gate to the second compartment was opened and simultaneously a light in the first compartment began to flicker. Ten seconds later the grid floor of the first compartment was electrified, and immediately after the animal jumped into the second compartment the gate was closed behind him. Three trials a day were given each subject in quick succession. Convulsive shock was administered by alligator clips attached to the ears after the third trial. This treatment continued for 4 days, resulting in a total of 12 avoidance trials and four convulsions. Approximately 5 minutes lapsed between the onset of the first trial and the administration of ECS on each day. On the 5th day each subject was given 15 successive avoidance trials without convulsive shock. These were essentially relearning trials, and the response measure was the number of successful avoidances on these relearning trials.

The critical aspect of the experiment was the place at which the subjects were convulsed. The subjects of one group were removed from the second compartment, alligator clips were attached to their ears, and they were put back in the first compartment, where they were convulsed. A second group was treated in an identical fashion except that these subjects were returned to the second compartment for convulsion. The third group was convulsed on an open white table.

In all cases the convulsive shock was a 35-ma current administered for 0.3 second. It produced a tonic-clonic convulsion which lasted from 5 to 15 seconds. Immediately after the convulsion began the subjects were returned to their cages where they recovered.

Because the properties of the electric current were uniform for all subjects and because the convulsion followed the learned response by the same time interval, the three groups should not have differed, according to a consolidation theory. The competing-response theory, however, predicts considerably different consequences.

When convulsive shock is given in the first compartment it should result in the strongest competition for the avoidance response, and therefore the greatest decrement for this response; subjects will crouch and huddle instead of jump. Convulsion in the second compartment should have little effect upon the avoidance response because the conditioned crouching and huddling will not occur until avoidance response is over. Convulsive shock on the open platform should also have little effect on the avoidance response because it occurs in the situation most dissimilar to that of the first compartment. Because the second compartment is like the first in size and shape, although different in color, more competition will occur when convulsive shock is given there rather than on the open table.

The total number of avoidance responses during the fifteen relearning trials for the group receiving convulsive shock in the first compartment was 61; in the second compartment, 84; and on the open white table, 98. A Kruskal-Wallis one-way analysis of variance yielded an H of 41.2 which was significant, $p < .001$. Mann-Whitney U-tests between the first and second compartment groups, between the first and third compartment groups, and between the second group and the white table group were all significant, $p < .001$.

These data add confirmation to the competing-response interpretations of retrograde amnesia, and the consolidation hypothesis, which has most frequently been applied to phenomena of this sort, does not seem to be adequate. The consolidation hypothesis was first advanced by Muller and Pilzecker (*4*) to explain the forgetting of verbal materials. The learning of a first list of verbal materials, they reasoned, produced neural engrams which consolidated as time elapsed.

If another list was given soon after the first, the consolidation of the engrams from the first list would be interrupted and forgetting of the first list would result. Most investigators of verbal learning (*5*), however, now prefer a competing response interpretation of forgetting rather than a consolidation theory. The consolidation theory remains widely held by many researchers with a physiological orientation and Glickman (*6*) ably marshals evidence to support this theory.

Coons and Miller (*7*) have explained the phenomena of retrograde amnesia as a result of fear-produced avoidance. The data of the fourth experiment reported here do not conform to this interpretation, for the animals would have had to avoid the compartment in which they were convulsed. Instead they remained in that compartment (*8*).

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Artificial Feeding of Neonatal Rats

Abstract. *Newborn rats, fed either cow's milk or rat's milk by tube, developed a "bloat" and the time required for emptying the stomach increased. When these animals were allowed to suckle on nonlactating foster mothers, no evidence of this syndrome was observed. Based on these observations, a technique was developed for the artificial feeding of newborn rats. When the diet was rat's milk, growth equivalent to that of animals fed solely by lactating females was obtained. A diet of cow's milk did not support adequate growth.*

There has been increasing interest in recent years in the influence of nutrition on the growth and development of the infant animal. With the exception of a limited number of studies in farm animals (*1*), most of these investigations have been performed with infant animals suckling on lactating females (*2*). This has been particularly true of the work with the rat, an animal whose feeding behavior is relatively complex (*3*). A notable exception to these studies has been that of Pleasants (*4*) with gnotobiotic animals. However, even in this case, the growth obtained with tube-feeding techniques was significantly inferior to that obtained with animals fed on lactating females.

During the course of an investigation of the nutrient needs of infant rats, it became apparent that a technique for feeding semipurified diets would be required. Using a modified intubation technique similar to that reported by Pleasants (*4*), we were unable to obtain reasonable growth rates and survival. In general, infant rats fed by intubation developed a syndrome which included an increase in the time required for the stomach to empty and a "bloat" characterized by an accumulation of gas in the stomach and small intestine. Death followed in 3 to 5 days. The few animals that survived this period grew at very slow rates, weighing only 12 to 15 g at 21 days. This syndrome was observed in animals fed either a diet of cow's milk, or of rat's milk obtained by the machine milking of lactating mothers (*5*).

Both the feeding behavior of infant rats in our colony as well as the strong impulse to suckle during intubation feeding indicated that there might be some relation between suckling and emptying of the stomach. To test this, two groups of eight animals were fed five times daily and then suckled on lactating females twice daily. No evidence of bloat or increased stomach-emptying time was observed.

Since the purpose of these studies was to develop a technique for feeding partially-purified diets, the use of lactating females as a source of suckling was not feasible. Therefore, a similar study was performed with nonlactating foster mothers.

These female rats had had at least one litter that had been weaned at least 3 weeks previously. To demonstrate the absence of lactation, the potential foster mother was given oxytocin and milked by machine for 3 to 7 days. No milk secretion was observed. In addition, no milk was found in the stomachs of 7-day-old rats allowed to nurse on these mothers. Since Bruce (*6*) had reported no induction of milk secretion until the 35th day of strong suckling in female rats allowed to rest 24 days after weaning of their litters, the nonlactating foster mothers could be used in 21-day experiments without secreting milk.

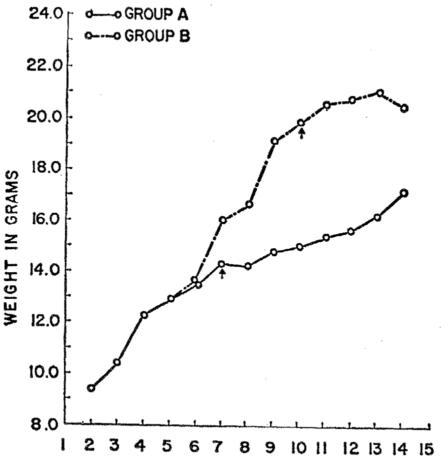

Fig. 1. The growth of neonatal rats fed rat's milk or cow's milk by tube and allowed to suckle on nonlactating female rats.

The results of this test were essentially the same as those obtained with lactating mothers. No evidence of bloat or of failure of the stomach to empty was observed. Growth, however, was reduced. This appeared to be related to the quantity of rat's milk fed rather than to the feeding technique itself.

Ten neonatal animals (6 to 7 g) were randomly assigned to each nonlactating foster mother. A number of additional foster mothers were available to replace any foster mother not accepting her litter. The infant rats were fed with a 24-gauge ball-tipped needle. During the first 24-hour period, they were fed 0.20 to 0.30 ml of diet at each of 11 feedings. In the next 48-hour period, the number of feedings was reduced to nine per 24 hours and the amount at each feeding was increased to 0.30 to 0.40 ml. After this initial 72-hour period, there were seven feedings during each 24-hour period and the volume was increased from 0.4 ml to as much as 1.0 ml per feeding.

While it is rarely necessary to stimulate evacuation of urine and feces by stroking the perianal area of these young animals, this must be done if the foster mothers are not accepting their litters. For this reason, the litters of animals must be carefully observed during the initial 48-hour period of the experiment. If the animals are scattered or appear cold, the foster mother must be replaced immediately.

Some results are illustrated in Fig. 1. Group A, fed rat's milk by tube from day 2 to day 7, grew as well during this period as animals fed solely by lactating females (group B, days 2 through 5). On day 5, group B was removed from the lactating females and fed rat's milk by tube and allowed to suckle on nonlactating females. No decrease in growth rate resulted. The growth of both groups was depressed when a cow's milk formula replaced the rat's milk diet (day 7 for group A and day 10 for group B).

Thus, the artificial feeding technique will allow normal growth in infant rats; and it provides a means of feeding semipurified and synthetic diets to the newborn rat (*7*).

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Food versus Perceptual Complexity as Rewards for Rats Previously Subjected to Sensory Deprivation

Abstract. *Rats raised in darkness or in a constantly lighted white cage go to food in a T-maze if the food is located in a checkerboard goal. They do not go to food if the food is located in a visually less complex, half-black, half-white goal. Normally raised rats go to food regardless of the visual complexity of the goal.*

Theory and research in the study of motivation assume that a hungry animal will learn those responses that produce food and cease making responses that do not produce food. Drive theories, especially, assume that operations such as deprivation of food or water are sufficient conditions for producing motivation, and that the presence of food or water after a particular response is a sufficient condition for learning that response, provided enough learning trials have been given. This report questions the assumption that food reward is a *uniformly* sufficient condition for reinforcing behavior in hungry animals (*1*). Specifically, it is asked if hungry animals, reared in an environment where they were deprived of varied visual stimulation during behavioral development, will prefer to eat food, or prefer to have commerce with visually complex stimuli.