MANNED MARS MISSION PSYCHOLOGICAL ISSUES

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ABSTRACT

A manned Mars mission would undoubtedly be the most ambitious undertaking mankind has ever attempted, but it is a logical extension of NASA'S Space Shuttle and Space Station programs. Many of the technical and engineering problems inherent in such a long journey have already been, or are being solved at this time. What may be some of the more important limiting factors of such an historic mission, however, are the potential psychological and social problems which might develop on such a long-duration space journey.

Many studies done over the last twenty years in environments that have similarities to the space environment have demonstrated clearly that it is not a question of "if such problems develop" but "when". All types of groups studied (and they include submariners, Antarctic expeditioners and others) had significant decrements in performance over time as well as increased social conflict and incidence of somatic complaints, all of which indicates that such environments take their psychological toll on both individual and group functioning. What unique factors the space environment may introduce into this picture is not yet well-defined, but a manned Mars mission will certainly be an unprecedented stressful psychological milieu for the human organism.

It is reasonable to assume that those issues which have been found to adversely effect isolated groups in other extreme environments will likely be present on the voyage to Mars. With careful planning, these problems can be minimized for the Mars voyager.

INTRODUCTION

A manned mission to Mars poses some very real psychological challenges to the individuals selected to carry out the plan, as well as to their families. Those issues which have been found to adversely affect isolated groups in other extreme environments will likely be present on any manned voyage to Mars.

Oberg (1) has pointed out that "if most of the great exploratory expeditions of the past. . .had been required to meet the safety and

comfort standards expected today from space expeditions, they never could have been made. Their ship losses and personnel losses were substantial, even--on tragic occasions--total.

"That could not be allowed to happen on the first expeditions to Mars, whatever the cost. . .the man-to-Mars effort must guarantee that the crew will stay alive the whole trip, without untoward medical or psychological complications, and perform their duties as well as the hardware allows them to". The purpose of this paper is to suggest that with careful planning, many of the potential psychological complications can be minimized or at least more effectively dealt with by the Mars mission crew members.

ISOLATION/CONFINEMENT

The problem of isolation and sensory deprivation was felt to be one of the more serious psychological issues early in the history of the Space Program. This problem has been shown to have serious effects on isolated individuals and groups in Earth-bound environments. Numerous studies done on groups such as submariners (2-8), Antarctic journeyers (3,4,8) and volunteers in simulated environments (9-16) reported remarkably consistent findings regarding man's response to isolation. Reported symptoms varied only slightly from study to study, and all studies recorded the following symptoms: boredom, restlessness, anxiety, sleep disturbances, somatic complaints, temporal and spatial disorientation, anger and (most important), deficits in task performance over time. Furthermore, in studies of isolated groups of men (4,5,7), researchers had to take into account such factors as group and social influences, individual and leader roles, and individuals' personality coping mechanisms. For example, Gunderson (4) and Gunderson and Nelson (5) studied groups in isolated and remote Antarctic stations over several months and followed subjective evaluation by the men of their symptoms. By far the most common complaint was sleep disturbance (reported by 72% of individuals), followed by depression, headache, irritability, and other somatic complaints. It was noted that all the symptoms increased over time. Even when such symptoms (especially depression and irritability) occur among only a few members of a small isolated group, they could pose serious survival problems for the rest of the group under certain circumstances. Consistant in all these group studies was evi-

dence that group compatibility and performance typically declined over prolonged isolation. On the other hand, Earls (6), who studies submariner groups, was struck by "the relative absence of overtly expressed hostility" on the part of the submariners. This conflict--between the individual's unwillingness to alienate the group (upon which one's individual survival depends) and the increasing and inevitable normal kinds of tension that must remain undischarged (no overt agression)--can arise in any group situation. Often the unresolved conflict can lead to depression and somatic complaints.

Berry (17) pointed out that sensory deprivation/isolation issues have (at least for the American Space Program) not been a significant issue. However, for a Mars mission, manned by individuals with heterogeneous background, personality styles, and scientific objectives etc., isolation issues will be extremely relevant and will require further study(18).

GROUP/SOCIAL INTERACTION

Since the beginnings of manned flight, the trend has been to increase the number of persons on each mission. The Space Station is expected to have up to 10-12 or more persons living and working together. A mission to Mars will of necessity have a diverse selection of individuals with different scientific and or mission objectives. It will require pilot astronauts who will need to fly the vehicle to and from the Red Planet; it will require scientists with different specialties (such as geology, physics, medicine). It is not known at this time the number of individuals which would make up the crew of the Mars mission, but any interplanetary mission will require numerous individuals working in a close knit, efficient team manner for a long period of time (possibly up to two years, or more). Obviously, psychological compatibility and the methods used to determine the selection of crew members will play a role in the ability of such crews to perform efficiently in the isolated environment of space. The Soviet space program has long recognized this as a potential problem--especially since they have kept several individuals in space for up to 240 days. But even the Soviets have little experience with crews of more than two or three individuals. However, from the beginning of their training, Soviet cosmonaut candidates are

subjected to the most grueling psychological tests and the candidates are grouped according to compatibility (19).

Almost all of the group studies done to date have been done on all-male crews, and thus far, the potential consequences of adding women to long-duration missions have not been dealt with. The issue of sexuality--especially on long-duration missions such as that to Mars--is not a trivial one. No matter how well trained the crew is, there is reason to expect that such issues as sexual arousal, tension, and competition are just as likely to occur in space as they are in any Earth-bound endeavor, and possible solutions may be to balance the crew with individuals of both sexes; or perhaps to have married couples. This is another area which may require careful thinking in advance.

One method of approaching the complexity of handling group problems on the way to Mars would be to train the crewmembers in simple group dynamics. In this way, an ongoing group process would help identify and resolve potential trouble areas and help crews develop problem-solving techniques before they arise in the more dangerous space environment. As a practical method, this would also give the crew a model for resolving in-flight hostilities and tensions that can lead to group-threatening behaviors and decrease crew performance (21,22). After all, on the journey to Mars, there will be nowhere to go to get away from it all. Such a method would offer useful ways of discharging tension and anger, and possibly help alleviate the symptoms of depression and somatic complaints reported in other isolated groups.

One final issue should be mentioned in this section and that is the question of how leadership should be structured on a Mars mission. Leadership style can have a significant impact on group morale and performance. There has been considerable research on different kinds of leadership on group function--obviously, some types work better than others. What will be the best type (or types?) of leadership for a Mars mission? (23)

HUMAN PERFORMANCE IN STRESSFUL ENVIRONMENTS

Research in human performance and productivity has grown to very large proportions in industry and the military. Primarily this has come about because of the desire to increase human productivity in these areas, each of which has its own peculiar environment which often

impedes attainment of maximum efficiency by its workers. The relevance of this type of research for an extended mission to Mars cannot be over emphasized. Such factors as the habitability of the space ship and other man/machine interfaces must be carefully planned in advance taking into account the specific complexities of a mission to Mars.

For example, what will the scientists on the mission do during the time it takes to get to the planet? How will we prevent boredom and restlessness from occurring--or at least minimize them? A mission to Mars will provide many environmental challenges to crew performance, efficiency, and productivity. Such factors as temperature, isolation, work/rest cycles, exposure to unfamiliar and possibly dangerous contingencies (which no amount of training beforehand can possibly cover completely), exposure to various physical/physiological alterations which may alter the body's ability to cope with other types of stress--all of these factors will have their effect on individual and crew performance capabilities. Can we devise a simple way for individuals to keep track of their own performance status, and thus give them some kind of feedback which they can use to enhance their efficiency? This is done in other environments where it is much less dangerous to fall below a certain level of functioning. Why not on a trip to Mars? This would enable an individual (or the entire crew) to put into effect pre-planned strategies to increase their own effectiveness. (24)

In paying attention to these factors, we can maximize crew performance for the entire mission and decrease the incidence of any psychological sequelae.

PSYCHOPHYSIOLOGIC RESPONSE TO STRESS

Coping responses, or how individuals avoid being stressed when exposed to threatening environmental situations, will be of particular interest on a long-term mission to Mars or other planets. Researchers have found that individual psychological defenses, such as isolation and denial, resulted in subjects' low cortisol secretion before a stressful event, compared with subjects who were overtly distressed before the event (25). Thus, a defense may be effective physiologically, but maladaptive psychologically, and it becomes an even greater threat to the organism. For example, women who had breast tumor biopsies and who denied the situation had low cortisol levels; however, because these

women had waited much longer before coming to medical attention than women who feared the situation and immediately sought help, they put their lives at greater risk (26). In the same way, defensive structures in Mars voyagers may be vitally important; they may be even more important than the voyagers' actual physiologic responses to stress.

PSYCHOSOCIAL SUPPORT FOR INDIVIDUALS ON A MARS MISSION

NASA has long recognized the importance of habitability in determining astronaut morale. Food items, for example, are selected to meet the tastes of individual astronauts, and favorite music has been permitted on longer missions such as Skylab. The Soviets make use of their Group for Psychological Support to help their cosmonauts get through record-breaking stays on the Salyut Space Station.

The literature in this area has many suggestions as to what factors might be particularly useful to focus on for the purpose of maintaining mental health or improving the quality of life on long-term space missions. The suggestions come from studies of other isolated groups such as those on submarines or in the Antarctic, and have been extrapolated to the space environment. It remains to be seen, however, if these "psychological support" measures are really going to be supportive or not in the rather extreme isolation of the voyagers to Mars. For example, how does one deal with the death of a loved one on Earth when you are millions of miles away--or handle a family crisis? Should Mars astronauts be told about such things when they may not be able to return to Earth for months or years? If they are told, then what can be done to help them deal with their feelings (especially the feeling of helplessness)? Will constant communication with families be supportive psychologically--or might it also be disruptive for the individual physically and mentally coping with the stresses of space? It seems likely that some important family problems or situations will develop over the two years of a Mars mission. How will we help astronauts and their families cope with this prolonged separation? Perhaps part of the solution would be to select individuals who are not married, or have no children, or have children who are grown. However, no astronaut that might be selected could possibly come from a complete social vacuum, and the problem of psychosocial support still remains.

There is probably no one simple answer for all individuals, but this area needs to be carefully thought about prior to a mission to Mars.

SUMMARY

The research on isolated environments over the last thirty years suggests that psychological factors associated with such environments will lead to negative changes in individual and group performance. A mission to Mars will be the greatest undertaking ever devised by the human species. The members of such a mission will be in an environment whose potential dangers are not even completely known at this time. The psychological factors generated by such an environment, and which might adversely affect accomplishment of mission goals, can be minimized or planned for in advance. This paper was written in the hope that these issues will not be ignored in planning for this great adventure.

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