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Impact of isolation on crew performance during the SIRIUS-19 campaign

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In the last decades, the main space agencies have been focusing on human space exploration missions in future lunar bases and long duration space travel. To ensure the success of long-term space missions, the potentially negative impact of isolation on the crewmembers should be studied for safety and performance monitoring purposes. In this project (TELEOP) this effect was investigated with regards to human-robot interaction, and more particularly during the remote control of a rover that collects samples on the surface exploration of the Moon. Isolation implies living in narrow spaces with limited privacy and having very little contact with people from the outside; those conditions mostly characterize human space missions. In order to study its impact, several analog mission campaigns have been run, such as: MDRS-189 and MDRS-206 (Mars Desert Research Station – Utah desert), ARES III (Lunares Research Base, Poland) and SIRIUS-19 (Scientific International Research In a Unique terrestrial Station at the Institute of Bio-Medical Problems of Moscow (IBMP) in Russia). In order to progress towards a more global assessment of a confined operator's cognitive state, an innovative protocol has been designed to analyze subjective and objective measures regarding a professional task. This study evaluates the correlation between the participants' performance (execution time and accuracy) in a teleoperation task with their reported mood, motivation and their measured cardiac activity during a ground-based analog space mission. The facility considered was the NEK at IBMP in Moscow, Russia, with six participants (3 females; Mean Age=33.4, $\sigma = 6.656$; 2 Americans and 4 Russians) during 4 months. Over the period of confinement, they undertook seventeen teleoperation sessions. Training sessions were run before and after the mission. The participants filled shortened versions of the PANAS and the IMI questionnaires to assess their motivation and mood before the task. Additionally, their cardiac activity was measured. The main results are significant Spearman correlations between the reported feeling of confinement and task completion time ($\rho = 0.375$, $p < 0.01$) and the reported feeling of confinement with the positive affect component of the mood ($\rho = -0.547$, $p < 0.01$). In addition, a general decrease of motivation was observed along the mission with the exception of a booster created by the Moon landing phase. The outcomes showed a strict link of confinement and teleoperation performance. Thanks to this unique approach in studying the impact of confinement in such realistic environments, the TELEOP project allows to learn more about this unexplored field and consequently to better prepare for future missions to the Moon and beyond.