PROBABILISTIC CLASSIFIERS CAN PREDICT RADIATION EXPOSURE IN RODENTS FROM PERFORMANCE TESTS

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INTRODUCTION: Astronauts will be exposed to ionizing radiation from galactic and solar cosmic rays during manned missions to Mars and other missions outside of the Earth's magnetosphere, which could negatively affect cognitive performance and endanger mission success. Data driven modeling techniques, which are capable of identifying underlying data trends with minimal user input, could be used to integrate complex observational data to create predictive tools to evaluate the impacts of space radiation on cognitive abilities. We present initial work that investigates the feasibility of creating data driven predictive models that correlate radiation exposure with cognitive performance using attentional set-shifting (ATSET) assay data from rodents after exposure to ionizing radiation [1].

MODEL APPROACH: The ATSET assay measures the ability of rodents to discern between cues to obtain a food reward after being exposed to varying amounts of radiation from a single ion beam. Performance in each test of the assay is quantified by two subject-specific values: the number of attempts to successfully complete a task and the mean completion time. For this work, we evaluate data from ^{4}He, ^{16}O, ^{28}Si, ^{48}Ti, and ^{56}Fe single ion beam exposure at various doses. A Gaussian Naïve Bayes (GNB) classifier, which models radiation doses for each ion and dose as a distinct group, is created from this data. The classifier then attempts to predict the amount of radiation received by a subject based on its performance during each ATSET test.

CURRENT PROGRESS: For each ion, the classifier distinguished between various exposure doses at probabilities significantly greater than chance (per class mean classification accuracy: ^{4}He: 71%, ^{16}O: 81%, ^{28}Si: 53%, ^{48}Ti: 76%, ^{56}Fe: 53%), suggesting that multifeatured data driven modeling can be used to create data driven models that capture cognitive effects resulting from radiation exposure. The results also highlight the need for a consistent experimental methodology when using collected information to construct data driven models, especially at low sample sizes. Control data, which was aggregated from multiple experiments where methods slightly differed, negatively affected classification performance. Due to the limited available data, the same dataset was used to train and test the classifier, making statistics describing each group highly representative of the underlying data. Additional data is needed to further validate this technique.

CONCLUSIONS: Results suggest that a multifeatured data driven modeling approach can be used to create data driven models that capture cognitive effects resulting from radiation exposure. Further work is needed to evaluate the classifier's generalizability, evaluate its performance for multi-ion exposure, and to translate these findings for use with human subjects.

[1] J.S. Jewel et al. Exposure to ≤ 15 cGy of 600 MeV/n ^{56}Fe Particles Impairs Rule Acquisition but not Long-Term Memory in the Attentional Set-Shifting Assay. (2018) *Radiation Research* 190(1), 565-575.