Recovery from Electroconvulsive Shock as a Function of Infantile Stimulation

Abstract. Eighty Wistar rats were handled at 2 to 5, 6 to 9, or 10 to 13 days of age, or not at all. In adulthood each group was split into halves with one-half of each group receiving electroconvulsive shock treatment. Assays of sugar concentration in the blood serum 24 hours after the convulsions indicated that subjects handled at 2 to 5 days of life exhibited no effect of the treatment, whereas all other groups showed marked increases in blood sugar concentration.

Several studies of critical periods in infancy have been made recently (*1*). On the behavioral level, Karas (*2*) found that rats handled during the first 10 days of life were better avoidance learners in adulthood than rats handled during the second 10 or first 20 days of life. Denenberg and Bell (*3*) demonstrated that mice handled and shocked at 2 to 3, 8 to 9, or 15 to 16 days of age displayed markedly different patterns of learning an avoidance response in adulthood; these differences also varied as a function of the intensity of the unconditioned stimulus used in the avoidance conditioning.

Investigating the physiological effects of handling during infancy, Levine and Lewis (*4*) have determined that rats handled at ages 2 to 5 or 2 to 13 days exhibit significant adrenal ascorbic acid depletion when assayed at 14 days, but that animals handled at 6 to 9 or 10 to 13 days do not show evidence of depletion. Observing that handled rats, when observed in an open field, show less defecation, urination, crouching, and wall-seeking behavior than nonstimulated rats (*5*), Levine has hypothesized that stimulation during the first 5 days of life accelerates the maturation of the "stress response" and that stimulated animals persist in being less reactive to stresses imposed later in life (*6*).

Both Denenberg and Karas (*7*) and Levine and Otis (*8*) have demonstrated significantly lower mortality rates after total food and water deprivation for stimulated rats than for nonstimulated rats. Further, adrenal hypertrophy was significantly greater in nonstimulated animals 24 hours after an injection of hypertonic glucose (*9*). However, an investigation of the effects of infantile stimulation on circulating adrenal steroids after electric shock to the feet in adulthood showed that stimulated animals showed a more rapid rise in corticesterone output and a consistently greater production of steroids for a 15-minute period after 1 minute of shock than nonstimulated animals did (*6*). This last finding casts considerable doubt upon the previously mentioned hypothesis and suggests that, rather than being less reactive, the stimulated animals are hyperactive to stress. However, the steroid values were computed only for the first 15 minutes after the shock, and Levine (*6*) has suggested that investigations of the long-term reaction to the shock might reveal that the stimulated animals show a greater immediate reaction, but possibly recover more rapidly, than nonstimulated animals. The present study reports some of the results of such an investigation.

The subjects were 80 Wistar strain albino rats which were handled daily from 2 to 5 days, 6 to 9 days, or 10 to 13 days, or not at all. Handling consisted of removing the complete litter from the home cage and placing the pups in a sawdust tray. After 3 minutes the pups were returned to their home cage. All litters were weaned at 21 days of age and reared thereafter in small cages with litter mates. At 46 days of age the four groups were split into halves. One-half of each group was subjected to a series of electric shocks by means of snap-on ear electrodes. Intensity of shock was systematically increased until a convulsion was produced, after which the rats were returned to their cages. At 47 days of age all subjects, both shocked and nonshocked, were anesthetized with ether, the wall of the right ventricle of the heart was punctured with a syringe, and a sample of blood was removed, after which the subjects were killed. A protein-free blood filtrate was prepared (*10*), and glucose concentration was analyzed by means of the Folin-Wu method (*11*).

Analyses of variances of the number and intensity of shocks required to produce a convulsion showed no significant differences between the groups. It may therefore be concluded that the handling of the rats at different ages during infancy did not differentially affect their resistance to electroconvulsive shock, and that the shock treatment was essentially identical for all groups.

Figure 1 presents the mean differences in blood sugar concentration between the shocked and nonshocked rats for each of the handled groups and the controls. These differences represent the effect of the convulsions 24 hours after they were induced.

An analysis of the mean differences indicates that those subjects handled during the first 5 days of life showed no significant differences in blood sugar concentration between the shocked and nonshocked subjects. Those subjects not handled during infancy and those subjects handled only after the first 5 days

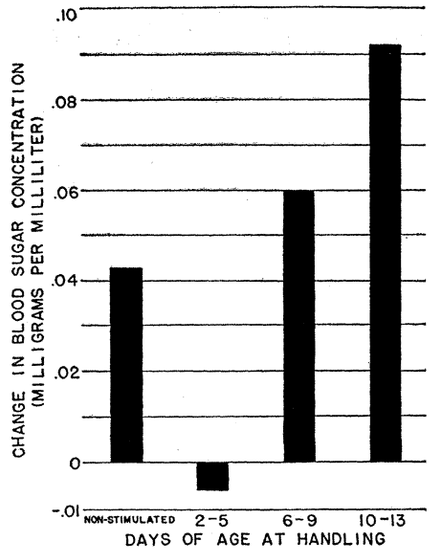

Fig. 1. Mean differences in blood sugar concentration 24 hours after electroconvulsive shock as a function of age at which handled.

of life showed significantly higher concentrations of blood sugar for the shocked animals as compared to the nonshocked ones ($P = .01$).

The present data, when combined with the findings reported by Levine (*6*), tend to support the hypothesis that handling rats during the first 5 days of life produces an animal which tends to show an immediate and marked reaction to stress, with a complete recovery within 24 hours. This is in contrast to the reaction to stress presented by nonhandled rats and those handled only after the first 5 days of life who tend to be hyporeactors and show no signs of recovery 24 hours after the stress. The present data are identical in pattern to Levine and Lewis's (*4*) results with ascorbic acid depletion; they demonstrate that the adult pattern is the same as that found in infancy.

ROBERT W. BELL
GERALD REISNER
THEODORE LINN

Allegheny College, Meadville, Pennsylvania

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