

against HgCl_2 through this mechanism (8).

Ancillary experiments (9) have shown that, under otherwise similar conditions, equivalent or even greater amounts of sulfur offer no protection against this acute intoxication with mercury, if administered in the form of glutathione, cystine, cysteine, penicillamine, or thioacetamide. Sodium thioacetate and dimercaprol (BAL) can prevent the nephrocalcinosis, but only at nearly lethal dosages. On the other hand, two additional thioacetylated steroids, emdabol and spiroxasone, are approximately as potent as spironolactone in inhibiting this form of renal damage without inducing manifestations of toxicity. None of these steroids was of prophylactic value when administered after the intravenous injection of HgCl_2 .

In any event, spironolactone, a virtually nontoxic and hormonally inactive steroid which increases resistance

against many organic drugs, also offers excellent protection against an otherwise lethal, acute intoxication with mercuric chloride.

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Brain Weight Increases Resulting from Environmental Enrichment: A Directional Dominance in Mice

Abstract. *A genetic analysis of brain weights of 544 mice reared in either enriched or standard laboratory environments indicated significant directional dominance in the percentage of increase in brain weight as a result of enrichment.*

Rats reared in enriched environments from weaning to 105 days old have shown approximately 4 percent increase in cortical weight and 1 percent increase in whole brain weight over control animals reared in isolation (1). When different genetic lines were used in these studies, and in studies with mice (2), substantial genetic differences in brain weights also occurred, usually exceeding those produced by enrichment. Similarly, genetic analyses of inbred strains of mice (3) indicate a high heritability of brain size. Unfortunately these latter studies have been limited to animals reared in the relative restriction of laboratory cages, and studies involving enrichment have not been designed to permit quantitative estimates of genetic factors. Although we are aware of the considerable influences of both genetic makeup and enrichment on brain size, we have little information on how these factors interact.

I have carried out a genetic analysis of brain and body weights of house mice (*Mus musculus*) from a large number of genotypes reared in stan-

dard laboratory cages or in enriched environments. This report focuses on the effects of directional dominance and enrichment on whole brain weight (see 4).

A total of 144 inbred mice from six strains (A/J, BALB/cJ, RF/J, C3H/HeJ, C57BL/10J, DBA/1J), 240 F_1 mice from the 30 possible crosses of the six strains, and 160 F_2 mice from ten four-way crosses derived from the F_1 strains were used. The four-way crosses were selected to represent parental lines in approximately equal proportions. At birth, half the litters in each genotype were assigned to be reared in the enriched cages, the remaining to be

reared in standard cages. The standard laboratory cage was constructed of semi-transparent plastic 14 by 20 by 9 cm. The enriched cages were 55 by 25 by 15 cm high and contained a variety of small objects for climbing and exploring. These objects and their location in the cage remained constant and were identical in all 35 enriched cages used (Fig. 1). Animals were undisturbed except for weaning at 3 weeks and brief behavioral testing at 6 weeks. Between the 6th and 7th week they were killed and the body and brain weights were measured. With the exception of the anterior portion of the ophthalmic division of the trigeminal nerves, the entire brain extending to the 12th cranial nerve was removed and weighed within 5 minutes after the animal was killed.

The mean brain weights were calculated for the combined inbreds, F_1 hybrids, and the F_2 four-way crosses reared in each environment (Fig. 2). In a design in which crosses from a number of lines were used, the average coefficient of inbreeding in both F_1 and F_2 progeny reverts to that of the base population (5). Therefore, mean scores for F_1 and four-way crosses should not be significantly different; however, any difference between inbreds and hybrids indicates directional dominance (or inbreeding depression). The brain weights of F_1 and F_2 animals in comparable environments were not significantly different from each other, but such animals had significantly larger brains than comparably reared inbred animals. Furthermore, among both hybrid groups enrichment led to a significant increase in weights of whole brain, whereas within the inbred parent strains, enriched and restricted animals were not significantly different. These data indicate that strong directional dominance is involved in increases in brain weight as a result of enrichment.

Contrary to the earlier studies with rats, where the relatively inactive restricted animals were generally heavier than their enriched counterparts, in this experiment weight increased (average, 21 percent) among enriched mice. Furthermore, since moderate genetic and environmental correlations existed between brain and body weights, and hybrids were generally heavier than inbred animals, it is important to demonstrate that the effects shown in Fig. 2 were not artifacts of differences in body weight. Two lines of evidence suggest that this was not the case. First, although some of the overall difference

Table 1. Brain and body weights of C3H $\times$ BALB hybrid mice reared in enriched, standard, and control cages.

Cage	Food hopper	Cage area	Weight (g)	
			Body	Brain
Enriched	Large	Large	19.1*	.469
Control 1	Large	Large	20.0*	.450*
Control 2	Large	Small	20.8*	.445*
Standard	Small	Small	15.3	.432*

* Not significant.

in brain weight between hybrid and inbred animals may be attributed to differences in body weight, the percentage of increase in brain weight as a result of enrichment cannot. A diallel cross analysis (6) of the percentages of increase in brain weight among inbreds and F_1 hybrids indicated significant directional dominance ($F = 7.6$, $df = 1/15$, $P < .02$), whereas no such directional dominance was detected in the percentages of increase in body weight ($F = 2.4$, $df = 1/15$, $P > .10$).

Another control experiment was designed to test whether differences in food hoppers in the enriched and standard cages was a source of differences in body weight found in the two environments; the larger food hopper of the enriched cage appeared to provide greater and easier access to food than the smaller wire-mesh hopper of the standard laboratory cage. To test this

possibility I used two control cages in addition to the enriched and standard cages. In control 1, F_1 hybrid animals (C3H $\times$ BALB) were reared in a cage identical to that used to house the enriched environments but lacking the various objects found in the enriched cages; in control 2 the cages were smaller (12 by 25 by 15 cm high), but they also contained no enrichment objects. Cages in both controls contained food hoppers similar to those in the enriched cages. Mean brain and body weights of four males and four females taken from two litters reared in each of the four kinds of cages are presented in Table 1. The body weight largely reflects the differences in food hoppers, whereas increased brain weight was primarily influenced by enrichment objects; still, a modest relationship between brain and body weight exists. Although heavier brain weights of hybrid animals

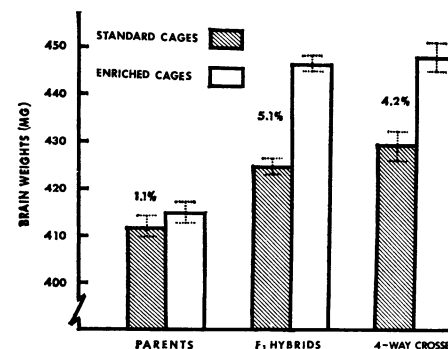


Fig. 2. Averaged brain weights of the six inbred strains and their F_1 and F_2 hybrid progeny reared in either standard cages or enriched environments. Small dotted bars indicate standard errors of each mean.

may in part reflect larger body size, the increase in hybrids' brain weight as a result of enrichment is largely independent of changes in body weight.

The results of the genetic analysis are significant for methodology and theory. The fact that there is a substantial difference in the degree of directional dominance found in the two environmental conditions suggests (7) that genetic patterns found within populations of relatively restricted animals reared in the laboratory can depart considerably from those in animals reared under more enriched or natural conditions. The small degree of directional dominance in brain weights detected among normally reared mice was relatively trivial, when differences in body weight are considered, whereas among animals reared in enriched environments substantial directional dominance was found.

Because of genetic depression as a result of inbreeding, the use of inbred animals for the study of neurological changes as a result of enrichment may not be advisable. In the present experiment the overall change in brain weight averaged across the six inbred lines was not significant compared to the rather large changes that occurred in both F_1 and F_2 mice. The use of an F_1 cross would of course provide the advantages of a uniform genetic population and the elimination of the effects of inbreeding depression.

It is generally acknowledged that when a substantial fraction of genetic variance can be attributed to dominance, the characteristic being studied has probably been subjected to selection pressure, and therefore is relevant to the survival of the organism (8). Furthermore, if the dominance obtained is largely unidirectional, the performance of hybrids relative to inbreds



Fig. 1. A group of enriched cages with covers removed.

indicates the direction of optimum value for the characteristic being studied. These arguments suggest that there is apparently some selective advantage in the mouse's ability to respond, with a change in brain size, to an enriched environment.

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Discussion Effects on Racial Attitudes

Abstract. *We predicted that discussion would enhance dominant group values, leading to increased polarization between homogeneously composed groups of high-, medium-, and low-prejudice high school subjects. In an experimental condition, group members made individual attitude judgments, discussed them, and remade judgments. Control groups discussed irrelevant materials before responding again to the attitude items. As predicted, discussion of the racial attitude items with others having similar attitudes significantly increased the gap between high- and low-prejudice groups.*

In recent years a number of social commentators have noted a growing polarization in attitudes and values within our society. The following social psychological experiment was designed as a laboratory analog of such real-world social phenomena and also as an attempt to extend to social attitudes some recent findings on the effects of group discussion on risk-taking.

Numerous studies in the past decade have indicated that discussion predictably affects responses to "choice dilemma" items on which subjects recommend the amounts of risk to be taken by hypothetical persons facing various life dilemmas (1). In general, discussion tends to produce an increase in risk-taking ("risky shift") following discussion, but this is especially true on items for which prediscussion decisions tend to be already fairly risky. On items for which initial decisions tend to be cautious, decisions following discussion tend to become even more cautious ("cautious shift"). In other words, discussion tends to enhance the mean initial tendency.

Empirically this may be seen as a significant correlation between the mean of initial decisions on an item and the mean amount of risky shift that discussion of that item elicits. For example, Arenson, Myers, and Resnick (2) had 40 small groups discuss 12 dilemma items and a correlation of .89 ($N = 12$, $P < .001$) between mean initial risk

decision and mean risky shift resulted. Other recent research (3) also indicates that the mean of initial risk-taking on an item is a good predictor of the mean amount of risky shift that discussion of that item will elicit.

These data are consistent with the idea that on given items risk or caution may be a prevailing value which is enhanced through discussion (4). One need merely assume that the initial decisions on an item are an index to subjects' prediscussion values on that item. If, for whatever reason, discussion does tend to enhance the dominant value elicited by an item, there is every reason to suppose that discussion-produced shifts should generalize to non-risk materials in which some dominant initial value can be shown to exist. Other investigators have also begun to wonder if the risky-shift phenomenon might be a clue to more general group discussion effects. Levinger and Schneider (5) postulate a general "choice shift" phenomenon and Alker and Kogan (6) speculate on discussion-produced shifts toward the ideological right and left.

In this research high school subjects responded before and after discussion to each of eight racial attitude items. Before discussion they were separated into high-, medium-, and low-prejudice groups. Generalizing from the life dilemma problems, it was predicted that discussion would enhance dominant

values, that the high- and low-prejudice groups would move farther apart in their scale responses to the eight-item questionnaire after discussion in their separated groups.

The subjects were seniors in psychology classes at three western Michigan high schools. About 2 weeks before the discussion experiment, 326 subjects were administered the Woodmansee and Cook (7) Multifactor Racial Attitude Inventory (MRAI) during a regular class period. The MRAI is a 100-item, ten-factor measure of attitudes toward blacks that can be used as a 90-item prejudice measure by ignoring the "overfavorableness factor." The total distribution of resulting prejudice scores was divided into equal thirds, defining the high-, medium-, and low-prejudice subjects. Of these 326 subjects, 256 participated in the subsequent discussion experiment. Thirty others were used in a pilot study and the remaining 40 were either absent at the time of the experiment or were members of three groups eliminated for failure to follow instructions or for lack of participants.

Materials for the discussions were eight racial attitude items selected on the basis of two pilot studies which indicated that initial responses to these items would be predictable from MRAI scores and would not already be clustered at the extremes. For example:

"Some people recently have been saying that 'white racism' is basically responsible for conditions in which Negroes live in American cities. Others disagree. How do you feel?"

Below this was printed a scale for responding, ranging from +9 at the left ("white racism" is responsible), through 0 in the center, to -9 at the right ("white racism" is *not* responsible").

Other items were concerned with such matters as federal versus local control of school desegregation, property rights versus open housing, two-way school busing to achieve integration, boycotting of a discriminatory business, and patience versus activism as an effective black strategy. To counterbalance any tendency to agree with the first alternative, low-prejudice alternatives were on the left end of the 19-point scale on even-numbered items only.

The eight-item questionnaire was administered to a class with instructions to circle a number indicating the direction and strength of opinion. After collecting the initial questionnaires, groups homogeneously composed according to preju-