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Emotional Reactivity and Alcohol Preference Among Genetic Crosses of the Maudsley and Roman Rats[1]

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SATINDER, K P AND G E WOOLDRIDGE. *Emotional reactivity and alcohol preference among genetic crosses of the Maudsley and Roman rats* PHARMACOL BIOCHEM BEHAV 24(4) 879–881, 1986 —The relationship between open-field emotional reactivity and alcohol preference was investigated in crosses of the Maudsley and Roman rat lines No significant differences were found in any of the behaviors between the respective reciprocal crosses The scores on the two variables showed a positive correlation between open-field defecation (OFD) and alcohol preference The findings confirmed a prediction for the relationship between OFD and alcohol preference in these genetic crosses In light of the previous findings it would seem that OFD and alcohol preference are not directly related to each other, and emotional reactivity acts as a mediating process between the two behaviors However, in these genetic crosses the observed relationship between OFD and alcohol preference can be explained by a possible genetic overlap between the mechanisms mediating these two behaviors.

Maudsley and Roman genetic crosses Open-field defecation in genetic crosses Alcohol intake in genetic crosses Open-field defecation Alcohol intake

THE relationship between emotional reactivity and alcohol preference has been investigated in man [7], monkey [5], rat [4, 6, 10, 12] and mouse [8, 9, 18] Rat emotional reactivity, has been operationally defined as the number of fecal boli excreted by an animal when placed in a strange situation, e.g., open-field [2]. Organisms highly reactive exhibit higher levels of open-field emotionality and alcohol intake [10]

Previous findings indicate that the Maudsley Reactive (MR) line shows the highest level of open-field defecation (OFD) [12,13] and alcohol intake [10,11] followed by the Roman high- (RHA) and low- (RLA) avoidance, and Maudsley Non-Reactive (MNRA)[2] lines. On the basis of these findings it can be predicted that the cross between the MR and the RHA lines would show the highest OFD and alcohol preference, followed by the crosses between the MR and RLA, the MNRA and RHA, the MNRA and RLA. Therefore, the main purpose of the present study was to investigate the relationship between OFD and alcohol preference among the genetic crosses of the Maudsley and the Roman rat lines.

METHOD

Animals

Eighty animals equally representing 8 reciprocal crosses between the Maudsley and the Roman lines and both the sexes within each genetic cross were involved in this study These animals were bred as a part of a larger project relating to the study of genetic interaction between avoidance learning and open-field emotional reactivity [15].

The MR and the MNRA genetic lines were established by selective breeding for extreme defecation scores in an open-field test Extensive summaries of the findings using these genetic lines have been provided previously [3] and further details regarding their genetic history are given elsewhere [16]. The Roman high- (RHA) and low- (RLA) avoidance lines have been selectively bred for differential rates of 2-way active avoidance learning [1]

The crossbreeding was carried out by mating each of the Maudsley lines with each of the Roman lines including the reciprocals, thus generating 8 crosses MNRA♀ × RHA♂, RHA♀ × MNRA♂ MR♀ × RHA♂, RHA♀ × MR♂, MNRA♀ × RLA♂, RLA♀ × MNRA♂, MR♀ × RLA♂ and RLA♀ × MR♂ All animals were bred and reared in the laboratory, weaned at 28 days of age, and were 100 days of age at the start of the experiment. Before experimentation the animals were housed in same sex-pairs Further details regarding the animal husbandry, care and maintenance have already been reported [17].

Animals were coded and housed individually to ensure

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[2]We recently found that we received MNRA sub-line rather than the MNR line as requested Detailed discussion of this issue will be included in another article dealing with the genetic history and reproductive performance [16] of the rat lines in our laboratory

that the experimenter did not know the genetic origin of the animals The laboratory temperature was controlled at 22±1°C The humidity level was maintained at 40% and the fluorescent lighting was on a 12:12 hour light/dark cycle Animals were maintained on ad lib Purina Rat Chow and fluids

Apparatus

Open-field The open-field was an arena, 90 cm on each side, divided into 16 equal squares marked on the floor The arena was made of plywood and white Melamine plastic The walls were 45 cm high, the front wall was a sliding door of transparent Plexiglas, which served as an observation screen and as a door to provide access for cleaning the open-field The arena was illuminated by four 90-cm-long fluorescent lights placed 90-cm above the floor level which provided an illumination of 230 ft-c (2476 lx) at the floor in the center of the arena A white-noise generator produced 65 dB (re 0.002 μbar) of masking noise (Sound intensity was measured at the center of the open-field floor with a General Radio sound-level meter, Type 1551-C) [13]

Alcohol intake The stainless-steel cage, 25×18×18 cm, was fixed with three metal holders and three calibrated fluid bottles in front and outside of the cage A food hopper was fixed on the inner back wall of the cage The food hopper protected the food from any contamination from urine or feces

Procedure

Open-field Each animal was placed under a Plexiglas container in the center of the open-field arena Both illumination and sound stimuli were turned on and at the same time the container covering the animal was lifted During a 2-min trial the number of defecation (fecal boli) and sections crossed (all four feet in one section) were recorded, by an observer The open-field arena was cleaned after every trial

Alcohol intake After completion of open-field testing each animal was given distilled water for one day The next day each animal was given choice trial between 10% absolute alcohol (v/v) and distilled water This choice trial was followed by 3 days of forced intake of 10% alcohol, i e , 10% alcohol solution was the only fluid available This cycle of 3 days of forced intake, followed by a day of choice intake, was repeated five times thus providing measures of 6 choice trials and 5 cycles of forced intake of alcohol. Choice of 10% alcohol concentration was based on our previous findings [10], as this concentration of alcohol maximally differentiated alcohol intake of the parental lines.

Alcohol solutions were prepared every day just before administration The animals were disturbed only at 24 hour intervals to record body weight and intake of fluids, to replenish food and to empty, clean, and refill the drinking bottles

During choice intake three bottles were used Two bottles contained the two fluids for choice and the third bottle remained empty The order of bottles was changes in a systematic rotation

RESULTS AND DISCUSSION

Evaluation of results by analysis of variance indicated no significant differences between the respective reciprocal genetic crosses in any of the measures Within each of the 8 crosses no significant sex differences were found that were independent of body weight differences This lack of sex differences supports our previous findings [11] and conclusions that probably no biological sex differences, independent of body weight differences, exist in relation to alcohol intake Hence in subsequent analyses data were pooled to produce 4 crosses (as represented in Fig 1) each involving 20 animals Because of the distribution of both OFD and ratio scores for alcohol preference, results were also evaluated by non-parametric Kruskal-Wallis one-way analysis of variance on ranked data corrected for ties

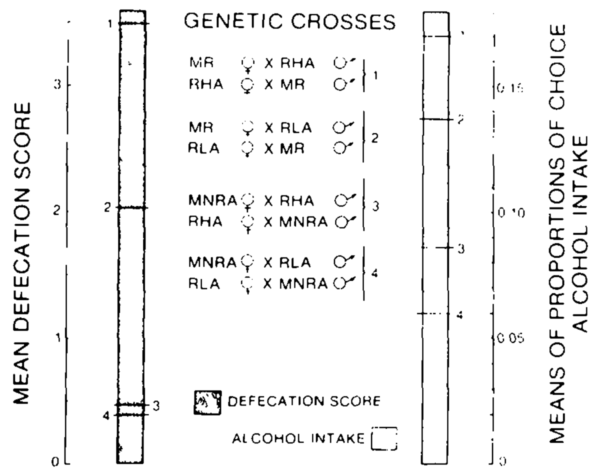

FIG 1 Mean defecation scores and proportional alcohol intake of the Maudsley and Roman genetic crosses of rats

Open-Field Behavior

Detailed analyses of open-field behavior of these Maudsley and Roman crosses involving much larger number of animals (N=384) are presented elsewhere [15] The mean defecation scores of the respective crosses are presented in Fig 1 The MR × RHA cross had the highest mean defecation score followed by the MR × RLA, MNRA × RHA and MNRA × RLA crosses, $F(3,76)=31\ 9$, $p<0\ 001$, $\chi^2(3)=41\ 6$, $p<0\ 001$ Except for the crosses of the MNRA with the RHA and the RLA lines (crosses 3 and 4 in Fig 1) all the other crosses differed significantly, $F_{min}(1,38)=9\ 3$, $p<0\ 005$, from each other on defecation score

Alcohol Intake

Intake of 10% alcohol during choice trials expressed as a proportion of the total fluid intake was calculated for each animal for each of the 6 choice days, and means for the 4 Maudsley-Roman crosses are presented in Fig 1 The MR × RHA cross had the highest alcohol intake on choice days followed by the MR × RLA, MNRA × RHA, and MNRA × RLA crosses, $F(3,76)=3\ 3$, $p<0\ 03$, $\chi^2(3)=8\ 9$, $p<0\ 05$ The MR × RHA cross showed significantly higher intake of alcohol on choice days than the MNRA × RHA, $F(1,38)=4\ 5$, $p<0\ 05$, and the MNRA × RLA ($p<0\ 007$) crosses and the MR × RLA cross also differed from the MNRA × RLA cross ($p<0\ 05$)

The relative positions of the 4 genetic crosses were the same in relation to the intake of absolute amounts of alcohol during choice and forced trials, but differences among groups were not significant

In an attempt to explain the lack of relationship between alcohol intake and OFD in the parental Maudsley lines [14], it was considered possible that a single open-field trial may not have provided adequate differentiation among the OFD groups The findings of the present investigation clearly indicate that the relative positions of the genetic crosses remained the same irrespective of the fact whether OFD score is based on a single (first day) trial or the mean for four daily trials (as presented in Fig 1). Hence it can be stated that the failure of the previous investigation to show such a relationship was not due to lack of differentiation among the OFD groups given only a single open-field trial [14].

The OFD scores of these genetic crosses depicting a clear correspondence with their alcohol preference (see Fig. 1) would suggest a relationship between these two measures, although such a relationship was lacking in the parental Maudsley lines [14]. However, in the crosses of the Maudsley and Roman rats a relationship between OFD and alcohol preference may emerge due to a genetic overlap between the mechanisms mediating these two behaviors

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