Genetic Control of Activity, Preening, and the Response to a Shadow Stimulus in *Drosophila melanogaster*

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Spontaneous locomotor activity, preening, and the change in frequency of each in response to a shadow have been studied in *Drosophila melanogaster* by means of a time-sampling technique. The genetic control of these four behaviors was elucidated by application of biometrical genetic analysis. The genetic architecture for spontaneous activity indicated a history of natural selection for comparatively high activity. There was a tendency for both activity and preening to decrease in response to shadow stimulation. The genetic control indicates that this form of reaction is advantageous and suggests a relation to the avoidance of predation.

KEY WORDS: genetics; activity; preening; stimulation; *Drosophila melanogaster*.

INTRODUCTION

In recent years, *Drosophila melanogaster* has been used extensively in the study of the inheritance of behavior. Most studies have been concerned with phototaxis, geotaxis, mating behavior, or locomotor activity. Four main types of approach have been employed: the effect of single genes, artificial selection, chromosome assay, and heritability estimation. Although the usefulness of the biometrical genetic approach to the behavior of other organisms has been clearly demonstrated by Broadhurst (1959), Broadhurst and Jinks (1961), and several more recent studies, the only reported uses of

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these methods for the examination of *Drosophila* behavior are those by Fulker (1966) and Hay (1972). Both the latter showed that these techniques can yield a considerable amount of information about the genetic control of the behavior, together with inferences regarding its probable evolutionary history, and hence its adaptive significance for the organism. The present report describes some further study of the inheritance of *Drosophila* behavior using biometrical techniques.

The level of locomotor activity of an organism may be expected to be an important factor in its evolution, as activity affects both the degree of inbreeding in a population and the probability of movement to new ecological niches or adaptive zones. It has been suggested that spontaneous activity is a basic component of many behavioral traits (Bindra, 1961; Manning, 1965), and so it may be regarded as a worthwhile trait to examine in any behavioral study. There have been several reports on the genetics of *Drosophila* activity (Ewing, 1963, 1967; Connolly, 1965, 1966, 1967, 1968a; Grant and Mettler, 1969; Kap[an and Trout, 1968, 1969; Hay, 1972].

A number of methods have been used for measuring the activity of *Drosophila*, several of which have been compared by Ewing (1963, 1967) and by Connolly (1967). A modification of the time-sampling technique employed by Hay (1972) was used in the present study, and an extensive comparison of this technique with the open-field method used by Ewing, Connolly, and other workers has also been made (Angus, 1974a).

Observation of *Drosophila* reveals that a large proportion of its time is spent in preening. Some studies of this trait have been performed (Connolly, 1968b; Szbenyi, 1969), but the only examination of its genetic control is that made by Hay (1972). Preening is regarded as a cleaning behavior and as a displacement activity, while Connolly and Hay suggest that it is also important in spacing flies in crowded conditions. Both Connolly and Szbenyi partition preening into a number of separate components, but this procedure was impractical in the present study because of the rapidity of the scoring technique, and seemed to be unnecessary in a preliminary investigation of the genetic control.

The only reported studies of the genetic control of reaction to stimulation in *Drosophila* are those of Kaplan and Trout (1969), studying the reaction of neurophysiological mutants to rapid passes of the hand just above the container, and Siegel (1967), studying the optomotor responses to an illuminated, moving, striped plate. The first of these showed differences between the mutants and the second differences between the thresholds of response of inbred lines, but no further genetic analysis was performed. Connolly (1967) has suggested that spontaneous locomotor activity and "reactivity" (which he uses to describe responsiveness to un-