BRIEF REVIEW OF EEG UTILIZATION IN HUMAN SPACEFLIGHT

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INTRODUCTION

- EEG Utilization in space biology remains limited despite 63 years human spaceflight activities[1-5].
- Advent of new operational paradigm for spaceflight with unknown and not well understood CNS pathophysiological consequences (isolation, radiation levels and exposure duration).
- Risk matrices are suggesting negative effects of prolonged exposure to microgravity and space radiation, affecting cognitive performance and other cerebral functions.
- To further expand the use of EEG as a research and health surveying tool, a review of past studies utilizing EEG data obtained during spaceflight seems indicated.

MATERIALS & METHODS

- Authors searched **Pubmed**, **Web of Science**, **Google Scholar**, and other scientific databases for relevant literature[**eeg AND spaceflight**, **sleep AND spaceflight**].
- Google pictures was searched with identical search terms for relevant pictures of EEG experiments during spaceflight missions.
- One limitation of the review is the author's limited access to literature of Russian, and Chinese space programs.

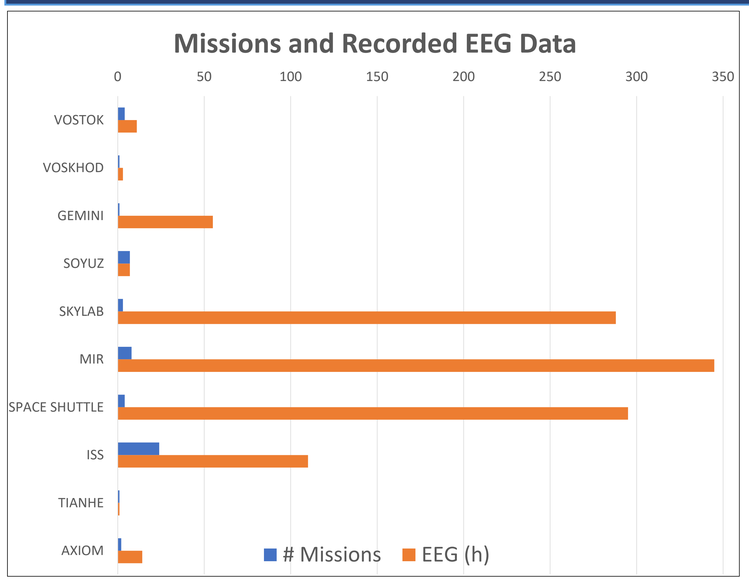
RESULTS

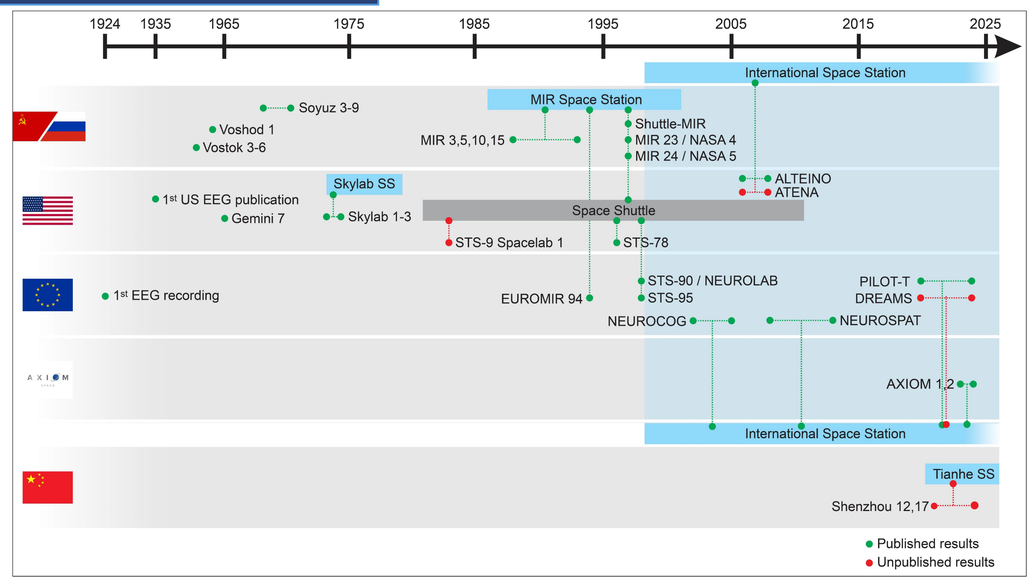
FEASIBILITY STUDIES (3% of collected data)
- Concept studies 1962-1964, basic neurophysiology
- SU: 5 missions

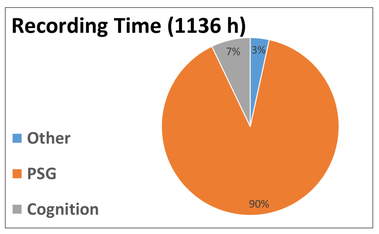
SLEEP STUDIES (90% of collected data)
- Pioneering Phase 1962 – 1973, mostly 1 or 4 electrodes
- Main Research Phase 1986 – 1998, mostly 8 electrodes, modified ambulatory EEG systems
- US: 9 sleep experiments (none on ISS), SU/RU: 6 sleep experiments (all on MIR Station), ESA: 3 sleep studies (Spacelab, Mir, ISS),

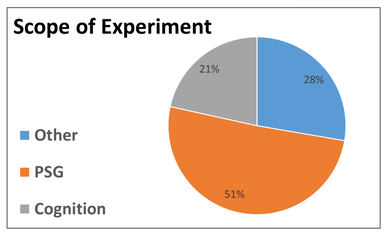
COGNITIVE STUDIES (7% of collected data)
- Introduced in early 2000 on ISS
- US/ESA: 1 experiment, RU: 1 experiment, ESA: 3 experiments

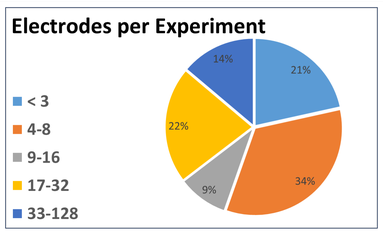
RECORDING SYSTEMS
- Single channel systems to high-density systems
- Analog to digital recording systems
- Data storage: Magnetic reel tape, stereo cassette, micro chips
- Conventional wet electrodes, dry-electrodes, individual mounted electrode, EEG caps

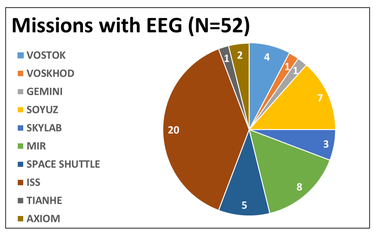


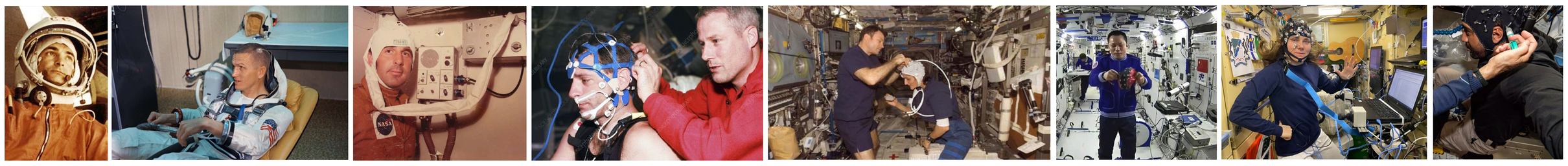












CONCLUSIONS

- Despite the findings of previous EEG studies and the importance of surveying mental and cognitive health status during expeditionary missions, EEG was - and still is - an **underappreciated and underutilized tool** in spaceflight. There is a lack of data / translational research in the EEG domain [5].
- **EEG is a spaceflight-ready technology**, and past operational issues with EEG have been overcome by modern EEG technology, electrode design, and analytical methods [4, 6, 7].
- The **increasing crew autonomy** during deep space exploration missions calls for additional risk, health, and clinical assessment means.
- EEG is a tool that **objectifies cerebral functional integrity** and **brain resilience**.
- See also poster IDs: 1648424, 1649526 , 1648732 , 1648440, 1648549, 1649258

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