Behavior Genetics, Vol. 11, No. 2, 1981

SHORT COMMUNICATION

The Albino Locus and Locomotor Behavior in the Mouse: Studies Using Extended Test Intervals

R. J. Katz[1] and R. L. Doyle[1]

Received 15 May 1980—Final 15 Oct. 1980

The influence of albinism upon initial activity in novel surroundings was examined using coisogenic and congenic lines of mice. In comparison with those of previous studies, an extended test interval was used, and this modification produced significant main and interaction effects of the c *locus upon activity for both lines. The present findings confirm and extend those of previous studies upon the depressant effects of albinism based upon coisogenic lines, and extend the findings to congenic lines as well.*

KEY WORDS: activity; albinism; congenic lines; coisogenic lines; mice.

INTRODUCTION

The albino locus (*c*) exhibits a number of behavioral pleiotropisms upon motivation and behavior including effects upon reinforcement (Cazala and Guenet, 1976), alcohol preference (Henry and Schlesinger, 1967), avoidance learning (Rhoades and Henry, 1977; Winston *et al.*, 1967), and a variety of exploration-related behaviors (van Abeelen and Kroes, 1967; Owen *et al.*, 1970). One of the more typical tests of initial exploratory behavior is the open field. Pleiotropic effects of albinism upon open-field activity have been suggested (DeFries, 1969) and have been replicated using a variety of genetic techniques including analysis of coisogenic lines. Fuller (1967) noted reduced activity in an open field in albino mutants in comparison with pigmented C57BL/6J controls, but his sample was not behaviorally naive. Indeed 30% of his experimental sample was

Dr. Katz is an Alfred P. Sloan Fellow.

[1] Mental Health Research Institute, Department of Psychiatry, University of Michigan Medical Center, Ann Arbor, Michigan 48109.

0001-8244/81/0300-0167$03.00/0 © 1981 Plenum Publishing Corporation

selectively killed in a previous test, producing a potential selection bias. Henry and Schlesinger (1967), using similar lines, found no significant test effect upon overall activity but an initial and short-lived reduction in activity of the albino for the first observation period. Apparently this reduction may actually reverse to a state of relative hyperactivity with continued testing (Goodrich, 1973), resulting in no significant main effect of genotype, but a significant gene by trial interaction. Still, other studies have reported neither main nor interactive effects of the albino locus upon activity (Rhoades and Henry, 1977).

The present report was designed to clarify, replicate, and extend previous studies on the pleiotropic effects of the *c* locus with respect to activity in response to a novel environment.

EXPERIMENT 1

The first experiment was designed to address the presence and stability across time of the albino locus' effects upon initial behavior in an automated open field. The technique of coisogenic analysis was used to replicate previous studies and isolate one gene as a behavioral determinant.

Materials and Methods

Subjects. Twenty-four (N = 8/cell) adult male C57BL/6J mice, C57BL/6J^{c} albino mice, and pigmented C57BL/6J mice heterozygous for albinism (*Cc*) were group housed with food (Teklad 4.0% fat rodent diet S-0836) and tap water continuously available and normal 12 hr/12 hr lighting (lights on, 0700–1900). All mice were originally obtained from The Jackson Laboratories (Bar Harbor, Maine) and were bred in the University of Michigan MHRI colony. Due to typically small litters in albino mice, it was necessary to use five or six litters to obtain each sample of eight mice.

Apparatus and Procedure. Between 0900 and 1000 hr of the light cycle mice were removed from group housing and individually placed in 51 × 41 × 22-cm white polypropylene containers (Scientific Products Series 70) with a bedding of fresh pine chips. The cages rested upon commercially available recording platforms which operated through remote capacitance sensing (Stoelting, Chicago). White masking noise (approx 50 dB) was provided by the continuous operation of an air circulation system, and illumination levels of 50 lux were provided by eight overhead fluorescent lights. Mice remained undisturbed for 90 min, with activity recorded as consecutive 10-min blocks. Naive mice were used for single trial exposures. Four mice were tested simultaneously, with at least one

mouse from each condition per test. Care was taken to vary placement systematically across monitors.

Statistical analysis was by two-factor repeated-measures analysis of variance, with three levels of groups (pigmented homozygous, heterozygous, and homozygous albino mutants) and nine time blocks of 10 min each. All results are presented as means and standard deviations.

Results

The albino group showed a different behavioral response than either the parent line or heterozygous mice. While some degree of progressive activity reduction was present in both of the latter groups, the albino group was relatively depressed at the outset of testing, and approached the same asymptotic degree of activity via a progressive increase across the testing session (Fig. 1). Statistically reliable main effects of groups ($F = 3.7$, df = 2,21, $P < 0.05$) and time ($F = 6.3$, df = 8,168, $P < 0.001$) were present, as was the interaction of groups × time ($F = 6.1$, df = 16,168, $P < 0.0001$).

Discussion

Previous studies using shorter testing intervals have found either main effects or interaction effects of groups by time, but not both. Using a novel testing apparatus and extended testing intervals, both main and

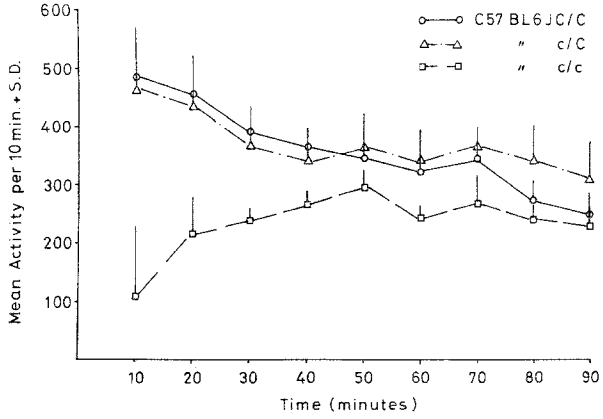

Fig. 1. Effects of a single gene insertion upon initial motor activity in a novel environment. A single 90-min placement was employed. Activity counts are presented as means and standard deviations.

interaction effects were confirmed. This suggests previous reports which were partially inconsistent are indeed consistent under related but more prolonged testing procedures.

It must be noted that in the present circumstances relative hyperactivity of albino mice was not seen at the end of testing, although the possibility of this finding with yet longer recording intervals cannot be denied. The relatively high terminal activity levels in all groups in comparison with those of previous studies suggest that apparatus and recording procedures may critically influence results. This is not surprising, especially given a number of studies to this effect (Ljunberg, 1978; Lynch, 1970). Any behavioral effects of the albino locus upon activity must be considered in terms of the testing environment. The present results, then, confirm and integrate previous findings on the behavioral effects of the albino locus.

EXPERIMENT 2

Experiment 1 demonstrated a reliable effect of a single gene substitution upon behavior. Inbred congenic lines may also be used to test the influence of the albino locus. Since little work upon the *c* locus and motor or exploratory behavior using congenic lines has yet been carried out, and since this offers a means of evaluating the effects of albinism using novel strains and techniques, Experiment 2 utilized congenic lines for additional behavioral-genetic analysis.

Materials and Methods

Subjects. Twenty-four (N = 8/cell) adult male mice of the congenic albino line C3H/Hej-C (N10F27), the inbred partner strain C3H/Hej, and the albino donor strain RIII/Wyj were group housed with food, tap water, and lighting as described previously. All mice were from the University of Michigan colony.

Apparatus and Procedure. Details of apparatus and testing and analytic procedures conform to descriptions in the first experiment.

Results

A trend toward decreased activity across time was present in both the C3H and the RIII mice. This trend was present, although to a lesser degree, in the C3H congenic albino line (Fig. 2). Both the albino inbred strain and the congenic line were less active than the C3H strain.

Statistical analysis confirmed the presence of reliable effects for

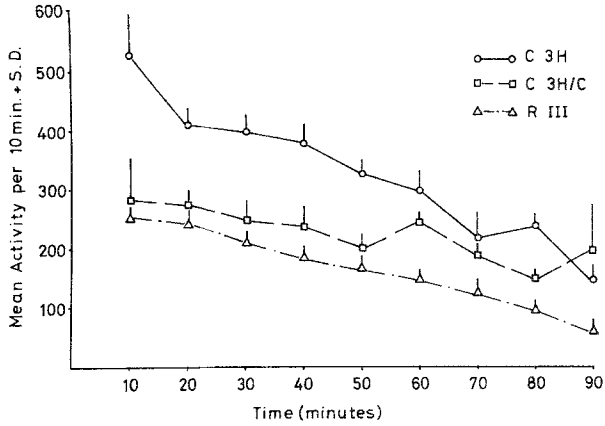

Fig. 2. Effects of insertion of the chromosomal segment for albinism upon initial activity in a novel environment. A single 90-min placement was employed. Activity counts are presented as means and standard deviations.

groups ($F = 10.1$, df = 2,21, $P < 0.0001$), time ($F = 9.8$, df = 8,168, $P < 0.0001$), and their interaction ($F = 1.8$, df = 16,168, $P < 0.05$).

Discussion

The present findings with different strains and different genetic techniques are nonetheless quite similar to those in the preceding experiment, suggesting a considerable degree of generality to the pleiotropic effect.

The present results argue that the *c* locus affects locomotor activity in either of two designs. This effect does not rule out further polygenic and epistatic influences. Indeed such influences have been identified in other studies. DeFries and co-workers (i.e., DeFries and Hegmann, 1970) argue for a pleiotropic effect of albinism and additional polygenic control. Similarly, Oliverio *et al.* (1972) noted the existence of a separate locus for exploration, based upon recombinant inbred lines. Other related studies from these and other groups argue strongly against any exclusive role for the *c* locus. Nonetheless, both the present and previous studies suggest that it may play a significant role inter alia.

In conclusion, we have demonstrated the simultaneous existence of main and interaction effects for the albino locus upon motor activity in a novel setting. Both coisogenic and congenic lines proved to have similar behavioral profiles. These findings extend and integrate those of previous reports.

ACKNOWLEDGMENTS

The statistical assistance of R. C. Shea and the editorial assistance of A. Feingold are gratefully acknowledged.

REFERENCES

Cazala, P., and Guenet, J. L. (1976). The role of genetic factors in the determination of self stimulation behavior in the mouse: Backcross analysis. *Behav. Proc.* **1**:93–97.

DeFries, J. C. (1969). Pleiotropic effects of albinism on open field behavior in mice. *Nature* **221**:65–66.

DeFries, J. C., and Hegmann, J. P. (1970). Genetic analysis of open field behavior. In Lindzey, G., and Thiessen, D. D. (eds.), *Contributions to Behavior Genetic Analysis*, Appleton–Century–Crofts, New York, pp. 23–56.

Fuller, J. L. (1967). Effects of the albino gene upon behavior of mice. *Anim. Behav.* **15**:467–470.

Goodrich, C. L. (1973). Exploration, activity, and emotionality of albino and pigmented mice: Inheritance and effects of test illumination. *J. Comp. Physiol. Psychol.* **84**:73–81.

Henry, K. R., and Schlesinger, K. (1967). Effects of the albino and dilute loci on mouse behavior. *J. Comp. Physiol. Psychol.* **63**:320–323.

Ljungberg, T. (1978). Reliability of the two activity boxes commonly used to assess drug induced behavioral changes. *Pharmacol. Biochem. Behav.* **8**:191–195.

Lynch, G. (1970). Separable forebrain systems controlling difference manifestations of spontaneous activity. *J. Comp. Physiol. Psychol.* **70**:48–59.

Nagy, Z. M. (1972). Open field activity of retinal degenerate C3H mice: Further evidence of some visual capacities. *Psychonom. Sci.* **26**:37–38.

Oliverio, A., Eleftheriou, B. E., and Bailey, D. W. (1973). Exploratory activity: Genetic analysis of the modification by scopolamine and amphetamine. *Physiol. Behav.* **10**:893.

Owen, K. Thiessen, D. D., and Lindzey, G. (1970). Acrophobic and photophobic responses associated with the albino locus in mice. *Behav. Genet.* **1**:249–255.

Rhoades, R. W., and Henry, K. R. (1977). Effects of single albino gene substitutions on the performance of mice in a compound avoidance discrimination task. *Physiol. Behav.* **19**:86–92.

van Abeelen, J. H. F., and Kroes, H. W. (1967). Albinism and mouse behavior. *Genetica* **38**:419–429.

Winston, H., Lindzey, G., and Connor, J. (1967). Albinism and avoidance learning in mice. *J. Comp. Physiol. Psychol.* **63**:77–81.

Edited by Norman D. Henderson