I22 From Forensic Sciences to the Stars: Study for the Implementation of a Protocol to Protect Astronauts Based on an Evaluation of Criminal Trials and Behavioral Genetics

Vincenzo Lusa, JD, Via Ferdinando, Palasciano #72, Rome 00151, ITALY; and Annarita Franza, PhD*, Via Delle Oche 15, Florence, ITALY*

After attending this presentation, attendees will better understand the importance of recent studies on behavioral genetics drawn from Italian criminal trials in which the defendants were found to have polymorphisms and brain abnormalities capable of predisposing deviance, assuming primary importance when they are applied to an area such as space exploration.

This presentation will impact the forensic science community by: (1) acquainting lawyers and forensic scientists of the benefits related to the creation of security procedures designed to safeguard humans on missions in which they will be isolated and in confined areas for long periods of time; and, (2) being able to identify both the types of biomarkers predictive of human behavior as well as the structural and functional abnormalities of those parts of the brain that promote criminal acts.

Since 2009 in Italy, some individuals (even some without criminal records) have been prosecuted who, although convicted of murder, benefitted from reduced sentences through the verification of some genetic polymorphisms and **Computed Axial Tomography (**CAT), **Positron Emission Tomography (**PET), and **functional Magnetic Resonance Imaging** (fMRI) results which showed brain malformations that may produce manifestations of violence.

The defendants in the trials were Bayout (Trieste court, 2010), Albertani (Cremona court, 2012), Mattielo (Venice court, 2013), and Gatto (Catanzaro court, 2013). In the first case, the offender responded to severe environmental stress. In the second and third cases, the defendants, with no prior criminal records, unexpectedly killed family members. In the last case, the offender acted emotionally in a crime of passion. The presence of biomarkers predictive of deviance in human behavior and significant anatomical abnormalities of the brain were ascertained in all the cases. The murders in question were committed because the defendants suddenly experienced manifestations of stress and environmental effects, in spite of being in full possession of their faculties.

This demonstrates the importance of developing a psychological protocol to evaluate the aspiring astronaut's genetic background in relation to the environment in which he/she will operate. In fact, the behavior of people working far from Earth is usually affected by high levels of stress, similar to what astronauts are often subjected to. Among the space travel risk parameters evaluated by the National Aeronautics and Space Administration (NASA) are behavioral health, bone metabolism and physiology, nutrition, immunology, cardiac and pulmonary physiology, space radiation, and space human factors. Moreover, NASA has identified three categories of behavioral health and performance risks associated with long-duration spaceflight and exploration: (1) adverse behavioral conditions and psychiatric disorders; (2) performance of errors resulting from sleep loss, circadian desynchronization, extended wakefulness, and work overload; and, (3) performance reduction due to inadequate cooperation, coordination, communication, and psychosocial adaptation within a Team Gap.[1] Billica reported a 2.86 per person-year incidence of such problems among the 508 crew members who flew on 89 space shuttle missions between 1981 and 1989.[2] The most common behavioral symptoms reported by crew members were anxiety and irritability. Data collected for 28.84 person-years of NASA space flight identified 24 cases of anxiety, for an incidence rate of 0.832 cases per person-year.[3]

Discussion will illustrate how security procedures to protect astronauts can be implemented and which genetic tests and diagnostic actions are suitable to studying the essential parameters under which biological tests on candidates will also be carried out to identify some polymorphisms such as Monoamine Oxidase A (MAOA), serotonin receptors 5-HTRIA and 5-HTR1B, serotonin transporter SLC6A4, Tryptophan Hydroxylase 1 and 2 (TPH1 and TPH2), the Catechol-O-Methyl Transferase (COMT) gene, human dopamine receptor DRD4, the DBH gene, the Androgen Receptor (AR), and the Estrogen Receptor (ESR1).

Reference(s):

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