Social interaction between rats on different schedules of reinforcement[1]

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Twelve Long-Evans rats were individually trained on different schedules of reinforcement and then run in pairs in a two-lever cage. Results indicated that various classes of social behavior could be experimentally produced and studied in the same manner as individual behavior by manipulating schedules of reinforcement

Although operant methods have enjoyed widespread application in recent years, they have not significantly penetrated the field of social behavior among animals. Animal social behavior has remained largely in the domain of the ethologists—with emphasis on natural observations rather than on manipulation.

The following experiment was designed to investigate social interaction among rats as a function of individual schedules of reinforcement. Specifically, in exploring various combinations of schedules, we were looking for the emergence of anv of the categories of social behavior (such as *dominance* or *cooperation*) as defined analytically by Keller & Schoenfeld (1950).

Method

Rats were trained in a two-lever Skinner box with a removable Plexiglas divider separating the two levers. During training the rat was confined to one side of the box; the rats were trained to stable performance.

Individual schedules of the six pairs were as follows:[2]

	Left lever (A)	Right lever (B)
Pair 1	DRL 10	FR 10
Pair 2	DRL 10	FR 20
Pair 3	DRL 10	FR 4
Pair 4	DRL 10	FR 10
Pair 5	FR 3	FR 30
Pair 6	FR 3	FR 30

Each experimental session consisted of running an A rat and a B rat together with the Plexiglas divider removed and the levers programmed to the respective pretrained schedules. During each session the data consisted of cumulative response curves and number of responses emitted on the untrained lever. Photographic records were obtained during a portion of the sessions.

Results

Figure 2 indicates that in pairs 1 through 4, B responded more on A's lever during the first half of the session than during the second half. This fact cannot be readily explained in terms of extinction because DRL lever reinforcement was available to B with an equal probability throughout the session. It should also be noted that although this decreasing trend was evident in all four pairs of animals, the actual number of B's responses on the A lever was smallest for pair 3, the pair whose B animal had the greatest probability of reinforcement on his own (FR 4 lever).

In all four pairs, A aggressed against B early in the session when B entered A's side of the cage. As the session progressed, A ceased attacking B and merely drove B away with postural responses. At no time did A attempt to respond on B's lever. B ate the pellets he worked for but rarely was allowed to eat those for which A had worked.

In pair 5, after less than 2 min. of responding on his own (FR 30 lever), B began responding on A's (FR 3) lever and also eating pellets which A had worked for. Throughout the remainder of the session both animals remained at the A lever and alternated lever pressing and eating. In pair 6, although B did obtain a total of 12 reinforcements at his own (FR 30) lever, both animals exhibited the same behavior pattern as pair 5; that is, cohabiting A's side of the cage, and alternating lever pressing plus eating from A's food tray. In neither pair 5 or 6 were there signs of aggression nor did A respond on B's lever.

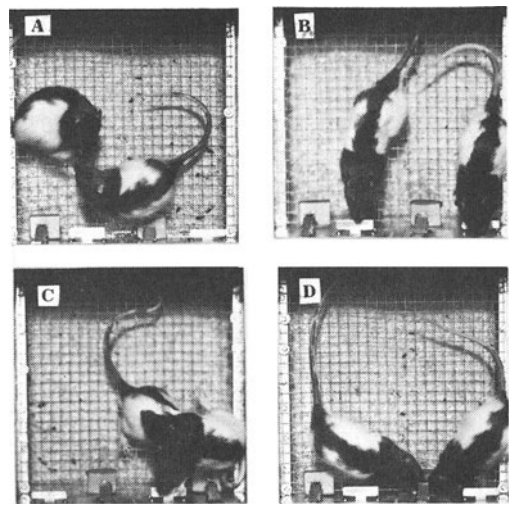

Fig. 1. (A) Initial exploratory behavior typical of all six pairs of subjects in two-lever situation. (B) Brief period of "individual" behavior prior to social interaction. The length of this period appeared to be a function of the schedule on which B was trained. (C) Typical interaction of A and B rats (pairs 1-4) following B's entrance to DRL side of cage. (D) "Compatibility" typical of Fixed Ratio animals of pairs 5 and 6 on A's side of cage.

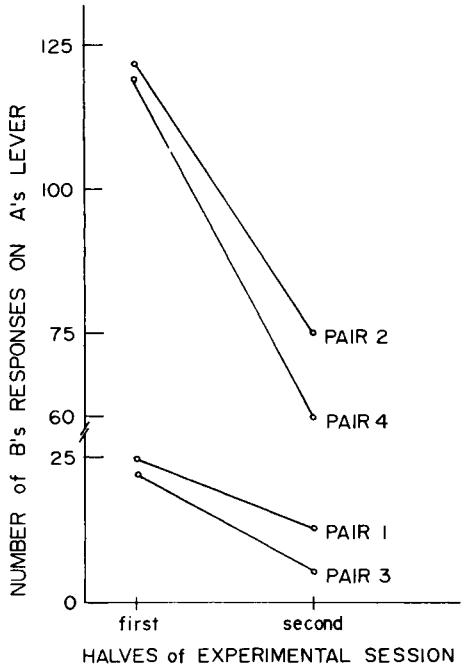

Fig. 2. Number of responses emitted by B animal (FR trained) on A lever (programmed on DRL 10) during first and second halves of each experimental session. Each half was defined by the delivery of 25 DRL reinforcements.

Discussion

This experiment has attempted to demonstrate that with same-sex animals of equal food deprivation, age and weight, social interaction can be manipulated by individual schedules of reinforcement.

The individual and social behavior observed is consistent with characteristic schedule performance. For example, DRL animals are known to establish complex "time consuming" behavioral chains (Hodos, Ross, & Brady, 1962; Davis & Wheeler, 1966). Such animals generally remain "chain-bound" and emit no new responses unless directly interrupted. Consistent with this is the fact that the DRL animals in the current experiment remained working at their own levers and did not sample the other available lever.

The behavior of the fixed ratio rats on the DRL lever was also characteristic in that all such responses on the opposite lever occurred during the pause times immediately following reinforcements. Thus, while the DRL animals could be expected to remain "chain-bound" until directly disrupted, the fixed ratio animals could be expected to sample or initiate other behaviors during pause time. The previously described decrease in aggression and increase in threatening postural responses by A is typical of the dominance pattern described by Keller & Schoenfeld (1950). In their terms, A has "...become a strong secondary negative reinforcer and discriminative stimulus (S^D) to the extent that a mere gesture will lead the submissive animal to beat a hasty retreat" (p. 356).

The case of pairs 5 and 6 is of special interest in that A (FR 3) allowed B (FR 30) to work with him at the "hotter" lever. It is suggested that A did not drive B away because (1) there was no disruption of a complex ongoing chain as there had been with the DRL animals, and (2) there were pellets enough for every rat on the FR 3 schedule. Thus, in contrast to pairs 1 through 4, the experimental situation of pairs 5 and 6 was structured to allow both animals compatible existence within A's territory.

Conclusions

Beyond the realm of elicited or hormonally-controlled responses, behavior in the multi-organism situation may be under the control of a variety of social and non-social stimuli. Although only a few of a sizable number of possible schedule pairings have been presented in this exploratory study, we are led to believe that if potential eliciting factors (sex, weight, etc.) are held constant, traditional categories of social behavior may be brought under the same degree of experimental control that has been exercised over individual behavior by schedules of reinforcement.

References

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Keller, F. S., & Schoenfeld, W. N. *Principles of behavior.* New York: Appleton-Century-Crofts, 1950.

Notes

1. From Bureau of Medicine and Surgery, Navy Department, Research Task MF022.01.03-1002. The opinions and statements contained herein are the private ones of the writers and are not to be construed as official or as reflecting the views of the Navy Department or the Naval Service at large.

2. On the FR (Fixed Ratio) schedule, reinforcement is contingent upon every n^{th} response. Thus, on an FR 10, each tenth response is reinforced. On the DRL (Differential Reinforcement of Low Rates of Response) schedule, reinforcement is contingent upon the passage of a specified minimum inter-response time. On the DRL 10 sec., for example, only a response which follows the previous response by at least 10 sec. is reinforced. Responses occurring sooner than the completion of the specified 10-sec. interval automatically recycle the timing mechanism and are not reinforced.