COAT COLOR DIFFERENCES AND RUNWAY LEARNING IN MICE

Patrick A. Tyler

Institute for Behavioral Genetics
University of Colorado

ABSTRACT—Parents and their offspring from a heterogeneous stock (HS/Ibg) of mice were tested for acquisition and extinction of a running response. A polynomial regression function was fitted to the learning curves of each individual and the resulting coefficients were used as the variables in subsequent analyses. Mice homozygous recessive at either the a, b or d locus, i.e., with coat color phenotypes of non-agouti, brown or dilute, did not differ significantly on any of the variables from animals heterozygous or homozygous for the corresponding dominant alleles (agouti, black or full color, respectively). In addition, none of the possible interlocular interactions was significant. Albinos, however, acquired and extinguished the response more slowly than did pigmented mice. Segregation at the c locus was found to account for 10 percent and 24 percent of the additive genetic variance in acquisition and extinction, respectively. These results, taken in conjunction with other findings on the impaired learning ability of albinos, suggest that there is central involvement in the albino syndrome.

INBRED strain comparisons have established that albino strains of mice perform less well than pigmented strains in avoidance conditioning (Royce and Covington, 1960; Schlesinger and Wimer, 1967), water escape learning (Winston and Lindzey, 1964) and a water maze (Meier and Foshee, 1963). That these strain differences are partly attributable to a pleiotropic effect of the c allele has been demonstrated for shock avoidance (Henry and Schlesinger, 1967; Winston et al., 1967), water escape (Winston and Lindzey) and water mazes (Fuller, 1967; Werboff et al., 1967). There is reason to believe that other recessive genes affecting coat color have pleiotropic effects on behavioral traits in various species (e.g., Keeler, 1968); however, such effects on learning in mice have not been extensively investigated. Henry and Schlesinger found no pleiotropic effect of the d allele on acquisition or extinction of an avoidance response in DBA mice. Werboff et al. found little effect of the b allele on a water-escape discrimination learning

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task. No pleiotropic effect on learning for positive rewards has been described for any major gene locus.

A quantitative genetic analysis of the components of learning by mice in a straight runway situation was recently reported (Tyler and McClearn, 1970). Two generations of laboratory mice from a heterogeneous stock (HS/1bg) were tested in a straight runway for acquisition and extinction of the running response. A second-degree polynomial regression was fitted to the acquisition function of each individual subject and the parameters (the mean, and the linear and quadratic coefficients) obtained from this function were then used as the variables in a parent-offspring regression analysis. Since the HS population used in this analysis is heterogeneous with respect to a number of coat color loci, it is also possible to assess the pleiotropic effects of alleles at these loci on the components of the learning task.

METHOD

Subjects

The HS population is segregating for alleles at 4 different coat color loci (c, a, b, and d). The genotypes and corresponding coat color phenotypes are shown in Table 1. The c locus is epistatic to all others, in the sense that genes at the other loci cannot be expressed if the animal is homozygous recessive for albinism. Thus, there are 9 possible combinations of coat color, one of which was recorded for each animal as part of its identification. HS mice are also segregating for alleles at the pink-eyed dilute locus; however, since the two dilute phenotypes were difficult to distinguish and occurred in low frequency, they were combined for this analysis. The parent and offspring generations measured in this study were considered as separate replicate populations (N = 125 and 268, respectively) for the single gene analysis.

Procedure

The experimental procedure and apparatus used in this experiment have been described in detail elsewhere (Tyler and McClearn). Each mouse was tested between the ages of 55 and 66 days in a translucent red plastic runway, brightly illuminated from the side. The basic data obtained were the means of 5 running times on each of 5 days of acquisition and 3 days of extinction. The means were obtained from transformed data: logarithmic transformations were used to remove heterogeneity in group variances. A polynomial regression was fitted to the data for each animal and tests of significance for differences between coat color classes were then applied