Avoidance of conditioned aggression*

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A pigeon was trained with food reinforcement to attack a target bird, and the subsequent aggression was brought under the control of an exteroceptive stimulus. The aggressor bird was then required to keypeck (FR 20) in order to produce the S^D condition, while the target bird was provided access to a second key which, when pecked (FR 3), instituted an S^Δ condition for the aggressor. These contingencies were effective in maintaining keypecking by both birds and warrant the conclusion that the target bird did find the behavior of the aggressor bird aversive.

There is now substantial evidence that aggressive behavior can be both operantly and classically conditioned. Classically conditioned aggression has been obtained by Thompson & Sturm (1965), who conditioned an aggressive display by Siamese fighting fish, and by Vernon & Ulrich (1966), who showed that a buzzer paired with shock will ultimately elicit attack in paired rats. Operant attack has been obtained by Reynolds, Catania, & Skinner (1963) using food reinforcement with pigeons, by Ulrich, Johnston, Richardson, & Wolff (1963) using water reinforcement with rats, and by Stachnik, Ulrich, & Mabry (1966a, b) using electric intracranial reinforcement with rats. Using an avoidance procedure, Azrin, Hutchinson, & Hake (1967) demonstrated that the biting attack of monkeys could be shaped and maintained. Azrin & Hutchinson (1967) have also shown that the duration and temporal patterning of attack behavior can be substantially influenced by the schedule and frequency of reinforcement.

In those studies which utilized a control (target) animal, the Es defined what constituted aggression on the part of the experimental animal independent of the target animal's behavior. This has led to questions such as "Is it *really* aggression?" "Does the target animal feel it is being aggressed against?" etc. Delgado (1966) has addressed this problem in his work with aggression elicited by intracranial stimulation. He contends that what may appear to the E to be a rage response on the part of an

experimental monkey or cat may not be seen as such by a control animal who responds with a yawn. He concludes that the behavior of the control animal must be considered in deciding if aggression has indeed occurred.

The present study analyzed this possibility in a situation where (1) food-reinforced attack by an experimental animal was brought under the control of an exteroceptive stimulus, and then (2) the target animal was provided the opportunity to terminate the stimulus condition which controlled the attack behavior.

SUBJECTS

The Ss were two male adult White Carneaux pigeons. The experimental S (E-S) had previously been trained to keypeck with food as a reinforcement. E-S was maintained at 80% of its free-feeding weight throughout the experiment. The control S (C-S) was experimentally naive and was allowed free access to food and water at all times.

APPARATUS

The experimental chamber was constructed of clear Plexiglas, 30.5 cm wide, 38.1 cm long, and 43.1 cm high, with a grid floor. One of the 38.1-cm sides was covered with a one-way mirror, while the other sides were black. A standard response key, 3.8 cm in diam, was mounted in the middle of the front wall and 35.5 cm above the floor. A food reinforcement magazine was located below the key, 15.2 cm above the floor.

A second response key was located on the side wall, 10.2 cm from the rear wall and 35.5 cm above the floor. A ventilating fan, a 60-Hz buzzer, and a 60-W houselight were located on the top of the chamber. Two white 17-W frosted bulbs located in the upper corners of the front wall were used as discriminative stimuli. The response keys were both translucent and were illuminated by either a red or white 7-W bulb.

PROCEDURE

The Ss were given either one or two

daily 30-min sessions. During Sessions 1-24, baseline operant level fighting was recorded, i.e., time spent fighting and number of attacks. During Sessions 25-50, attacks were reinforced with a 3-sec presentation of food. Attack was defined as physical contact made by wing-boxing or pecking and was scored by one of the four authors responsible for that particular session. All four authors were present during the operant level and shaping aggression phases to insure uniformity in subsequent scoring. Food presentation was accompanied by the onset of a hopper light and the two 17-W discrimination lights.

Discrimination training began during Session 51. The S^D period was signaled by the presence of the two discrimination lights and a white response key, while S^Δ was signaled by the presence of the buzzer and a red response key. All aggressive responses during S^D were immediately reinforced during initial discrimination training, while responses during S^Δ were not. S^D and S^Δ periods were randomly presented for 15 sec each. During Session 52, S^Δ was presented only after every third reinforcement and, between Sessions 55 and 59, was gradually increased to 30 sec, where it remained throughout the study.

E-S was shaped to keypeck beginning with Session 63. Immediate reinforcement during keypeck shaping was the onset of the S^D (termination of S^Δ) which, if followed by an aggressive response, was followed by food reinforcement. Between Sessions 63 and 68, the number of responses required to terminate S^Δ was gradually increased and maintained at a fixed ratio of 20 (FR 20).

Beginning with Session 71, C-S was trained to peck at the response key on the side wall, using the onset of S^Δ as the reinforcement. During Session 110, C-S was placed on a fixed ratio of 3 (FR 3) and remained there throughout the study. At this point, E-S was required to make 20 responses to produce the S^D , while C-S had to make 3 responses to remove the S^D . Every third response by C-S reset E-S's counter and therefore made it possible for C-S to postpone indefinitely the onset of S^D and the associated aggression by E-S. The only primary reinforcement presented was given to E-S for aggressive responses during S^D .

RESULTS AND DISCUSSION

Operant Level

There was some aggression during early operant level sessions, initiated mainly by E-S. However, after what appeared to be establishment of territories, the aggression gradually decreased to zero by the last 6 days of operant level. At this point, both Ss usually stood motionless in their

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Table 1
Mean of the First and Last Six Sessions of Each Phase*

Phase	Keypeck Responses				Fightings (Seconds)		Number of Attacks		Sessions	
	E-S	E-C	E-S	E-C	S ^D	S ^Δ	S ^D	S ^Δ	Total	Cumulative
Operant Level	0.0/ 0.0	0.0/ 0.0			13.8/ 24.5	—	2.3/ 1.7	—	24	1- 24
Shaping Aggression (E-S)	21.3/ 0.0	0.0/ 0.0			159.3/ 88.5	—	45.0/73.3	—	26	25- 50
Discrimination Training	0.0/ 0.0	0.0/ 0.0			128.7/123.3	148.3/43.1	84.4/77.8	11.2/4.5	12	51- 62
Keypeck Shaping (E-S)	155.2/446.3	1.2/ 2.3			71.3/ 69.8	23.0/31.0	50.8/50.8	2.5/3.8	8	63- 70
Keypeck Shaping (C-S)	722.2/668.8	2.0/96.5			61.0/ 75.5	31.8/ 4.5	35.8/29.3	3.0/0.5	56	71-126

*The first number in each column is the mean of the first six sessions of that particular phase, while the second number is the mean of the last six sessions of that phase. Also shown is the number of sessions each phase was in effect.

respective corners, E-S by the food hopper and C-S at the opposite side of the chamber.

Shaping Aggression

Examination of Table 1 shows that the introduction of food reinforcement to E-S for aggressive behavior brought about an immediate increase in both the time spent fighting (from 24.5 to 159.3 sec) and the number of separate attacks (from 1.7 to 45.0) per session. The dramatic increase in both of these measures demonstrates the powerful control exerted by the food reinforcement.

The appearance and disappearance of keypecking by E-S can most readily be explained by recalling that E-S had previous keypecking experience and then extinguished. By the end of the shaping phase, although the time spent aggressing had decreased from 159.3 to 88.5 sec, the number of individual attacks had increased from 45.0 to 73.3. Also, keypecking by E-S completely disappeared. Thus, both Ss were responding appropriately to the contingencies: E-S was no longer keypecking, attacking frequently, and breaking off the attack upon presentation of the food reinforcement. C-S was not initiating attacks, only defending itself and occasionally counterattacking when E-S was retreating for its reinforcement.

Discrimination Training

As can be seen in Fig. 1, the amount of aggression increased and showed less variability during discrimination training. In assessing that change, it should be remembered that the total amount of S^D time was decreasing as S^Δ time increased. Therefore, although the increase in aggression was not great, percentage of available S^D time spent aggressing increased substantially in both time and number of attacks. One tentative explanation for the increase is that E-S was not receiving reinforcement where it had ordinarily been given, and therefore the aggression could be considered extinction-produced, as noted by Azrin, Hutchinson, & Hake (1966).

Near the end of the discrimination phase, the amount of control exerted by the discriminative stimuli was tested by presenting S^Δ a number of times during fighting. Although no systematic record was kept, it was noted that the presentation of S^Δ ordinarily produced immediate cessation of fighting. It should also be noted that all keypecks during this phase were accidentally made during fighting, i.e., errant aggressive or flight responses.

Keypeck Shaping (E-S)

Both time spent fighting and number of attacks decreased as shaping of keypecking began for E-S (123.3 to 71.3 sec and 77.8 to 50.8 attacks, respectively). The decrease is understandable, since S^D was not presented until the appropriate response was made, thus frequently extending the S^Δ periods beyond 30 sec and thereby decreasing the amount of S^D (attack) time per session. Since the number of responses required of E-S to terminate S^Δ had been increased to FR 20 during

Sessions 63-68, a high of 958 responses was reached in Session 68.

All keypecks recorded for C-S during this phase were accidentally made while fighting. These accidental responses occurred frequently, since C-S nearly always positioned itself away from E-S (who occupied the front of the chamber where the food hopper was located) and thus near its response key which was located on the back wall. Also, the response key was extremely sensitive and therefore easily operated by a misguided wing box, bump, or peck.

Keypeck Shaping (C-S)

Teaching C-S to keypeck was a difficult task which presumably meant either: (1) termination of the S^D condition was not a reinforcing event for C-S, or (2) the anticipated aggression by E-S was eliciting some respondent behavior that interfered with the acquisition of the keypeck response. The latter proved to be correct.

Twenty-two training sessions were required to shape the first response by

Fig. 1. Number of attacks by E-S, illustrating the progressive change in aggressive behavior during the five phases of the study.

C-S before being attacked by E-S (an avoidance response). At that point, C-S gradually increased its keypecking rate. As C-S's rate increased, the number of responses required to terminate S^D was gradually increased to FR 3. As noted in Table 1, C-S averaged 2.0 responses for the first 6 sessions of this phase and 96.5 responses for the last 6 sessions. During the last 20 sessions, C-S made approximately 80% of its keypecking responses while E-S was either eating or keypecking (during S^A), about 18% before the attack but during S^D, and around 2% during the actual attack. Therefore, it can be concluded that keypecking by C-S was functionally related to postponing the onset of S^D and the associated aggression by E-S.

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