MATERNAL BEHAVIOUR IN RICHARDSON’S GROUND SQUIRREL, 
SPERMOPHILUS RICHARDSONII RICHARDSONII: RETRIEVAL OF 
YOUNG BY LACTATING FEMALES

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Abstract. The experimental study of retrieval has been extended to a Sciurid. Young were placed outside the nest and the time for the mother to retrieve them noted. Average retrieval time per young fell from 45 s on the first test to 15 s on the second. The improvement resulted from a decrease in the time spent in the nest between retrievals. No improvement in latency to retrieve nor in handling time was noted. The same improvement occurred if tests were started 10 days post-partum. Retrieval ceased abruptly about 3 weeks after birth. Retrieval of up to 200 young was noted.

Studies with several rodent species have shown that retrieval of young by lactating females improves with experience. Beach & Jaynes (1956) and Carlier & Noirot (1965) found that laboratory rat mothers take longer to retrieve pups on the first test than on subsequent tests. The improvement results from a decrease in the latency to start retrieving, from a decrease in the time spent on dispersed activities, and from more skilful handling of pups. The former authors found that the same improvement occurred whether the tests were begun 1, 3 or 7 days after birth. Rosenblatt & Lehrman (1963) found that lactating rats showed a rapid improvement in retrieval during the first 4 days as a result of reduced latency to retrieve the first young, and from use of a more direct route to the nest. Golden hamster and deer mice mothers also showed a rapid decrease in retrieving latency from the first to subsequent tests (Rowell 1960; King 1958).

Retrieval in rats rapidly declines when young are about 15 days old (Rosenblatt & Lehrman 1963; Rosenblatt 1969). Cessation of retrieval in golden hamsters occurs abruptly when the young are 20 to 24 days old and is preceded by an increase in the latency to retrieve (Rowell 1960). King (1958, 1963) found that deer mice failed to retrieve 15- to 18-day-old pups which were active enough to return to the nest and avoid the mother. In laboratory mice retrieval ceases rapidly when the young are about 13 days old (Noirôt 1964).

Retrieval of large numbers of pups has been noted in rats, mice and flying squirrels. Zippelius & Schleidt (1956) performed an experiment in which a mouse mother retrieved 148 young. Post-parum rats will repeatedly press a bar, which delivers a rat pup, and take the young to the nest (Wilsoncroft 1969). One female bar-pressed for, and retrieved, 684 pups in 3 hr. Lactating flying squirrels have been observed to retrieve thirty-five and fifty young (Muul 1970).

Retrieval of young has been observed in red squirrels (Eibl-Eibesfeldt 1963) and flying squirrels (Muul 1970), but I am not aware of any experimental work that has been performed to study the improvement in retrieval with experience in a member of the Sciuridae. The purpose of this work was to determine whether lactating Richardson’s ground squirrels would retrieve their young, whether they would show an improvement in performance with experience, and whether they would retrieve large numbers of young.

Methods

Subjects

Fourteen female Richardson’s ground squirrels (Spermophilus richardsonii richardsonii) were live-trapped in southern Saskatchewan (seven in 1969 and seven in 1970). The animals were trapped in mid-April, 2 to 3 weeks prior to the expected time of parturition.

Materials

The animals were housed indoors, under temperature and light regimes which fluctuated with outside conditions, in wooden cages (76 x 41 x 30 cm) with wire mesh floors and front panels. The back of each cage was divided into two boxes (30 x 20 x 30 cm), one to serve as a nest site, the other as a reward food box. Each box had a 9 cm² opening fitted with a door which could be closed and opened from outside the cage.
Oats, sunflower seeds, dog food cubes and water, containing a multiple vitamin solution, were provided ad libitum. Lettuce leaves and dandelion heads (Taraxacum sp.) were used as reward foods. Paper towels were provided for nest material.

Testing Procedure

The animals were undisturbed for the first few days and then a training procedure, similar to that used by Carlier & Noirot (1965), was initiated. Reward food was placed in the food box and the female allowed to enter freely. The animals quickly learned to respond to the reward. The next stage was to accustom the females to being closed in the box. The door was closed as soon as the female started eating; if she showed signs of fright the door was immediately opened. After several days all but one animal, which was dropped from the experiment, were accustomed to entering the box and being closed in it.

The purpose of training was to ensure that the retrieval study would not be complicated by the fear response shown when young are removed from the mother. With the female eating in the food box the young could be taken out of the nest without disturbing her.

Eleven of the remaining animals gave birth between 31 April and 8 May; the other two did not litter. The retrieval behaviour of nine females was first tested as soon as possible after parturition. The other two were not tested until 10 days post-partum. Tests were given daily until retrieval ceased.

Each test began by enclosing the female in the food box, removing her young (using forceps or disposable plastic gloves) and placing them at the front of the cage. The door to the food box was then opened and the female allowed to leave voluntarily. The following times were recorded: time from the food box to pick up the first young, time to deposit the young in the nest, time to pick up the second young, time to deposit the young, and so on, until all young were back in the nest.

Discovery and handling time per young refers to the time required for the mother to go to and then pick up the young after having left either box. Deposit and reappearance time per young refers to the time spent taking the pup to the nest, putting it down and reappearing to retrieve another. Retrieval time per young includes both the discovery and handling time and the deposit and reappearance time.

Two experiments were performed with 5- and 12-day-old young in an attempt to exhaust retrieval. For these the retrieved young were placed back on the floor while the female was retrieving another, so that there were always young out of the nest.

Results

Figure 1 shows the daily average retrieval time per young for the first 3 weeks after parturition.

![Graph](image)

Fig. 1. N=9, average litter size 7-2. A total of sixty-five young is involved.

The rapid drop in average retrieval time per young between the first and second tests indicates improved performance. In order to determine where the improvement occurred the first five tests for eight females with litters of six or larger were analysed in detail (Table I). Since young were always taken directly to the nest, the deposit and reappearance time reflected the time spent by the mother in the nest before reappearing for another young. On the first test 71.5 per cent of the time to retrieve six young was spent in the nest with the first retrieved young. Less time was spent with the second, and subsequent, young. The pattern of quickly depositing young, established by the end of the first test, was maintained in the following tests.

Table II gives the average discovery and handling time per young for the first five tests. The
Table I. Performance of Females* on the First Five Daily Tests Post-Partum

<table>
<thead>
<tr>
<th></th>
<th>Day 0</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average time to</td>
<td>354</td>
<td>83</td>
<td>71</td>
<td>77</td>
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<td>retrieve first</td>
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<td>six young (s)</td>
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<td>Average deposit and</td>
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<tr>
<td>reappearance time for:</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1st young</td>
<td>253</td>
<td>14</td>
<td>16</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>2nd young</td>
<td>35</td>
<td>10</td>
<td>8</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>3rd young</td>
<td>18</td>
<td>10</td>
<td>7</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>4th young</td>
<td>15</td>
<td>12</td>
<td>9</td>
<td>8</td>
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<tr>
<td>5th young</td>
<td>11</td>
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<td>9</td>
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</tbody>
</table>

*Eight females with litters of at least six young.

Table II. Average* Discovery and Handling Time per Young for the First Five Daily Tests Post-Partum

<table>
<thead>
<tr>
<th></th>
<th>Day 0</th>
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<th>Day 3</th>
<th>Day 4</th>
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<tbody>
<tr>
<td>Average time (s) to</td>
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<td>8</td>
<td>9</td>
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<td>discover and handle:</td>
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<tr>
<td>1st young</td>
<td>5</td>
<td>5</td>
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<td>6</td>
<td>5</td>
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<tr>
<td>2nd young</td>
<td>5</td>
<td>5</td>
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<td>6</td>
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<tr>
<td>3rd young</td>
<td>3</td>
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<td>4th young</td>
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<tr>
<td>5th young</td>
<td>3</td>
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<td>3</td>
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<td>4</td>
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</tbody>
</table>

*Eight females with litters of at least six young.

time to go to and pick up the first young on the first test was no greater than on later tests and there was no inter-test improvement in discovery and handling time for subsequent young. Pups were generally held by the nape of the neck or the back, in contrast to the ventral holding found in rats (Carlier & Noiroi 1965) and deer-mice (King 1958). The mother frequently manipulated the young in her mouth with her forepaws. On fourteen occasions two young were picked up together and both taken to the nest.

Two females were not tested until 10 days post-partum in order to determine whether the improvement in retrieving was a result of increased experience or increased familiarity with the experimental situation. During this time, the animals were able to handle their young and retrieve any which strayed from the nest or were dragged out on the teats. When tested these females showed the same pattern as those tested soon after birth. Average retrieval time per young was 48 s on the first test, and 24 s on the next test. One hundred and thirty-eight seconds were spent in the nest with the first retrieved young, 44 s with the next young, and for subsequent young and subsequent tests 12 to 20 s were required to deposit young.

For 160 tests the behaviour of the female after retrieving the last young was noted. In 98 per cent of the tests the female came out of the nest and searched the area where the young had been. In the other three tests the female poked her head out of the door but did not come out fully.

Retrieval ceased abruptly 20 to 25 days after birth. At this stage the young were mobile, large (40 to 50 g) and their eyes were opening. Because of their mobility they could pull themselves back to the nest. For twenty tests, in which no retrieval occurred, it took an average of 209 s for all the young to return to the nest.

The first attempt to exhaust retrieval resulted in retrieval of 200 young in 46 min 6 s, at which stage the test was terminated. On the other test 154 young were retrieved in 44 min 15 s, when the female stopped and ate for 34 min. Retrieving recommenced and the test was terminated when a further sixteen had been retrieved.

Discussion

Lactating Richardson's ground squirrels showed a rapid improvement in retrieval performance, and most of the improvement occurred not only between the first and second tests but during the first test. Unlike laboratory rats, deermice and golden hamsters, the ground squirrels showed no decrease in the delay to retrieve the first young. On all tests it took about 8 s to collect the first young. This was slightly longer than the time to pick up subsequent young in the same test because several seconds were spent investigating the young before initiating retrieval. The improvement instead resulted from a decrease in the time spent in the nest before reappearing for another young. King (1958) found that deermice spent no more time depositing the first young on the first test than for other young. Rosenblatt & Lehrman (1963) found a decrease in the time for rats to go out and retrieve further pups. The fact that ground squirrel mothers spent an average of 253 s with the first retrieved young suggests that the presence of only one young in the nest was sufficient.
to release nursing and cleaning behaviour. Once the animal had come out again and discovered more young, she established a pattern of rapidly depositing young and searching for more.

After retrieval of all pups the female generally looked for more before returning to the nest or eating. This behaviour and the data from the exhaustion tests indicate that the mother had no exact concept of the number of young in the litter and retrieved until no more were left. Similar results were obtained for flying squirrels by Muul (1970). Unpublished data show that sight of the young is an important stimulus for retrieval under laboratory conditions.

Retrieval stopped abruptly at a time when the young were opening their eyes. Although the pups could crawl to the nest, they took longer to do this than the mothers did to retrieve. Therefore mobility of the young per se was not the cause of cessation, but their increased size and activity probably resulted in a weaker stimulus for retrieval.

The previous history of only two of the experimental animals was known, and undoubtedly the group consisted of both yearling adults and adults which had littered in the field in previous years. It was known that two animals were primiparous; their performance generally fell within the range of the others. Carlier & Noirot (1965) found that rats performed better on their second lactation period, whereas Beach & Jaynes (1956) discovered no difference between primiparous and multiparous rats. The former authors, had, however, remated their primiparous subjects and retested them, so the subjects had previous experience with the experimental situation. Allowing ground squirrel and rat mothers several days to handle their young before testing made no change in the retrieval pattern. It can be concluded that testing animals with their first or a subsequent litter and testing them soon after birth or after a delay makes no difference to their performance, providing they have never been tested in the specific experimental situation before.

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REFERENCES


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