sequence (*7*). For 20 days each monkey was given 16 trials per day for each of the four conditions (a total of 64 trials per day).

The results of learning under the four conditions are shown in Fig. 1, where they may be compared directly with those obtained by McClearn and Harlow (*2*). Performance improved under all conditions in both studies. In the experiment reported here, the number of correct reactions increased significantly from the first to the last 4-day period (block) of training with each amount of separation (*8*).

Another parallel with the McClearn and Harlow data is the increase of correct reactions as the amount of separation decreases. Table 1 presents the overall performance of the animals under each condition. The exact probability that the rank order of difficulty should be the same for every subject is $(1/24)^4$ for my experiment (*9*). If results from the two experiments are pooled, this probability becomes $(1/24)^8$.

The only major disparity between the findings of the two studies lies in the relatively depressed performance of the monkeys with frontal brain lesions at each separation, differences which are statistically reliable (*10*). Thus, while the general findings of McClearn and Harlow are confirmed for monkeys with frontal brain lesions, the data are also in harmony with the previously noted deficiencies of these animals in learning situations with temporal discontiguities.

For monkeys with frontal brain lesions, the ability to learn is apparently impaired in those contexts in which contiguity relations, either temporal or spatial, are less than optimal. Their improved responses after practice suggest that the loss may not be permanent. Training procedures that would allow animals to achieve mastery of the easier conditions before the more difficult are attempted might well facilitate recovery from the effects of spatial separation just as they do from the effects of temporal separation (*4, 11*).

Riopelle and Churukian (*12*) report that when differential color is confined to areas at the centers of visual forms, both normal monkeys and those with frontal brain lesions discriminate less effectively than when only the borders of the forms are colored. The performance is least efficient among monkeys with brain lesions when only the center of a form is colored. The results may be explained in terms of the spatial relationships involved. Since the forms consist of plaques that the monkeys must move away from food-wells to obtain a reward, there is a relative lack of contiguity when colors are present at the center rather than at the edges of the forms.

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9. Since there are $4! = 24$ possible permutations of order, the likelihood that N subjects would show the same order is $(1/24)^N$.
10. For Mann-Whitney tests of the differences, $P = .029$ for the 0- and 4-inch conditions, $P = .014$ for the 1- and 2-inch conditions, and $P = .014$ for all condititions combined.
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Tonic Immobility: Differences in Susceptibility of Experimental and Normal Sheep and Goats

Abstract. Tonic immobility ("animal hypnosis" or catatonic trance) could not be induced in 1-year-old foster lambs and kids. Control animals, conforming to a characteristic of their species, could be readily immobilized. The suggested explanation for this difference in behavior is that the foster animals did not develop a normal flight distance because of the ambivalent behavior of the "stepmother," who alternately permitted and refused nursing.

"Tonic immobility refers to negative or quiescent behavior even in the presence of disturbing stimulation" (*1*). While it is in effect, an organism makes no attempt to change position or struggle for freedom. Theories have associated the phenomenon with sleep (*2*), spacial disorientation (*3*), death feigning (*4*), and the paralysis of fear (*5–7*). Birjukov and Karmanova (*8*) consider tonic immobility to be a special form of internal inhibition, and Lobashey *et al.* (*9*) agree with Pavlov that the phenomenon is based on a process of inhibition in the motor analyzer related to unconditioned self-protective reflexes. Fear plus the physical prevention of flight, as in the capture situation, seem to bring on the response, which appears suddenly. This response has been described by such names as animal hypnosis, catatonic trance, akenesis, action inhibition, thanatosis, and death feigning (*10*).

A number of different animals, including cockroaches, lizards, fish, snakes, geese, ducks, chickens, pigs, horses, sheep, goats, foxes, hares, mice, guinea pigs, opossums, lions, and monkeys, are subject to tonic immobility (*11*). Animals too young to show the fear-flight response when approached are not susceptible (*7*), and adult animals tend to lose the response as familiarity with the human being increases (*6, 12*). If a food signal is coupled with a strong fear stimulus (loud rattle), chickens become less susceptible to tonic immobility, whereas increased periods of wakefulness increase the duration of the response (*9*).

In the experiment reported here (*13*), when nine kids and ten lambs reached physical maturity (1 year of age), they were subjected to the immobilizing procedure by the experimenter (M.S.A.), who had never seen them before and did not know which were control and which were experimental animals. Four of the kids and five of the lambs had been raised by foster ("step") mothers who had born young of their own which were removed at birth (*14*). None of the "stepmothers" immediately accepted the substitutes as if they were their own young, so there was a period varying from 3 to 30 days during which the new mother at times allowed the young to nurse but at times butted it. The young formed watchful, tense attachments to the mothers, and their persistent nursing attempts were only partially fulfilled. During the period of butting the mothers were confined by stanchions in rooms away from the rest of the flock or herd, but they were released daily long enough to find out if they still butted the young when free to do so. The foster mothers were released permanently as soon as acceptance was reasonably well established (that is, when it was certain that they would not injure the young by butting them), and by this time the young were adept at

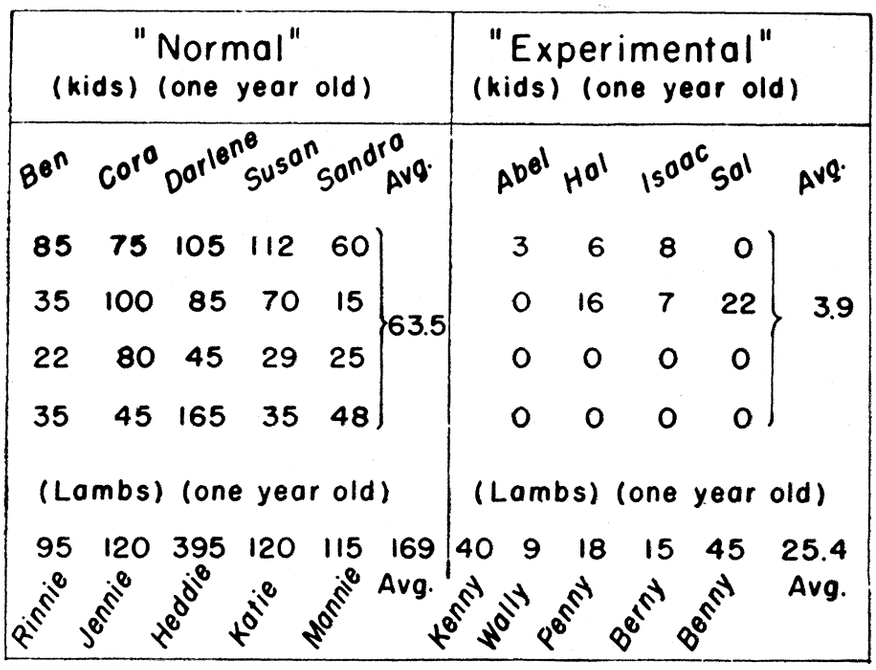

Fig. 1. Duration (in seconds) of tonic immobility in successive trials is less in each instance ($p < .05$) for the experimental animals (animals raised by "stepmother" goats or sheep).

avoiding the threatening behavior. Upon release from the stanchion the mother and young were returned to the control flock or herd. During the period of cold weather, all sheep and lambs were kept in one shed and all goats and kids in another. When the season permitted (about 1 May), the sheep and goats were turned out into separate pastures.

During infancy the kids and lambs in both the control and experimental groups were weighed at intervals so that each group was familiar with the experimenter (A.U.M.) and his assistants at close range. During the first few days of life both groups of animals were handled when they were put into the "weigh-crate," a wire, cage-like, scale platform (4 by 2 feet). From then on the young animals learned to walk into it themselves and there was no further handling. Both groups were accustomed to seeing the experimenter and his assistants walking through the sheds where the experimental and control animals were living together.

Immobilization was done in a room adjacent to the sheds. The animal was led into the room, where it was left alone for approximately 15 minutes to become accustomed to its surroundings. The "hypnotist" (M.S.A.) then entered alone, knelt before the unconfined animal, grasped its four legs, and lay it on its left side with all four legs extended straight out. The deep muscles of the animal's neck were grasped, and steady pressure was applied. When the animal's head was felt pushing back against the hand, the grip was slowly relaxed, and both hands were removed from the animal. Immediately after breaking contact the experimenter started a timer, which was stopped when the animal righted itself. The criterion for the "time out" was thus from the time when the experimenter broke all contact with the animal until it had righted itself and stood on all four feet. Any trial with a "time out" under 10 seconds was considered unsuccessful, and another attempt was made at once. Five unsuccessful attempts at immobilization constituted an unsuccessful trial. Two "successful" trials (or sets of attempts) were given each animal, 5 minutes apart. This procedure was repeated 1 month later with the kids, but not with the lambs owing to other circumstances. As before, the "hypnotist" did not know which were experimental and which were control animals.

The results of the tests are shown in Fig. 1. The "time out" periods for each kid (four trials) and for each lamb (one trial) are tabulated. The averages are based on the number of seconds in all trials, including those of 10 seconds or less, which are technically designated above as "unsuccessful."

It is interesting to note that in the two trials given after a month had elapsed all control kids could be immobilized as easily and for approximately the same time as they were in the first session but that the experimental kids were even less susceptible than before.

At 1 year of age *all* of the control sheep and goats were susceptible to immobilization, whereas *none* of the experimental animals could be immobilized for comparable periods ($p < .01$). The difference may be explained in terms of the interaction between the experimental young and the partially accepting "stepmothers" during the nursing period. The alerting toward the mother as a source of food became intensified because it was coupled with the anticipation of possible butting, and the desire for food dominated the fear response. The young animals never developed flight distance toward other normal sources of fear, including human beings, but showed contact rather than avoidance responses. Later, in the immobilizing situation, the mature experimental animals maintained the same ambivalent attitude they had shown earlier in the nursing situation, with the impulse toward making contact dominating fear responses. This tends to corroborate other experimentation (*9*) which showed that a food signal coupled with a startle stimulus lessened the potential for immobilization.

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