

Behavior and Performance Discipline Report on Countermeasures

I. Nature of the Problem

Before specific countermeasures can be proposed, developed and tested, specific spaceflight, ground support, crew, and associated family problems in Behavior and Performance (BP) need to be defined and quantified. NASA has begun this process by initiating the Behavior and Performance Working Group (BPWG).

Behavior and performance issues become increasingly more important as space missions become longer, and space flight teams become larger and more heterogeneous. The isolated and unique environment of space and space vehicles present crews with additional stresses above and beyond that which are normally encountered in training. Extended duration missions will place a greater stress on individuals, interpersonal and group relations for astronaut crews, between astronaut crews and ground control, and on astronaut families.

The BPWG believes that the first two recommendations listed below should be given the highest priority. The third should be planned and conducted as soon as possible, but should build on the current knowledge and experience base within NASA. Research activities which directly involve astronauts should be based upon the experience and knowledge of the issues particular to this unique mission environment, and require good personal rapport and trust with the subjects. There are both intramural and extramural scientists nationally, as well as international space agency based or external scientists, that meet these requirements.

II. Countermeasures to the problem

Current countermeasures focus primarily on the individual, mission crew, and to some extent the families of mission crews. Some work has been done to address: the overall mission and ground crew as a team, cultural issues for the mission and ground crews, and families of ground crews and the larger cultural and overall team aspects of space missions. Current countermeasures are part of an organized psychological and training program addressing the full spectrum of requirements from selection through post-flight readaptation. No quantitative validation of these measures has been made to date.

Selection criteria focus on:

Select Out - based on medical criteria

Select- In - based on non-medical criteria (job proficiencies, mission drivers).

Astronauts receive training in cross-cultural issues; information regarding what is known about psychological factors in extended space flight; lessons from Analog Environments; leadership and team functioning; crew resource management; and clinical resources for astronauts.

Preflight support for overseas assignments include two-way video visits on weekly basis with family stateside; video library; journal/newspaper subscriptions; daily electronic news; advocacy (Moscow rest and recreation base, including some sports equipment); site visits; e-mail; and pre-deployment lunches with families.

Inflight support for overseas assignments include packages delivered to MIR on a regular basis; audio and video family conferences; e-mail; ham radio; audio and video US news, sports, events; special conferences on holidays (e.g. Birthdays, Mother's Day); personal diversions (e.g. special cassettes, books, CD ROM, videos, family album, audio messages); and continuing psychological support services to family members of astronaut mission crews.

Monitoring of the astronauts includes a questionnaire on mood sleep and stress, and countermeasure usage and effectiveness; weekly family tag ups; private medical conferences; daily reports from ground crew; private psychological conferences (planned for Space Station); and Russian psychological group reports.

Postflight support includes debriefs of astronauts alone and with family; daily contact during physical rehabilitation; and daily medical review.

III. Concerns:

Substantial data may be available in the area of behavior and performance from environments analogous to space flight. International experiences, as well as information gathered on the US Space Program, need to be fully analyzed.

IV. Recommendations:

It is the consensus of the BPWG that the highest priority activities are:

1. Critical Review of Analog Studies - There is a great deal of literature from many isolated and unique 'analog' environments. A comprehensive, systematic review of these studies undertaken with the viewpoint of their true analogy with space flight would clarify the usefulness of these studies to NASA, and may present a more integrated and complete picture of life in isolated environments. After this project is completed, remaining areas of research that should be undertaken in analog environments should be identified. Analog studies that are felt to have a high correlation with space flight should be used to define information that is particularly pertinent to small teams operating in harsh environments. Examples of information that would be very useful to operational

space flight include: the identification of psychological factors of good performers; the natural history of psychological adaptation to harsh environments; the identification of types of problems that arise during deployments; the outcomes of attempted interventions and preventative measures - - all of which should include the issue of balance between crew autonomy and integration with ground support teams.

2. Review of the Russian Experience - Nearly all the world's experience in long term space flight is resident in the Russian space program. A comprehensive review of the Russian data and observations in the field of behavior and performance should be undertaken and a written summary should be produced. This should include initial selection and pre-flight selection processes, preflight psychological evaluation, training and support, and in-flight evaluation (monitoring) and support activities, and post-flight monitoring and interventions. The importance of this information is based upon the fact that it is derived from real events in the space flight environment. This activity would enable NASA to conduct a research program at a higher level of understanding and knowledge. A systematic look at Russian selection procedures, training, flight experience and related issues may offer transferable areas of expertise.

3. Astronaut Selection and Crew Composition - Psychologically healthy individuals and well-functioning crews are critical to mission success. One would like to be assured of selecting psychologically healthy individuals well-suited for the unique duties and stresses of this job. Additional efforts should be made to follow-up on the 1990 study by Rose and Helmreich which looked at using objective, validated personality measures to psychologically screen astronaut applicants as part of the initial selection process. An emphasis should be placed upon factors related to long term space flight missions, of greater than 30 days. After this, research that improves our ability to assemble optimal crews - - not just as individuals, but also as a whole unit - - would be valuable. Related to this, research should be solicited regarding the best methods and protocols for training individuals and whole crews prior to flight on topics such as conflict management and resolution, communication skill enhancement, cross cultural training, team maintenance, and stress management.

4. Other - A research program that addresses the specific area of countermeasures through a three part program of:

1. retrospective analysis of previous space missions and appropriate analogs,
2. ongoing analysis of current space and analog activities including Shuttle, MIR, and appropriate analogs and simulations and
3. future research on a range of applied and basic areas of behavior and performance.

And a process that addresses:

1. the space mission team, ground support team and space mission crew families
2. preflight, flight and postflight time periods

3. technology design processes.
4. participation with other federal agencies
5. participation with international partners
6. maintaining the BPWG and expand its scope to fully address age, gender, culture, group dynamics.

In addition, many different areas related to the field of behavior and performance would benefit from further research. The committee also recognizes that resources are limited, and not all studies can be done. The group does, however, recommend that research in the area of behavior and performance be actively pursued. Appendix F of this report contains greater detail on the areas of research recommended for consideration with respect to countermeasures. The three general areas of research recommended are:

- psychiatric issues
- individual/personal psychological development:
- group (dyad, team, culture) psychological development:

V. Overarching Issues and Recommendations

Potential future countermeasures touched on by the BPWG specifically focused on the need to have a balanced BP program addressing the individual, group and cultures involved in space missions. These countermeasures address areas of selection, training, pre-, in- and post-flight and monitoring as well as addressing space mission crews, ground control and mission crew families. These countermeasures need to be addressed further:

- Maintaining the presence of behavior and performance specialists through all phases of space mission design,
- Selecting full mission crews and critical ground personnel as a team,
- Embedding tests of cognitive, emotional and behavioral performance in functioning mission hardware and experiments,
- Greater use of simulators for training on board the mission,
- Further development of self report tools (personal logs, computer files),
- Developing virtual environments and telepresence to address behavior and performance aspects of missions,
- Using ground based analogs and simulators for selection and training
- Further training of mission and ground crews together.