# Reliability of the disruptive effects of exposure to protons on neurocognitive performance

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## INTRODUCTION

On exploratory class missions a significant portion of the radiation dose astronauts receive will come from protons. Using 250 MeV/n protons at Loma Linda, we found that there were no effects of exposure on neurocognitive performance. In contrast, exposing rats to 1000 MeV/n protons at the NSRL did affect performance. The present experiments were conducted to assess the reliability of the effects of exposure to 1000 MeV/n protons on neurocognitive performance. Given the ubiquity of protons in the space radiation environment, an assessment of the reliability with which exposure to NASA relevant doses of protons can affect performance is important.

## METHODS

*Radiation:* In two independent replications, rats were exposed to 1000 MeV/n protons at doses of 35-200 cGy. Control rats were taken to the NSRL, but not exposed. Nominal dose rates were between 10 and 50 cGy/min depending upon the total dose.

*Procedures:* Both irradiated and non-irradiated controls were shipped to UMBC for behavioral testing. Performance on three behavioral measures was tested: plus-maze performance to measure proton-induced changes in baseline anxiety; fixed-ratio operant performance to measure proton-induced changes in motivation; and novel object recognition to measure proton-induced changes in memory.

## RESULTS

In the first replication, exposure to protons at NASA-relevant doses (≤100 cGy) disrupted performance on all three tasks (plus-maze, operant performance, object recognition), although the lowest dose required to disrupt performance (threshold dose) varied as a function of the specific task. In the second replication, performance decrements were seen with the plus-maze and operant tasks, but not with the novel object recognition task. In addition there were differences in the threshold doses for the disruption of performance on the plus-maze and on operant responding.

## CONCLUSIONS

Overall these results show that exposure to NASA-relevant doses of protons does affect cognitive performance. However, there were differences between the two replications in terms of the specific behaviors affected and in terms of the dose of protons needed to disrupt performance. These differences in the effects of exposure to protons may reflect differences in the way the animals were handled or other environmental factors. Also, the reasons for the discrepancy of the effects on neurocognitive performance with the results obtained following exposure to 250 MeV/n protons at Loma Linda remain to be established.

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