

SOCIAL EFFECTS IN THE WEANING OF DOMESTIC RAT PUPS¹

BENNETT G. GALEF, Jr.²

McMaster University, Hamilton, Ontario, Canada

Results of previous experiments have indicated that adult members of a wild rat colony play a major role in determining the diet on which rat pups born to colony members first feed. The present experiments examine the nature of the interactions between adult and young rats which affect the initial food choices of the young. The results indicate that the interaction is not due to imitation of the adults by the young, but rather to a tendency on the part of the young to approach areas in which the adults are located and begin feeding there.

The period during which altricial mammals wean from a pure milk diet to one of solid food is a time of major stress (Ewer, 1968). Not only do the young have to locate the necessary solid foods (unless these are transported to the nest site by adult conspecifics), they must also learn their way about an unfamiliar and potentially hostile environment in order to find them. Scott (1958) has stated that wild rat pups in the process of weaning "have to go out and find their own food once the nursing period is over [p. 117]." However, the results of a recent study (Galef & Clark, 1971) indicate, to the contrary, that adult members of a wild rat colony play a rather active role in directing early ingestions of solid food by their young. In the paper by Galef and Clark evidence was presented demonstrating the marked effect of the learned food preferences of adult wild rats on the initial food choice of their young. The young rats ate only the food the adults of their clan were eating and completely avoided ingesting a normally preferred diet which the adults of their colony were avoiding as a result of its previous association with poison. The observed behavior of the pups was interpreted as depending on a three-stage

process in which (a) the young wild rats first follow the adults to food, (b) then learn cues associated with that food, and (c) thereafter tend to avoid ingesting alternative diets as a result of their learned familiarity with the diet they first ate and their general neophobia with respect to novel alternative diets (Barnett, 1963).

The present series of experiments examines more closely the initial and most important stage in the formation of the learned feeding preference described above, the influence of adult rats on the weaning of the young, and explores the nature of the interactions between adult and young rats which influence the course of weaning to solid food on the part of rat pups.

Although both Scott's (1958) statement and the previous experiment were concerned with the behavior of wild rats, the present investigations were conducted solely with hooded domesticated rats for three reasons. First, domesticated as well as wild rats demonstrate the behavior of interest, a following response oriented toward the parents (Galef & Clark, 1971). Second, the considerable ferocity of adult wild rats and timidity and shyness of their pups in the presence of human observers make them inappropriate for the present studies, and, third, the presence of conspicuous and readily identifiable naturally occurring individual markings on hooded rats greatly facilitates observation of individual behavior.

EXPERIMENT 1

If adult rats have an important effect on the weaning of their young, then the adults'

¹The research reported here was supported by National Research Council of Canada Grant APA-0307 and a McMaster University research board grant to the author. Thanks are due to J. Alberts, A. Martinson, K. Plosbay, K. Fawcett, and S. Dunn for their assistance in observation of the animals.

²Requests for reprints should be sent to Bennett G. Galef, Jr., Department of Psychology, McMaster University, Hamilton, Ontario, Canada.

presence during the time food is available to the young should have observable effects on the weaning behavior of the young. The present experiment was designed to determine whether or not the absence of adult rats during the time food was available

Method

Subjects. The subjects were 11 16-day pregnant female hooded rats obtained from the Quebec Breeding Farm, and their offspring.

Procedure. Individual pregnant female rats were established in clear plastic nest boxes (12 × 14 × 6½ in.) with food and water constantly available. Ample sawdust was provided as nesting material and one end of the nest box was covered with an opaque lid 4 in. wide to induce nesting beneath it.

Litters were reduced to eight pups on the day following parturition and further reduced to four pups 9 days later. On the tenth day postpartum mothers and their respective litters were assigned to one of two groups so as to equate as nearly as possible their mean gestation period. Females in both groups were placed on a 3 hr/day feeding schedule, eating a wet mash composed of Purina powdered Lab Chow and water from two metal food cups (2 in. diam × 1½ in.). Females in one group (Group 1) received their food in the nest boxes with their pups and were then removed to individual holding cages for the 3-hr. period immediately following feeding. The food cups for this group were placed approximately 9 in. apart and approximately 11 in. from the nest.

Females of the second group (Group 2) were removed from their respective nest boxes and offered the Purina and water mash for 3 hr. while being held in individual cages. During this period two metal food cups containing the Purina mash were placed in their home cages in the same position as those placed in the nest boxes of Group 1. Thus, the pups of the females in the two groups differed only in the presence or absence of their mother during the time food was available to them in their nest boxes.

The experimenter observed the pups throughout the 3-hr. feeding period and recorded any instances of feeding from the wet mash by the pups. All pups were weighed on Day 16 postpartum.

Results

The results of Experiment 1 are presented in Figure 1 which indicates the percentage of pups in both groups eating wet mash as a function of days postpartum. As can be seen by inspection of Figure 1, there is very little overlap between the two groups. All pups whose mothers were present in the nest

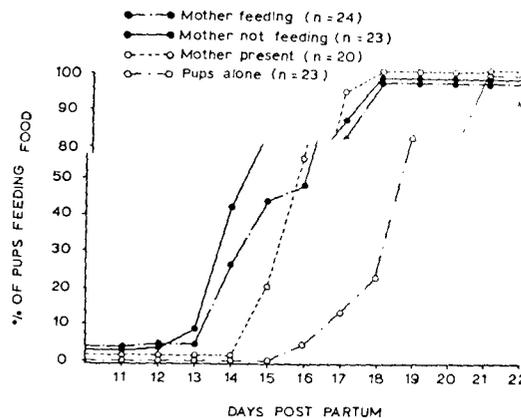


FIG. 1. Percentage of pups feeding on solid food in Groups 1 and 2 of Experiment 1 (open circles) and in Experiment 2 (filled circles).

box when food was available to the pups began to eat the mash before 77% of the pups which did not have their mothers present when food was available.

The mean weights of the two groups of litters at 16 days postpartum were 28.9 gm. for Group 1 and 29.6 gm. for Group 2 and there was no correlation between the weight of pups and their age at first feeding on the Purina mash ($r = -.09$, $df = 46$).

Discussion

The fact that the pups of the two groups did not differ appreciably in weight suggests that the observed differences in behavior were not due to differential rates of maturation resulting from differences in the treatment of their mothers. The marked differences in age at weaning for the two groups demonstrates the importance of adult-offspring interaction in the initiation of feeding on the part of the pups. The present experiment indicates neither the nature of the effect the parent is having on the young nor the behavior of the parent responsible for the observed reduction in age of initiation of feeding. Experiment 2 was designed to examine the latter of these problems.

EXPERIMENT 2

It was demonstrated in Experiment 1 that the presence of a feeding mother in the

home cage with a group of pups markedly reduces the age at which weaning occurs. The present experiment was designed to determine whether the fact that the mother was feeding was an important factor in initiating feeding on the part of the pups or whether her presence in the vicinity of the food cups was in itself sufficient to produce the previously observed effect on the age at weaning of the pups.

Method

Subjects. The subjects were 12 pregnant female hooded rats and their offspring.

Apparatus. The nest boxes were identical to those in Experiment 1 except that an ancillary cage (10 × 8 × 5½ in.) was attached to the far end of each nest box from the covered end under which the nest site was located. An opening 9 × 4 in. covered with hardware cloth connected the nest box and ancillary cage.

Procedure. The procedure was identical to that in Experiment 1 for the first 9 days postpartum. On Day 10, the females were divided into two groups so as to equate the mean gestation period of the groups and placed on a 3 hr/day feeding schedule. Each of the females in one group was offered the Purina mash diet from two food cups secured 8 in. apart against the hardware-cloth partition separating the nesting box and ancillary cage. The feeding period for this group lasted 3 hr/day, during which time each female was confined in the ancillary cage attached to her nest box. These females were then removed to individual isolation cages for a further 3 hr. Each female in the other group was placed in the ancillary cage attached to her nest box with two empty food cups 8 in. apart secured against the hardware-cloth partition for 3 hr. and was then removed to an individual isolation cage where she was fed on Purina mash for 3 hr.

Pups in both groups had two food cups filled with wet mash available to them during the 3 hr. in which their mothers were confined in the ancillary cages. The food cups presented to the pups were located immediately adjacent to the cups presented to their mothers but separated from those cups by the hardware-cloth barrier. The pups' food cups were located about 11 in. from the nest site. The sole difference between the two groups of pups was with respect to the presence or absence of feeding on the part of their mother while the pups had food available to them in the nest box proper. The experimenter recorded the age of first ingestion of mash for the two groups of pups and weighed all pups at 16 days of age.

Results

The results of Experiment 2 are reported in Figure 1. Both of the groups in Experi-

ment 2 showed distributions of age at weaning similar to those of the animals in Experiment 1 whose mothers were present while food was available. Comparison of the two groups in the present experiment reveals that the pups whose mothers were feeding while in the ancillary cages tended to wean slightly later than those whose mothers were not feeding while in the ancillary cages. The mean weight at 16 days postpartum for pups whose mothers were fed in the ancillary cages and in the nest boxes were, respectively, 27.4 and 27.8 gm.

Discussion

The results of the present experiment indicate that the feeding behavior of the mother is not important in eliciting the feeding of the young. Pups whose mothers were not feeding while food was available to the pups tended to wean slightly earlier than those whose mothers had food available during the same period. Further comparison of the present data with that from Experiment 1 demonstrates that neither tactile cues nor an actual following of the parent by the pups is necessary to produce the accelerated weaning of the pups observed in Experiment 2. The presence of an adult in the vicinity of the food seems to be sufficient to attract the young to the food and initiate feeding on that food.

EXPERIMENT 3

The results of Experiment 2 suggest that the main influence which an adult has on pups is to lead them into the vicinity of the food cups as a result of the pups' tendency to approach adults. Rosenblatt and Lehrman (1963) have reported that starting at approximately Day 16 postpartum the nursing-suckling relationship of domesticated rats begins to be initiated solely by the young which follow the female as she moves about the cage. Such an approach response oriented toward the mother could be the mechanism responsible for bringing the pups into the vicinity of the mother and hence into contact with the food. If the pups approach an adult and tend to eat whatever they find that is edible, then

clearly pups which have food available 11 in. from the nest site and an adult in the vicinity of that food will begin to eat before pups lacking the presence of an adult in the vicinity of the food. If this interpretation of the results of Experiments 1 and 2 is correct, the acceleration of weaning induced by the adults would seem to depend on their leading the pups into areas which the pups would not normally explore. One might therefore hypothesize that if food were available to the young in an area immediately adjacent to the nest site, in which the young move independent of the mother, the social facilitative effects of the mother on the weaning of the young should disappear. The present experiment was designed to test this hypothesis.

Method

Subjects. The subjects in the present experiment were 10 pregnant female hooded rats and their litters.

Procedure. The procedure was identical to that in Experiment 1 except that the food cups were placed 1 in. from the nest site rather than 11 in. from it.

Results

The results of Experiment 3 are presented in Figure 2. It is clear that the presence or absence of the mother has no important influence on the age at weaning of the pups if the source of solid food is located in the immediate vicinity of the nest site. These results contrast markedly with those of Experiment 1 in which the food cups were located 11 in. from the nest site and the presence of the mother markedly affected age at first ingestion of food.

GENERAL DISCUSSION

The results of the present series of experiments strongly suggest that the acceleration of initiation of feeding by the young produced by the presence of their mother when the food source is located at some distance from the nest site is not the result of an active imitation of the adult by the young. The observed acceleration would appear, rather, to result from a tendency on the

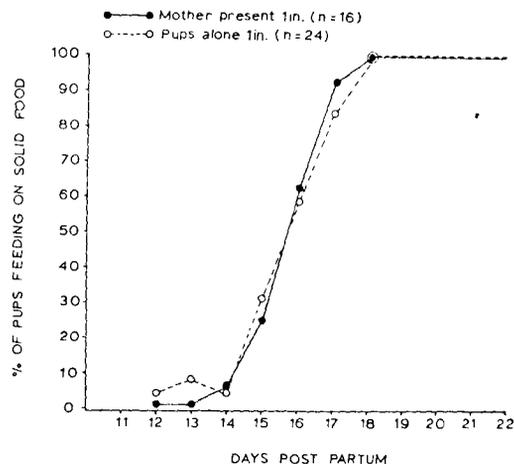


Fig. 2. Percentage of pups feeding on solid food in Experiment 3.

part of the pups to approach adults when they are at a distance from the nest site and for the pups to begin feeding on any food they encounter. Observations reported by Rosenblatt (1969) indicate that between 15 and 17 days postpartum nursing females begin to evade the feeding approaches of their pups and the pups begin self-feeding on solid food. The results of the present study indicate that during the same period the mother, probably inadvertently, leads the young to their first meals of solid food.

The data reported here also have important implications for the understanding of the phenomenon reported previously by Galef and Clark (1971) in that they clarify the nature of the social interaction which leads the pups to initiate feeding on the same food that adult members of the colony are eating. The present observations indicate that the pups do not actively imitate the adults but rather tend to move into areas near the adults and begin eating whatever food they find there.

REFERENCES

- BARNETT, S. A. *The rat: A study in behaviour*. London: Methuen, 1963.
 EWER, R. F. *Ethology of mammals*. London: Plenum Press, 1968.
 GALEF, B. G., JR., & CLARK, M. M. Social factors

- in the poison avoidance and feeding behavior of wild and domesticated rats. *Journal of Comparative and Physiological Psychology*, 1971, **75**, 341-357.
- ROSENBLATT, J. S. The development of maternal responsiveness in the rat. *American Journal of Orthopsychiatry*, 1969, **39**, 36-56.
- ROSENBLATT, J. S., & LEHRMAN, D. S. Maternal behavior of the laboratory rat. In H. J. Rhein- gold (Ed.), *Maternal behavior in mammals*. New York: Wiley, 1963.
- SCOTT, J. P. *Animal behavior*. Chicago: University of Chicago Press, 1958.

(Received July 30, 1970)