Effects of age and exposure to heavy particles on a behavioral measure of anxiety

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On forthcoming exploratory class missions astronauts will be expected to function in novel and possibly dangerous environments. This requirement may produce anticipatory fear or anxiety. Previous research has shown that exposure to HZE particles, such as those experienced on missions beyond the protection provided by the magnetic shield of the earth, can affect the performance of the organism on a variety of tasks. In addition, research has shown that there is an interaction between age and exposure to heavy particles on a variety of behavioral tasks such that older organisms are more susceptible to the deleterious effects of irradiation. Because there are changes in exploration-induced anxiety as a function of age, it is possible that exposure to HZE particles will also affect a middle-aged astronaut's ability to respond appropriately in anxiety producing situations. The present experiment utilized the elevated plus-maze to evaluate the effects of age and exposure to HZE particle radiation on anxiety.

Fischer-344 rats, 2, 7, 12 and 16 months of age at the time of irradiation were exposed to ^{56}Fe particles (1 GeV/n; 0.25-2.00 Gy) in the NASA Space Radiation Laboratory at Brookhaven National Laboratory. Control rats at each age were not irradiated. At the time of testing the rats were 3-, 11-, 13- and 20-months old, respectively. Anxiety was studied using an elevated plus-maze. The maze is composed of four arms in the shape of a + sign placed 90 cm above the floor. Two of the arms are enclosed and two of the arms are open. The amount of time spent in either the open or closed arms of the maze is measured using a series of infra-red photocells. In general, the greater the level of anxiety, the greater the avoidance of the open arms of the maze.

The results showed that the oldest non-irradiated rats showed significantly less exploration of the open arms of the maze than the younger control rats. For the rats irradiated at 2 months of age, a dose of 2.0 Gy of ^{56}Fe particles was required to produce a significant reduction in exploration of the open arms of the maze. In contrast, significant reductions in open arm exploration were seen in the rats radiated at 7 and 12 months of age following exposure to 0.5 Gy of ^{56}Fe particles. Irradiating the 16-month old rats produced no additional decrease in open arm exploration beyond that due to age.

These results show that both radiation and age of the organism can affect the willing-

ness of an organism to explore a novel environment under conditions which produce an increase in anxiety.

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