stimulus (CS) that had been previously paired with shock. Baum (1969) showed that a signalled avoidance response in rats extinguished more rapidly if a second rat was present during a period in which the avoidance response was made impossible than if the subjects were isolated during this period. Hake and Laws (1967), and Hake, Powell, and Olsen (1969) showed that the suppression of appetitive responding normally occurring in the presence of a preaversive stimulus (conditioned suppression) was reduced when the stimulus signalling shock to the subject also signalled the availability of reinforcement to the model and thereby controlled higher rates of responding. All of the above studies dealt with the effects of models after the behavior appropriate to the aversive paradigm had first been established in the observer in the absence of another member of the same species.

Attempts to produce behavior appropriate to a given paradigm when the aversive events occurred to a model but not to the observer appear to be limited to a single unsuccessful instance. Church (1959) attempted to produce

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vicarious conditioned suppression in rats. Instead of predicting a shock to the subject, the CS preceded delivery of a shock to another visible rat in an adjacent cage. Subsequent test presentations of the light to the observer failed to produce any of the expected interference with appetitive responding.

One previously untested possibility for producing observational learning of a stimulus contingency is to transfer the CS used in classical conditioning to an avoidance baseline. Contrary to the suppression produced by this procedure with an appetitive baseline (Estes and Skinner, 1941) the normal result with an aversive baseline is acceleration (Pomerleau, 1970; Riess, 1969; Riess and Farrar, *in press;* Riess and Martin, 1969; Sidman, Herrnstein, and Conrad, 1957). The present effort explored this possibility and was designed to provide an additional test of whether observational learning of a stimulus contingency is possible in animals and whether operant behavior during this stimulus can be used as a measure of such learning.

METHOD

Subjects

Five naive female Wistar albino rats, 72 to 83 days of age, from the home colony maintained by the Galesburg State Research Hospital Psychology Laboratory, were housed in individual cages during the study. Two additional nonexperimental females of the same weight and litter served as models.

Apparatus

An 18.25 by 8 by 8 in. (46 by 20.5 by 20.5 cm) modified Lehigh-Valley Model 5-2721 plastic shuttlebox contained 40 rods, 2 mm in diameter and aligned parallel to the hurdle that formed the grid floor. No single circuit supplied any two adjacent bars. A 1.75 in. (4.5 cm) (high) hurdle divided the box into two equal compartments. The hurdle was made of two stainless steel strips separated at the corner by four nonconducting plastic plugs, with each strip connected below the grid to a separate circuit. An 8-in. (20.5 cm) wide transparent plastic guillotine gate could be lowered between the two compartment ceilings to a position flush with the hurdle. A 34 by 16 by 21 in. (87 by 43 by 54 cm) wood chest housed the shuttlebox. Air was circulated from outside the chest by a blower. A speaker mounted on the inside center rear of the chest provided masking noise from a Grason-Stadler model 901B white noise generator. Transparent plastic doors permitted observation of the subject and allowed light to enter the chest. Two 60-w red lights were located in opposite halves of the sound chest ceiling. A Grason-Stadler model E1064GS combination shock generator and scrambler provided the shocks.

An observation platform was constructed so that a subject placed on it could be confined to one side of the shuttlebox with the other side fully visible through the transparent drop gate. A Masonite floor sloping slightly forward and a wooden back separating the subject from the metal wall of the shuttlebox opposite the drop gate protected the subject from shocks.

Procedure

All five subjects received the following sequence of treatments:

1. *Avoidance acquisition* consisted of nine daily half-hour sessions of unsignalled avoidance with 2-mA, 0.2-sec shocks. Each hurdle cross postponed the next shock by 20 sec (R-S interval) and shocks continued every 5 sec (S-S interval) in the absence of a response. Placing the subject in the apparatus began an R-S interval.

2. *Adaptation* was identical to Step 1 except that five 15-sec red light presentations occurred at the start of the tenth, fifteenth, twentieth, twenty-fifth, and thirtieth minute of the session. A modified conditioned suppression ratio [CSR, (Kamin, 1961)] was computed from the formula $CSR = 4B/(A + 4B)$ where A (baseline) = responding during the 1 min preceding the light and B = responding during the light. The preCS period was four times as long as the CS period to make the baseline as representative as possible. This was continued until each subject met a criterion of two consecutive sessions with the mean CSR for all 10 presentations between 0.475 and 0.525.

3a. *Vicarious classical conditioning* began on alternate days with the subject confined to one side of the shuttlebox and the side of confinement alternated on successive sessions. The experimental rat (observer) was confined to the observation platform while a nonexperimental rat (model) received six light-shock (CS-UCS) pairings. The CS-UCS interval was varied with two values each of 5, 10, and

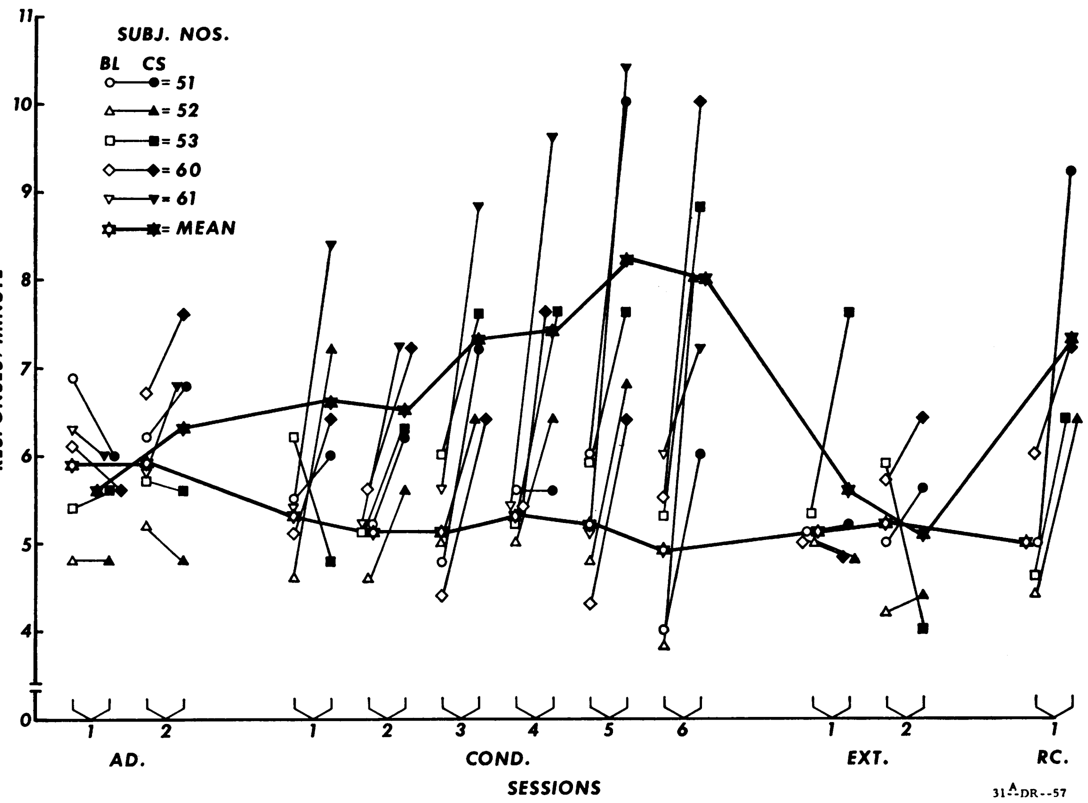

Fig. 1. Absolute rates of response for preCS periods (open figures) and CS periods (solid figures) across four experimental conditions with adaptation and extinction shown only as criterion performance.

15 sec. The intertrial interval (ITI) was also variable with two values each of 60, 90, and 120 sec. The UCS was a 4-mA shock of 3-sec duration. The white noise generator, chamber fan, and air conditioner were all off during these sessions so that the vocalizations of the model would be fully audible to the observer.

3b. *Testing* was conducted on alternate days following (3a) and was identical to Step 2. There were no unavoidable shocks at the end of the CS, although the avoidance schedule remained in effect throughout. Step 3 was continued for 12 days (*i.e.,* six alternating sessions of 3a and 3b).

4a. *Vicarious classical extinction* was identical to Step 3a except that the shock was omitted. A naive rat of the same sex, weight, and litter as the shocked rat was used as the extinction model.

4b. *Extinction testing* was identical to Step 2 and continued on alternate days until a criterion identical to that for adaptation was met.

5a. *Classical reconditioning* was identical to Step 3a with the original model reused.

5b. *Reconditioning testing* was identical to Step 2 and was continued for a single session, thus completing the fourth leg of an ABAB design.

RESULTS

Before proceeding to the major results on observational learning, the acquisition of the avoidance response itself deserves some attention. The range of response rates for all five subjects was between 3.0 and 5.5 responses per minute in the first half hour. In all subjects, peak rates (between 6.5 and 8.2 responses per minute) were achieved in either the second or third session and continued around 6.0 responses per minute through Sessions 4 to 9. The mean shock rate was 2.3 per minute in Session 1, dropped to about 0.8 in Session 2, and dropped again to about 0.2, where it remained in Sessions 3 to 9. The rapid acquisition of

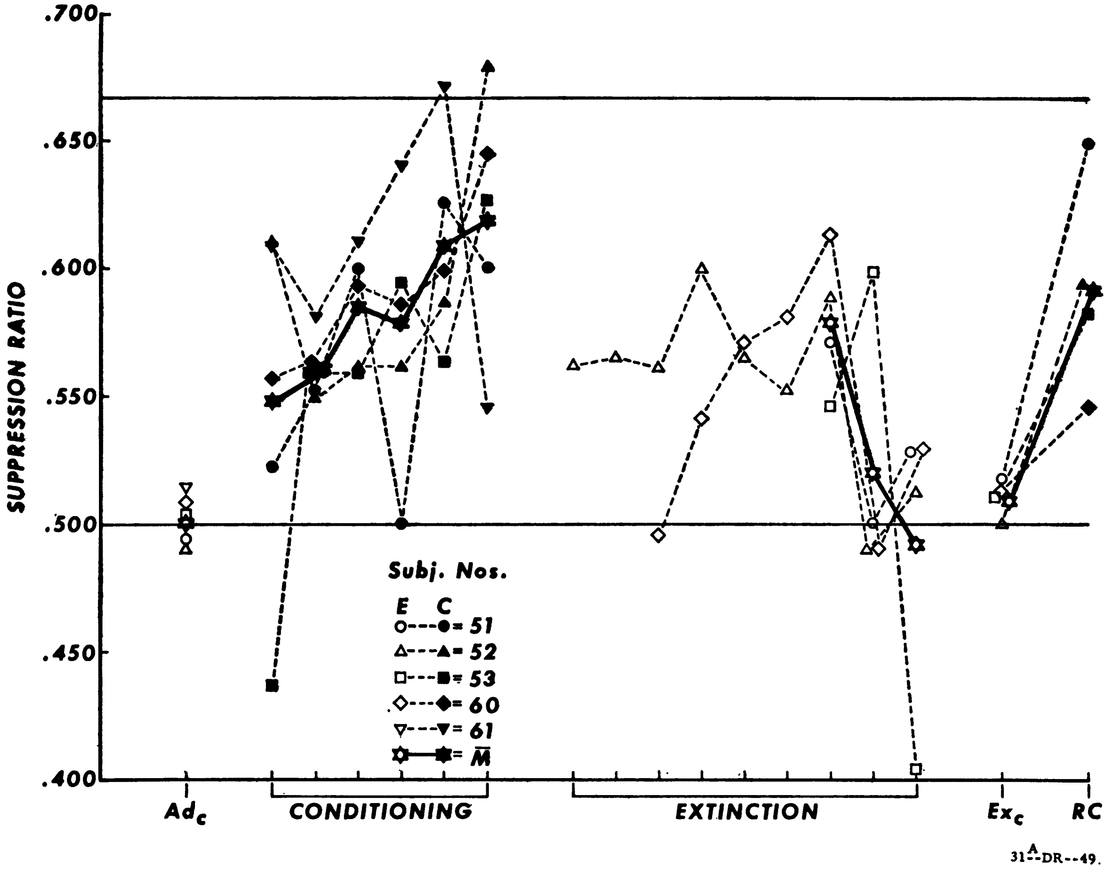

Fig. 2. Conditioned suppression ratios during Steps 2 to 5. Ad$_c$ (adaptation criterion) is for last two days of Step 2. Ex$_c$ is criterion performance for extinction. No data for extinction or reconditioning (RC) are presented for Rat 61 and the means are for four subjects only. The horizontal line at 0.500 indicates no change in rate and the line at 0.667 indicates a doubling of rate.

responding was typical of free operant avoidance in the shuttlebox (Riess and Farrar, 1972).

The absolute rates of response across all experimental conditions (Figure 1) show that the preCS and CS rates were approximately equal during terminal performance in adaptation and extinction, with the CS rates exceeding the baseline during conditioning and reconditioning.

The light presentations before exposure to the model initially suppressed avoidance, with the mean suppression ratio for all five subjects on the first session being only 0.467. The ratios gradually rose to the 0.500 range (Figure 2).

During the vicarious conditioning phase, there was a steady rise in the mean ratio from 0.547 on Test Day 1 to 0.619 on Day 6. This latter ratio represents about a 60% increase in response rates. The extinction data are presented as "backwards" curves (Hayes, 1953). The last two extinction sessions (the two consecutive sessions with suppression ratios below 0.525) are shown last, and the remaining data are plotted backwards from the criterion sessions (origin). This method of graphical presentation lends itself to behavioral processes defined by some arbitrary criterion in which the process of reaching the criterion is abrupt in individual subjects but occurs at different times for different subjects. Rat 61's behavior proved to be inextinguishable within 20 extinction sessions, with the CSR for the entire two months only about 0.02 below that for conditioning. The terminal test session (RC) data for the other four subjects (far right-hand column) show that acceleration reoccurred in a single session, with the rate increases about

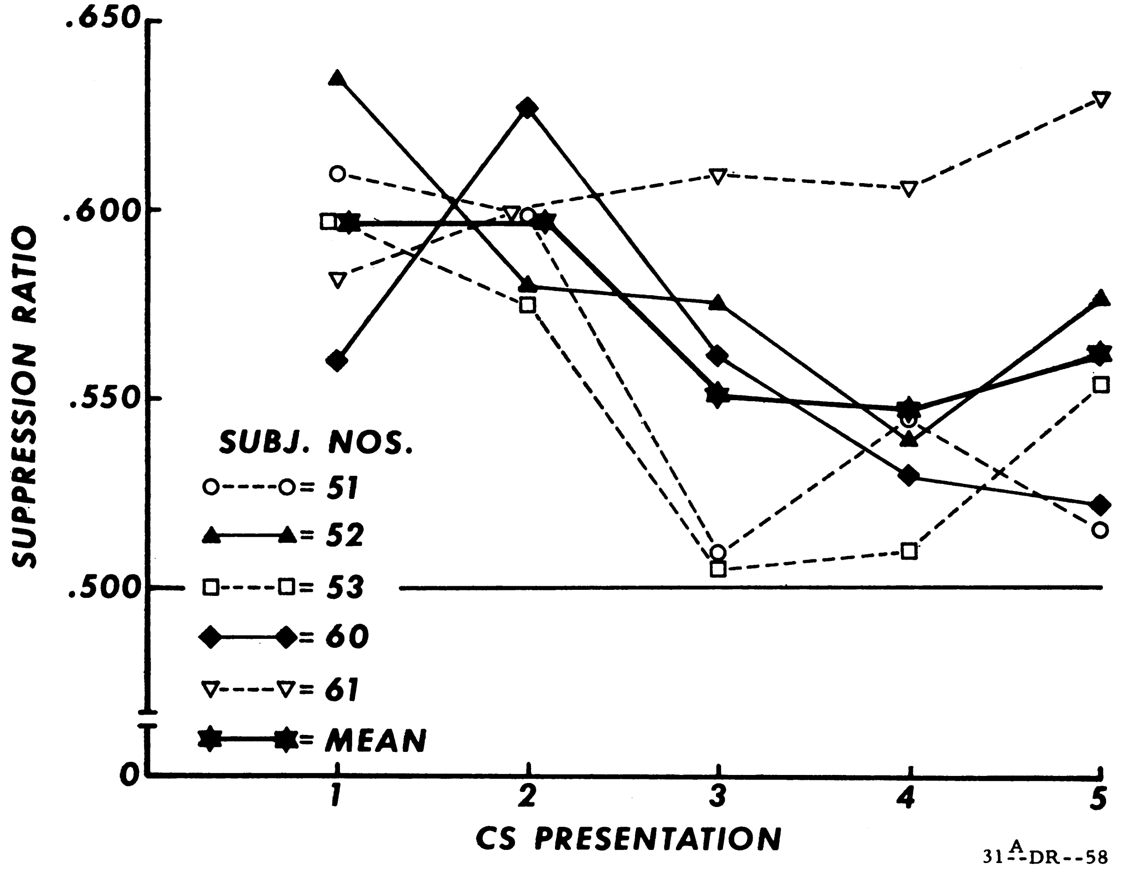

Fig. 3. Mean suppression ratios across five consecutive CS presentations per session averaged for single subjects for all six sessions.

100% larger than they were on the original conditioning test session.

One phenomenon that is obscured in Figures 1 and 2 was the tendency for the first two CS presentations in a single session to produce larger rate increases than the last three, which occurred in four of five subjects (Figure 3).

The within-session rates of responding were elevated during the first five min of the session. This is a typical feature of free-operant avoidance in the shuttlebox (Riess and Farrar, 1972) and is unrelated to CS presentation. Also, a rate-by-minute examination of between CS periods failed to yield any evidence of local rate changes cyclically related to CS presentation schedule (*i.e.,* there was no tendency for responding to increase as a function of temporal proximity to CS onset). Lastly, the rank-order correlation between the magnitude of the suppression ratios during conditioning and resistance to extinction was 1.00. Rat 61 had a ratio of 0.609 and 20+ days in extinction; Rat 52 had a ratio of 0.591 and nine days in extinction; Rat 60 had a ratio of 0.590 and seven days in extinction; Rat 51 had a ratio of 0.567 and three days in extinction; and Rat 53 had a ratio of 0.555 and three days in extinction.

DISCUSSION

Previous research has demonstrated that appetitive observational learning can occur as a simple function of vicarious exposure to the behavior of a demonstrator organism (Danson and Creed, 1970; Myers, 1970). It has also been shown that the effects of aversive conditioning can be attenuated by exposure to another organism under a variety of conditions (Baum, 1969; Davitz and Mason, 1955; Hake and Laws, 1967; Hake, Powell, and Olsen, 1969).

The present experiment extends these results by showing that vicarious aversive learning is possible with infrahuman species, as has been previously demonstrated in humans (Bandura, 1969).

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