

## Generative AI Support for Crewed Long-term Space Missions

### The Problem

The psychological stability of mixed international long-term space mission crews is very fragile and depends on many imponderables \*). This led to the idea to find out whether generative AI might help to secure the integrity of a crew during long-term flights, e.g. to Mars with the help of the new tools. An example of what can happen was a Russian long-term simulation for the ISS in 1999.

*On December 3, 1999, Judith Lapierre, a 32-year-old Canadian health sciences specialist and astronaut candidate, arrived in Moscow to help find out. On the outskirts of the city, researchers from Russian and international space programs had set up the Simulation of Flight of International Crew on Space Station mission. It was halfway through the experiment, and Lapierre was joining two other prospective astronauts, one from Japan and one from Austria, who planned to spend 110 days in the module, alongside four Russian men who had already been inside for six months. She was the only woman. Things were fine until December 31—less than one month after Lapierre and her Japanese and Austrian counterparts had arrived at the simulation—when the inhabitants held a small New Year's Eve party.*

*“We should try kissing, I haven't been smoking for six months,” the Russian mission commander, Vasily Lukyanyuk told her. “Then we can kiss after the mission and compare it. Let's do the experiment now.” Lukyanyuk then attempted to yank her out of the line of sight of the two cameras that kept a constant surveillance on the crew and its activities. He aggressively kissed and manhandled her twice, even as she protested loudly. [1]*

### A New generative AI Tool: Chat GLM

In April 2025 the Chinese artificial intelligence (AI) start-up Zhipu AI introduces world's first AI assistant capable of comprehensive research and multitasking. [2]

The AI assistant, called AutoGLM Rumination, works with Zhipu's proprietary models, including GLM-Z1-Air, a reasoning model, and GLM-4-Air-0414, a foundational model. The core set of models and technologies is fully open-sourced as of April 14, 2025 according to the company.

AutoGLM Rumination is based on three key characteristics: deep thinking, perception of the world, and use of instruments.

Unlike some leading international technologies, AutoGLM Rumination can not only conduct in-depth research but also complete tasks, transforming this AI assistant from a mere thinker into an intelligent performer capable of delivering results, the company says.

Through reinforcement learning, the AI assistant is able to self-criticize, reflect, and think deeply, thereby developing the ability to reason far-reaching and perform tasks.

The AI assistant is currently available in the PC version of **ChatGLM**, which allows users to test its research and application capabilities free of charge. This version is a preview version that primarily supports research applications.

### The Test

In order to test the performance of the new tool I asked chatGPT and chatGLM the same question to see whether there would be any new insights to solve the problem of the psychological stability of the crew of long term space missions:

<p><i>How can Generative AI support the ideal psychological composition of long-term mission astronaut crews?</i></p>
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## ChatGPT

Generative AI can play a crucial role in supporting the ideal psychological composition of long-term mission astronaut crews by enhancing selection, training, and in-mission support. Here's how:

### 1. Crew Selection & Psychological Profiling

**AI-Enhanced Personality Matching:** Generative AI can analyze psychological assessments and past team dynamics to optimize crew composition based on personality compatibility, cognitive diversity, and resilience.

**Simulated Interactions:** AI can generate realistic mission scenarios and virtual personalities to test candidate responses, identifying those best suited for teamwork under extreme conditions.

### 2. Training & Scenario Simulation

**AI-Generated Conflict Scenarios:** AI can create realistic, adaptive conflict-resolution training by simulating different crew personalities and stress-induced interactions.

**Adaptive Training Modules:** Personalized training materials can be generated based on crew members' psychological profiles, helping them strengthen weak areas in emotional regulation and teamwork.

### 3. Psychological Well-being during Missions

**AI-Generated Conversational Companions:** To mitigate isolation, AI chatbots with human-like conversation abilities can provide emotional support and companionship.

**Dynamic Morale Boosting:** Generative AI can tailor entertainment, music, or stories to individual crew members' preferences, maintaining morale and reducing stress.

**Custom Therapeutic Content:** AI can generate guided meditation scripts, cognitive-behavioral therapy (CBT) exercises, and personalized coping strategies for astronauts experiencing anxiety or depression.

### 4. Conflict Resolution & Team Cohesion

**Real-time Sentiment Analysis:** AI can analyze speech and text communications to detect rising tensions and suggest de-escalation strategies.

**Virtual Mediators:** AI-driven mediation tools can propose solutions during interpersonal conflicts, providing objective recommendations based on historical data from successful resolutions.

### 5. Cognitive Performance Optimization

**AI-Powered Motivation Strategies:** Generative AI can adapt task structures to align with astronaut motivation levels, adjusting workloads and suggesting cognitive exercises to prevent burnout.

**Customized Learning & Engagement:** AI-generated content can help astronauts continue learning new skills, preventing cognitive stagnation during long missions.

### 6. Post-Mission Reintegration

**AI-Assisted Psychological Debriefing:** AI-generated reports can analyze personal journals, mission logs, and social interactions to help astronauts reflect on their experiences and transition back to Earth life smoothly.

**Virtual Therapy & Support Networks:** AI-generated peer support groups and therapy modules can help astronauts process post-mission challenges.

By combining real-time psychological monitoring, adaptive AI-generated content, and team optimization strategies, Generative AI can ensure that astronaut crews remain psychologically resilient and well-adapted for deep-space missions.

## **ChatGLM**

Generative AI can support the ideal psychological composition of long-term mission astronaut crews in several ways:

1. **Mental Health Monitoring and Support:** AI can analyze communication patterns, facial expressions, and other behavioral cues to detect signs of stress, anxiety, or depression. It can provide personalized mental health support, suggest coping strategies, or alert mission control to potential issues.
2. **Crew Selection and Compatibility:** During the selection process, AI can analyze psychological profiles and predict how well potential crew members will work together over extended periods. This can help in assembling a team with complementary personalities and skills, reducing the likelihood of conflict.
3. **Conflict Resolution:** AI can assist in mediating disputes by offering neutral, data-driven solutions. It can also provide training modules to help crew members develop better communication and conflict resolution skills.
4. **Social Interaction and Engagement:** AI can create virtual companions or simulate social interactions to help alleviate feelings of isolation. It can also organize team-building activities and games to maintain a positive group dynamic.
5. **Personalized Training and Development:** AI can tailor training programs to the individual needs of crew members, helping them develop the psychological resilience and skills necessary for long-term missions.
6. **Cognitive Enhancement:** AI can provide cognitive training exercises to maintain and enhance mental sharpness, which is crucial for performing complex tasks in space.
7. **Stress Management:** AI can offer personalized stress management techniques, such as guided meditation, breathing exercises, or virtual reality relaxation environments.
8. **Communication Facilitation:** AI can help streamline communication between crew members and mission control, ensuring that information is clear and concise, which can reduce misunderstandings and stress.
9. **Cultural Sensitivity Training:** For international crews, AI can provide cultural sensitivity training to help members understand and respect each other's backgrounds and perspectives.
8. **Routine and Structure:** AI can help create and maintain a structured daily routine, which is important for psychological well-being. It can remind crew members of important tasks and help them manage their time effectively.
9. **Feedback and Reflection:** AI can provide regular feedback on crew dynamics and individual performance, encouraging self-reflection and continuous improvement.
10. **Emergency Response:** In critical situations, AI can offer immediate psychological first aid, helping crew members to stay calm and focused.

By integrating these capabilities, Generative AI can contribute significantly to the psychological well-being and effectiveness of long-term.

## My Summary

While both tools present standard “state-of-the-art” methods used for crew selection, training and flight support, by NASA enhanced with AI tools since 2022 (project called everMind [3]), two items in the chatGLM presentation are noteworthy: (a) The analysis of facial expressions for mental health monitoring and support, and (b) The cultural sensitivity training for international crews.

Although the analysis of facial expressions of crew members might be considered as problematic private invasion, the chatGLM digs a little deeper, but triggers a bunch of new questions about privacy and professional conduct.

\*) One of the least researched psychological space phenomena is the “away from home”- syndrome impressively illustrated by an image of the view to Earth from surface of Mars by NASA’s Curiosity Mars rover. [3]



## References

- [1] <https://www.vice.com/en/article/sexism-in-space/>
- [2] German.people.cn
- [3] <https://spaceambition.substack.com/p/mental-health-in-space-dont-get-too>

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