were isolated projected to all of the motoneurons from which recordings were taken. In each of the five remaining cases a single negative result was obtained. Clear-cut evidence for a projection was thus found in 72 of the 77 motoneurons. The results when stretch (53 units) or electrical stimulation (24 units) was used were not different.

There are approximately 300 alpha motoneurons innervating the medial gastrocnemius muscle (*4*). When these cells were discharged antidromically, field potentials were recorded with microelectrodes over a 6-mm length of the spinal cord. According to Sterling and Kuypers' recent study (*5*) on motoneurons, their "predominant dendritic orientation is longitudinal." Since these dendrites contribute to the field potentials, increasing their total extent, we infer that the cell bodies of the motoneurons are distributed over a more limited range, probably a 4- to 5-mm length of spinal cord. In all experiments we tried to obtain recordings throughout the full extent of the medial gastrocnemius pool. It was difficult, however, to find and record from motoneurons at the limits of this cell column. The maximum longitudinal separations of cells from which positive responses were obtained in each experiment is given in Table 1. The greatest separation found in this rather small sample was 3.8 mm, but studies on projections of Ia fibers to heteronymous motoneurons (lateral gastrocnemius) indicate that the terminals of a single Ia fiber are distributed more widely.

The amplitudes of the EPSP's recorded in this series ranged from 17 to 700 μv, which encompass the values reported by Kuno (*6*). The "rhythmic EPSP's" described by Burke and Nelson (*7*) were much greater in amplitude and probably represent the largest EPSP's to be found in gastrocnemius motoneurons. They were noted in only 10 percent of the cells examined and probably were produced by impulses in large Ia fibers terminating on the somas of small motoneurons with large input impedances (*8*). In our experiments the responses produced by the same afferent in different motoneurons varied widely in their amplitudes, rise times, and subsequent time courses, suggesting that the numbers of boutons terminaux and their locations on the motoneurons differed from cell to cell in a manner consistent with the model of Rall and his colleagues (*9*).

Two different types of negative results were encountered. One type resulted from conduction blocks produced during the dissection of dorsal root filaments. Blocks which were distal to the recording electrodes were readily recognized, but those occurring at the zone of root entry proximal to the recording electrodes were not suspected until intracellular recordings revealed a complete absence of EPSP's in all motoneurons. We discarded four filaments for this reason and did not enter the negative results in Table 1. The other type of negative result occurred in experiments in which the afferent fiber was known to be conducting normally as evidenced by positive results in the initial penetrations and in penetrations subsequent to the negative finding. Five examples of this type were found and tabulated. In all cases the negative results were obtained after numerous insertions of the microelectrode into the spinal cord. It is possible that a branch of the afferent fiber had been damaged by the microelectrode or by bleeding within the spinal cord.

We conclude that a primary spindle afferent fiber sends its terminals to a large percentage of the motoneurons of its muscle. Conversely, a single motoneuron must receive afferent fibers from almost all of the spindles of the muscle it innervates. In view of the nearly complete projection of a Ia fiber found experimentally, one is tempted to conclude that the projection is, in fact, complete and that in the case of the medial gastrocnemius each primary afferent fiber sends terminals to all 300 of the motoneurons.

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Agonistic Behavior in Organized and Disorganized Cotton Rat Populations

Abstract. *Agonistic interaction rate is significantly lower in groups of caged cotton rats* (Sigmodon hispidus) *from naturally occurring organized populations than in groups composed of strangers. Some type of social structure is apparently present between animals sharing a common area under natural conditions. After a 24-hour period, there is no significant difference in the behavior of the two groups, an indication that a social structure is rapidly formed in the disorganized groups.*

Most observations on the social behavior of rats and mice are made on caged populations under artificial conditions due to the fact that these primarily nocturnal animals inhabit areas where observation on naturally occurring populations are impossible. Social disorganization (forcibly placing strangers together) is probably a major factor influencing the intense agonistic behavior commonly observed in caged populations (*1, 2*). Data on social encounters under natural conditions are very limited and suggest that mutual avoidance may be a common (*1, 3*) but not universal (*4*) result of encounters between strange mice.

Calhoun (*5*) reported on the results of social disorganization caused by introducing aliens into natural populations of Norway rats, but there has been no comparison of the social behavior of animals taken from naturally occurring organized populations with that of disorganized populations created by placing strangers together. We now provide information on the presence or absence of social structure or organization in natural populations of cotton rats, the effects of social disorganization on the behavior of groups of strangers, and the development of social structure in the disorganized groups.

Adult cotton rats (*Sigmodon hispidus*), one of the most widespread and successful mammal species in southern North America, were trapped live from an area of 0.2 hectare or less. Trapping of these "organized" groups was conducted in Tuscaloosa, Etowah, and Mobile counties, Alabama. No estimate of the home range of the species is available for this area, but recapture of approximately 40 animals indicates that individuals usually move over areas larger than this. Animals in the "disorganized" groups were trapped from areas several kilometers apart. The possibility of previous contact between any of them is negligible. Captured animals were housed singly in the laboratory for 1 to 5 days before being tested. Each group was composed of four animals. We used a large observation cage (2.4 by 1.2 by 1.2 m) with a glass front. The floor was covered with soil, and grass was planted in the cage to simulate natural habitat. Rocks and logs were included for cover, and food and water were available at all times. Social interactions were recorded during the 30-minute period immediately after the introduction of each group into the cage (trial 1). There was another 30-minute observation period (trial 2) 24 hours after the first. Introductions into the large cage occurred at approximately 9 p.m., and observations were made under illumination from two 20-watt red light bulbs. The sex composition of the organized and disorganized groups (Table 1) was not equated more exactly because some difficulty was encountered in obtaining groups of four adults from areas small enough to insure previous contact between the individuals. To minimize the amount of time during which captured animals were kept singly, we began the tests as soon as four adults were secured from a given area. However, three of the organized groups have identical disorganized counterparts, and a comparison of these groups gives the same results as an overall comparison. Agonistic encounters are grouped as major (fights and chases) or minor (threats and avoidance behavior by subordinate animals).

In trial 1, the disorganized groups showed significantly more total encounters ($P > .98$) and major encounters ($P > .99$) than the organized groups did (Table 1). In trial 2, there was no significant difference in number of agonistic encounters. The organized groups showed no significant decrease in number of encounters in trial 2. The disorganized groups exhibited a significant decrease, in both total ($P > .99$) and major encounters ($P > .99$).

The higher agonistic interaction rate noted in the groups of animals which had had no previous contact must be attributed directly to social disorganization. Other factors such as confinement and laboratory conditions were equal and apparently much less important. This difference in the behavior of the organized and disorganized groups indicates a familiarity between individuals trapped from the same area and strongly suggests that some social organization existed in the natural populations from which they were taken.

Table 1. Comparison of agonistic encounters in organized and disorganized cotton rat populations. Disorganized groups: I, four males; II, three males and one female; III, three males and one female; IV, four males; V, three males and one female; VI, three males and one female. Organized groups: I, three males and one female; II and III, four males each; IV, two males and two females.

Groups	Major encounters		Total encounters	
	Trial 1	Trial 2	Trial 1	Trial 2
		Disorganized		
I	30	11	6	1
II	23	7	7	2
III	15	4	6	1
IV	31	5	11	0
V	13	9	2	0
VI	33	4	12	0
		Organized		
I	5	6	0	0
II	11	5	0	1
III	9	5	2	1
IV	12	7	0	0

The rapid decrease in agonistic behavior during the first 24 hours in the disorganized groups indicates that dominance relationships are established rapidly. Thus, it seems that social disorganization in this species does not persist long and may be a factor in studies on social behavior only for a short initial period.

Intense exploratory behavior immediately after introduction of the animals into the cage undoubtedly was a factor in the higher number of interactions during trial 1. If the apparent (although not statistically significant) trend toward fewer encounters on trial 2 in the organized groups is real, this probably accounts for it.

Our observations, along with trapping results which indicate extensive overlap of home areas, suggest that the social behavior of the species in nature is characterized by relative dominance (*6*).

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Reversal Learning and Forgetting

Gonzalez, Behrend, and Bitterman (*1*) assert, on the basis of their experimental findings, that improvements in reversal learning occur as the result of increasing decrements in retention. In their report, however, they fail to include some data vital in the testing of their hypothesis. When such data are provided (see, for example, *2*, *3*) the hypothesis is invalidated.

If we accept the claim of Gonzalez *et al.* that decrements in retention account for improved reversal learning, it is logically impossible for the error curve to fall below the initial error level (on reversal 0), unless initial performance of the group is above chance —a situation not ideally suited for studying reversal learning. That is, if progressive improvement in reversal occurs because the pigeon remembers progressively less about the reward contingency of the previous session, then, after a large number of sessions, the pigeon is effectively naive when confronted with the discrimination task. Therefore, the lowest error score the pigeon could attain on a reversal problem would be no better than in its very first session (reversal 0). Data on error scores in the first session, which the authors do not present, are needed to determine the validity of their hypothesis.

Such data are provided in an experiment of Gonzalez, Roberts and Bitterman (*2*). Using a simultaneous black-white discrimination, they find that their rats make a median number of 16 errors in reversal 0. In subsequent reversals the error score rises at first and then declines to a stable level of eight errors per reversal. Since, for the rat, performance after a large number of reversals is superior to that at reversal 0, it is clear that there *is* retention of information concerning earlier sessions. Further, since, according to Bitterman (*3*, p. 404), "in experiments on habit reversal . . . the pigeon behaves like the rat," we would predict that if the data for reversal 0 were provided (and perhaps the number of reversals increased) the above results would also hold true for the pigeon. Thus, the data for the rat, and no doubt for the pigeon, render highly questionable the hypothesis of Gonzalez, Behrend, and Bitterman that improvement in reversal learning is a result of decreased retention.

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