Problems of Intergroup Behavior in Human Spaceflight Operations

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This paper discusses intergroup dynamics in human spaceflight operations. A definition of intergroup behavior is presented and prerequisite conditions for intergroup conflict are explored. Research and anecdotal evidence of intergroup conflict between groups and subgroups in exotic environments and space operations is presented. Concepts from the literature on intergroup conflicts are discussed in the context of possible conflict resolution interventions. Factors that may affect intergroup dynamics in human spaceflight operations and the need for intergroup research are highlighted.

Introduction to Intergroup Behavior

IN human spaceflight operations, many individuals belonging to one group interact with members of other groups. For example, scientists interact with engineers, vendors with customers, NASA with Congress, managers with workers, space-based crews with Earth-based mission control teams, mission specialists with mission pilots and commanders, blacks with whites, men with women, etc. The occurrence of intergroup behavior is so prevalent that when it is collaborative, it might escape notice entirely, or when it is conflictual or competitive, it may be discounted as a "personality conflict." Because of the nature of intergroup dynamics, evidence of intergroup conflict emerging in various human space operations, and the potential problems caused by intergroup conflict, special attention to this topic is warranted.

Intergroup behavior has been described as occurring "whenever individuals belonging to one group interact, collectively or individually, with another group or its members in terms of their group identification."[1] Tajfel[2] points out that this explanation of intergroup behavior is dependent on the concepts of group and group identification. He states that a group can be defined by external designations, such as engineer, manager, or astronaut, or by internal criteria that imply personal identification with a group. For intergroup behavior to emerge, however, both the external and internal definitions of a group must exist. In other words, I see myself as a member of one group (internal definition of my in-group) and I also see you as a member of another group (external definition of your in-group). Simultaneously, you see yourself as a member of your group (internal definition of your in-group) and me as a member of my group (external definition of my in-group).

Tajfel argues further that, in addition to the cognitive component of awareness of group identification, an evaluative component regarding the group membership must be present. Not only do I belong to my group, but it is good (or bad) to belong to my group. These two components are sufficient to produce intergroup behavior. However, a third component often exists: an emotional investment in both the awareness of the group identification and the evaluations of group membership. No matter how complex the description of the criteria, group identification and subsequent intergroup behavior appear to emerge easily and rapidly in our culture.

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Although intergroup behavior can be collaborative and often is, in most intergroup situations there appears to be a tendency for the development of intergroup competition and conflict. Intergroup competition and conflict are not in and of themselves bad, and it can easily be argued that intergroup competition between the United States and the Soviet Union is one of the primary underpinnings of past and probably current human space operations. Competition can be motivating and arguably "improves the breed." However, there are times and tasks, particularly within an organization and in endeavors as expensive and risky as space exploration, that require intergroup cooperation and collaboration.

It is possible to argue that an individual can manifest his or her own internal (intrapsychic) intergroup conflict, if that individual's membership or identification with two different groups leads to internal turmoil. However, for the purposes of this paper, intergroup behavior will be confined to interactions between two individuals, between an individual and a group or among groups where group affiliation and identification are potentially relevant factors to the parties in the interaction.

Emergence of Intergroup Conflict

Intergroup conflict can be measured by assessing either biases in favor of the in-group (in-group bias) or biases against an identified out-group (out-group discrimination), or both. The minimal conditions required to generate measurable behavior that reflects a propensity toward intergroup conflict have been an area of much research and debate. In one of Sherif et al.'s[3] classic studies of intergroup behavior, boys arrived at camp in two separate groups. As soon as the groups became aware of the other's existence, and before the competition between them was institutionalized, there was evidence of competitive attitudes between the groups.

Another example of the minimal conditions required to demonstrate in-group bias is from an experiment by Billig and Tajfel.[4] They divided subjects into groups randomly and then measured the subjects' distribution of points that were worth money to two other anonymous subjects. The anonymous subjects were identified as either from the in-group or the out-group. There had been no interaction between the "groups," nor during the experiment was there any interaction among the subjects. The results consistently showed bias toward the in-group. In other words, subjects consistently gave more money to certain individuals simply because they reportedly belonged to the same group as the subject, and the subjects did not give as much money to others identified as not belonging to the subject's group. The research subjects never met each other; they were simply told that the others belonged

to the same group as the subject or that they belonged to a group other than the subject's group.

There is other evidence that in-group bias is manifested even during situations of intergroup collaboration.[5,6] In Tajfel's review,[2] he points out that in "at least thirty studies which used minimal or near-minimal categorizations with diverse populations of subjects, independent variables and dependent measures ... all show in-group-favoring bias."

In exotic environments and space missions, one criterion for identifying one's in-group has proven to be relatively predictable. A particular in-group bias that has been evident in most exotic environments differentiates those members of the mission that are in the exotic habitat and those who are not. For example, space-based crews have had conflicts with the Earth-based support teams,[7] in underwater space simulators hostility has been directed toward outsider observers,[8] and in wintering-over expeditions to Antarctica "norms" against outsiders have been reported.[9]

Consequences of Intergroup Conflict

As mentioned, intergroup competition and conflict are not necessarily bad. Most Americans would support the contention that the intergroup conflict between the American colonists and the British led to the expansion of democratic ideals and improvements in government. Also many people would argue that competition between companies in a given market has led to better products. Also, within an organization, intergroup competition can, if managed well, lead to better solutions to problems.[7]

However, within organizations competitive win-lose situations have significant drawbacks. Drawing on the research on intergroup competition and conflict, Schein[10] has summarized the typical behaviors evident in intergroup competition and conflict. First, each group begins to see the other group as the enemy rather than a neutral object or collaborator. Second, each group tends to deny its weakness, perceiving only the best parts of itself, while tending to perceive only the worst parts of the other group and to deny its strengths. And third, hostility toward the other group tends to increase, whereas interaction and communication with the other group tend to decrease. These typical behaviors tend to have an escalating effect on conflict between groups.

The influence of intergroup competition on the dynamics within a group (intragroup) is another area of prolific research. In particular, the impact of intergroup competition has been linked to the formation of centralized leadership within the competing groups.[11] Schein,[10] again drawing on research, summarized the impact of intergroup competition on intragroup dynamics in the following ways: 1) Each group becomes more closely knit and elicits greater loyalty from its members; members close ranks and bury some of their differences; 2) leadership patterns tend to change from more democratic to more autocratic; 3) each group demands more loyalty and conformity from its members in order to be able to present a solid front.

There are significant consequences to the competing groups after the competition has been won or lost. The losing group may deny or distort the loss, blaming the authority that decided the outcome for being biased or in some other way denying that the other group effectively defeated them. The tension in the group increases, they are ready to work hard, and they are desperate to find someone or something to blame. Often, the leader is blamed and replaced. If the defeat is accepted, the group may splinter, intragroup conflicts surface, and internal fighting is likely to occur. There is less concern for an individual member's needs and more concern for recouping by working harder, perhaps for a rematch. If the loss is realistically accepted, reevaluation tends to occur, reorganization is likely, and a return to a cohesive and effective group is possible.[10]

The winning group in an intergroup competition or conflict also changes its behavior. Although it may become even more cohesive, there is relatively less concern for work and task accomplishment. The winning group releases its tension, becoming complacent, casual, and playful. It tends to lost its fighting spirit. There is little if any growth evident, the winners tend to feel justified in their positive stereotypes of themselves and in their negative stereotypes of the losers.[10]

Win or lose, there are clearly negative consequences to both groups in intergroup conflicts. Intergroup conflict could obviously lead to potential problems if it emerged between interdependent teams, such as space-based crews and Earth-based support teams or between subgroups within larger space-based crews. As noted, there is evidence that these behaviors can be expected from groups in isolation and that these intergroup behaviors have already been manifested in both American and Soviet space missions.

Evidence of Intergroup Conflict in Exotic Environments

Numerous anecdotal accounts of intergroup conflict in various exotic environments have been reported. Exotic environments manifest the characteristics of isolation, confinement, and risk.[12] Four different types of exotic environments have been investigated: 1) simulators or artificial environments designed to simulate space; 2) nuclear submarines and other submersibles; 3) large and small wintering-over camps in Antarctica; and 4) U.S. and Soviet human space missions. One fairly consistently reported behavior in these studies is conflict with external authorities or outside observers, in other words, intergroup conflict.

Simulation studies conducted by the U.S. Air Force School of Aerospace Medicine (SAM), involving two subjects and lasting up to 30 days, found that feelings of irritation between the subjects were either suppressed or "projected" to the people monitoring them.[13,14] In longer SAM studies involving four men in a 56-day simulation, interpersonal aggression was observed among the subjects and hostility directed toward the outside observers.[15]

Sensitivity training was used with selected crews prior to a Douglas Aircraft space cabin simulation[16] in which four subjects spent 30 days. Psychological testing was used to select the "crews." Group cohesion was reported as high and there was no evidence of intragroup hostility. However, there was a tendency for the subjects to become irritated with outside observers. In a subsequent McDonnell Douglas simulation[17] using four subjects and lasting 60 days, sensitivity training was again used. Group cohesion was again reported high and intragroup hostility low. However, once again, there was a tendency for the subjects to get angry with outside observers. Negative attitudes toward observers also were reported in a one-year simulation conducted in the USSR.[18]

In a 90-day McDonnell Douglas[19,20] simulation that did not report the use of sensitivity training, subject morale suffered, group cohesion decreased, and hostility among crew members was reported. Of greater significance was the absence of reported irritation or anger between any of the crew and outside personnel. In his summary of simulation studies, Kanas[8] has intimated that the hostility directed at "outsiders" may be a "displacement" of the unexpressed hostility within the isolated groups. The absence of externally focused hostility in the clear presence of internal group strife would appear to support his interpretation.

While simulators do not involve the risk associated with space missions, conditions such as isolation and confinement are similar and some of the simulations have been designed to approximate spaceflight conditions. One simulation study that did include attributes of space, e.g., a hostile external environment and the associated physical risks, was conducted underwater. Ferguson[9] reported that during a 30-day mission the six crew members of the Ben Franklin submersible gradually withdrew from each other and showed anger toward the surface personnel who were monitoring them.

Similarly, reports from camps in Antarctica describe the development of a norm against outsiders. One particular manifestation of this norm was the refusal to provide shelter to travelers.[21] The shunning of visitors to Salyut has also been reported.[21]

Conflict between space-based crews and Earth-based support teams has been frequently noted. Cunningham[22] reports that during the first Apollo mission a "low-grade" conflict occurred between the crew and mission control. During Skylab IV, the strain between mission control and the crew climaxed when the crew decided to take a day off.[23-25] A similar incident is believed to have occurred when a Salyut crew broke off communication with ground control for a day.[21] Sharp exchanges evidently also occurred between Columbia and mission control.[26]

Intergroup conflict in spaceflight operations can be interpreted as the displacement of intragroup conflict.[18] Bluth[7] interviewed Lieutenant General Georgy Beragovoi, then head of cosmonaut training, who reported that approximately 30 days into a mission, hostility becomes evident between crew members. He suggested that although the conflict is controlled, the hostile feelings are displaced to the Earth-based support team. Although the tendency to displace anger to outsiders is an unconscious process, from Beragovoi's comments, one could extract that a potential strategy for controlling the hostile emotions of intragroup conflict is to redirect then to an outside group. From an intragroup perspective, a leader, if conscious of these dynamics, might choose to increase conflict with the outsiders in order to increase group cohesion. As mentioned, a group in an intergroup conflict situation tends to become more closely knit and to bury individual differences. Although this strategy might be beneficial for the group in an exotic environment, there are potential risks to the overall mission.

A laboratory study by Bekkan[27] implied that leaders in precarious leadership situations, i.e., when their authority is unclear, tend to exacerbate intergroup conflicts if they believe they stand a good chance of winning. While Bekkan's study was not on groups in exotic environments, it raises the question of whether or not some of the hostility directed toward outsiders may be intentional. Perhaps unclear authority delegation places leaders of space-based crews in precarious leadership positions, and conflict with Earth-based support teams is used to better establish their position. Certainly, authority issues between space-based crews and mission control have been noted in the literature.[21-26]

Crew Size and Heterogeneity

As human spaceflight evolves and crews become larger and more heterogeneous, intergroup dynamics may be expected to emerge within space-based crews. Johnson[28] has pointed out that as groups grow to a certain size (five plus or minus two), coalitions form and subgroups or cliques emerge. Subgroups or cliques are common on submarines and in the Antarctic. These groups commonly form around work roles.[29,30] The formation of cliques tends to diminish group cohesion. Conflict between cliques can lead to the withholding of information between the subgroups and can be detrimental to tasks that require collaboration of the group as a whole.

Another form of intergroup behavior that may emerge is stereotyping and prejudice. This form of intergroup behavior does not require the actual presence of two subgroups. A single individual may be treated as a representative of an out-group and fall prey to the displaced hostility of the in-group, i.e., be scapegoated. Scapegoats and deviants have been reported on submarines and in Antarctica. Another manifestation of this form of intergroup behavior occurs simply between two individuals within a crew, with each identifying the other as a member of some particular out-group. This intergroup dynamic is often mislabeled as a personality conflict and may affect crew cohesion and teamwork beyond the animosity evident between two individuals.

Harrison and Connors[31] highlighted certain demographics that may affect intragroup dynamics in space; these include gender, age and seniority, race or ethnicity, and work-related status.

Chaikin,[12] Oberg,[21] and Cunningham[22] all report that some male astronauts and cosmonauts do not feel that women are suited for space missions. Gender stereotyping is a form of intergroup conflict that could emerge and adversely affect group cohesion and deploying decisions. The effects of gender on intergroup behavior in exotic environments have been studied empirically. For example, Harrison and Connor[31] reported on a laboratory study of isolated and confined groups in which conditions that triggered conflict within an all-male group and between the all-male group and the researchers did not trigger similar reactions from an all-female group.[32]

Age and seniority of leadership have been studied in underwater simulation[33] and have been shown to affect intragroup hostility. Groups led by individuals who are significantly higher in rank and had significantly more seniority than other members manifested less hostility than groups led by younger men with only slight differences in seniority. The teams that performed best reportedly projected their hostilities toward the environment, a potentially superior strategy to displacing any hostility to outsiders.

The author is unaware of studies that investigated the effects of race in exotic environments; however, some problems in the Soviet Salyut program have been attributed to differences in language, culture, and politics.[7,11,21,34] A Czech cosmonaut visiting Salyut 6 reported feeling uncomfortable and ignored (left out) due to language and other communication difficulties. He jokingly referred to having his hands slapped whenever he reached for a dial or switch.[21]

Status and work roles have also been the source of stereotyping and prejudice. Cunningham[22] and Wolfe[35] both reported that some military test pilots who later become astronauts expressed hostility toward mission specialists (or "hyphenated" astronauts), who served in scientific and other nonpiloting roles.

From the available evidence, it would appear that as human space operations become more routine and crews become larger and more heterogeneous, the probability of conflict within a crew, due to intergroup prejudices, stereotyping, or clique formation, will increase.

Interventions

None of the evidence to date has suggested that a manned space mission has been significantly threatened or its objectives compromised by intergroup conflict. However, as missions grow longer, the influence of intergroup dynamics on morale and performance may become critical. Conscious attention to intergroup tensions may help maintain high levels of morale and performance throughout a mission. The literature on intergroup behavior and, in particular, intergroup conflict and conflict management contains a variety of concepts and intervention strategies that may be useful when considering ways to manage intergroup conflict in spaceflight operations.

Some specific factors that should be considered when contemplating and/or designing an intervention are the nature of conflict, the impact of intergroup conflict on individuals, and the emotional context in which the conflict takes place. Different interventions are most appropriately employed at different points in a mission's life cycle. Some of the premission variables that might be manipulated to influence later intergroup and interclique conflict during a mission include personnel selection, training, mission structure, habitat design, and mission duration. During a mission, the points of potential intervention are far fewer. Some interventions that might prove useful come under the headings of predicting conflict, conflict avoidance, communication interventions, conflict resolution

techniques, changes in activity schedules, third-party and remote intervention.

Nature of the Conflict

Before an intervention can be attempted to resolve a conflict, it is important to ascertain the nature of the conflict. Real conflict occurs when the satisfaction of one set of goals excludes the possibility of achieving another set of goals. This type of conflict is known as a zero sum game, where there is a finite resource, and the more one party takes, the less the other gets. Whenever one party wins, the other loses. This perfect inverse relationship is the basic assumption, conscious or unconscious, of any competitive endeavor.

Many conflicts that emerge are not zero sum games. Coser[36] differentiated the realistic conflict (the zero sum game) from autistic conflict (the nonzero sum game). In autistic conflict, while one or both parties may believe that the accomplishment of the goals or priorities of the other party will inhibit them from accomplishing their goals, an objective third party would not perceive the goals as incompatible. Often, autistic conflict is characterized by 1) perceived threat and its concomitants of fear, anxiety, and insecurity; 2) distrust, as manifested in suspicion regarding the motives, intentions, and objectives of the other party; and 3) misperception of self and/or an inaccurate view of the other.

For example, some resources in space missions that evidently have been sources of conflict are time and space. Competition for these resources will reflect the perceived priorities of the various groups. Careful attention should be paid to assessing which aspects of the conflict are real and which are autistic. Often apparently conflicting goals can be accomplished within the confines of a finite resource. Shifting intergroup conflict to collaboration can be accomplished using structured intergroup conflict resolution techniques.[37] Training in these techniques, prior to a mission and involving all or most members of the mission team (Earth-based as well as space-based personnel), allows members of conflicting groups to trust the process to achieve a satisfactory resolution to the present conflict.

Premission Interventions

Schein[10] has pointed out that it is easier to avoid an intergroup conflict than it is to resolve one, and as noted, it is difficult to avoid them. It is easier, he contends, to prevent conflict within an organization by not establishing a competitive reward structure in the first place. Rewarding people and groups for collaborative behavior sets the stage and helps develop a culture in which conflicts are less likely to emerge.

The issues surrounding personnel selection have been discussed elsewhere.[20,31] Evidently, current selection methods are focused on eliminating or selecting out individuals who might experience mental health problems under the conditions of stress inherent in space missions. The simulation research suggests that various factors of psychological compatibility affect group hostilities and should be considered when "selecting in" a crew. Work by Kilmann[38] on individual differences in managing conflict might provide a mechanism to help select out overtly competitive individuals and select in collaborative ones. His measurement instrument might also be employed in helping to train potential crew members in collaborative behavior. However, as recognized earlier, as crews become larger and missions more complex, the ability to select in on psychological compatibility factors will become more difficult.

Selecting out overtly racist and sexist individuals from heterogeneous team assignments is one possible intervention. However, prejudice, or some form of in-group bias, is part of every individual to some degree. Therefore, a focus on developing crew awareness of the dynamics of stereotyping and prejudice may prove beneficial. As noted in the simulation studies, sensitivity training evidently helped to reduce intragroup hostilities. Perhaps similar training that includes a focus on understanding and valuing differences within a crew might also prove useful. On missions that will include individuals from diverse cultures, training in the specific cultural differences of the members would help provide a conceptual model for understanding each other's behavior. Training in these issues should include the entire mission team, i.e., the space-based crew and their associated ground support team. Training of all members in conflict resolution methods might increase the likelihood that all forms of irrational conflicts are recognized early and interventions made before the conflict escalates.

It should be noted that there is no evidence to suggest that prejudice and stereotyping will be any more severe in space missions than they are currently within any Earth-based operation. In fact, some aspects of exotic environments, such as the shared risk, interdependency of individuals, common goals, and similar attitudes toward work, may function to reduce prejudice.[31]

Cross training crew members so that they can serve in multiple, overlapping roles may increase everyone's appreciation for the roles of others, thereby diminishing the potential for conflict among groups formed on the basis of work roles. However, as Blake et al.[39] point out, cross training may prove impractical because of the significant level of training required to learn each particular specialty. They suggest teaching crew members strategies for resolving conflicts on site. They report significant success in improving the effectiveness of airline cockpit crews using group and intergroup relations trainings.

Increasing the overlap or crossing the membership of groups, so that some individuals find themselves belonging to many different groups, including the two groups that are in conflict, has provided some level of control over intergroup conflict.[18] This conflict control mechanism can be applied both within space-based crews and between space-based crews and Earth-based support teams. For example, assigning space-based individuals to multiple teams in which everyone has the opportunity to work with everyone else on some collaborative task might prove beneficial. Involving astronauts-in-training, as well as veterans of previous spaceflights, in various facets of ground support operations throughout the stages of a mission would help them establish membership identification with the ground support crew. Including the ground support crews in mission-specific training with the space-based crews may also be beneficial. Exposing the Earth-based team to simulators and the austere conditions of space-based habitats might sensitize them to the difficulties and needs of the space-based crew. Mission-specific ground-based interface teams that work alongside the space-based team help establish trust and an identity as one team, and may help reduce the conflict that has been evident between these two groups.

Superordinate tasks or goals that require intergroup collaboration have been shown to reduce intergroup conflict.[1] It has even been argued[2] that the focus on superordinate goals may eliminate intergroup distinction; while focused on those goals, a single group exists. Focus during training and throughout a mission on the interdependence of all personnel and the goals of the mission may help minimize the conflict between groups.

During the Mission

In light of the evidence, it would be unrealistic not to expect some form of conflict during any long-duration human spaceflight operation. Some possible strategies for intervening in a intergroup conflict during a mission are presented next.

To predict conflict and determine when an intervention might be appropriate, the Soviets monitor stress levels through voice analysis of their space-based crews.[7] Interventions they have employed when tensions become evident included changing activity schedules and setting up conversations with relatives and celebrities.[7] Two-way televideo technologies have

been employed by the Soviets to enhance these communications. Harrison and Connors[31] highlighted some problems associated with communications links with friends and family, but overall this intervention has been described as positive.[21,40] Negotiated changes in activities helped to reduce the conflict between the Skylab IV astronauts and ground control.[41]

When conflict has emerged either between subgroups within a space-based crew or between the spaced-based crew and their Earth-based support team, some effort at conflict resolution must be made. Awareness of the effects of intergroup anxiety by members of the competing groups can help them better understand their own behavior in the context of the conflict. Analysis of the conflict, assessing the antecedents, understanding the biases of each group regarding itself and the other group, focusing on the interdependent nature of the situation, and differentiating autistic conflict from real conflict may help all parties acquire a better understanding of the nature of the conflict.

As noted, conflict resolution techniques that all parties have been trained in and have learned to trust can help manage a conflict once it emerges. In extreme conflict situations, trusted third parties may be required.[10,28] A technique often used in third-party interventions is a confrontation session in which all parties are brought together to air their differences and focus on finding a satisfactory solution to the conflict. The "bull sessions" used effectively in simulators and Skylab IV[41] should be studied as models for such confrontation sessions.

Some other techniques for reducing group conflict that evolved in exotic environments include avoiding competitive games, avoiding emotional communication, cocooning/withdrawing, and, as mentioned, displacing hostility to outside personnel.[31] It must be considered that, on occasion, the displacement of intragroup hostility among the space-based crews to Earth-based personnel could be a necessary strategy for decreasing potentially dangerous subgroup conflicts within the space-based crew. History has repeatedly shown that an external enemy presenting a perceived threat to all factions (subgroups) within a group provides an excellent rallying point (superordinate goal) for uniting a group.

Other Concerns About Intergroup Dynamics

Concerns about intergroup dynamics raised earlier were based on information from either studies of groups in simulators or from anecdotal accounts of groups in exotic environments. There are other concerns about intergroup behavior in human spaceflight operations that also deserve comment.

Habitat and Work Design

Although the author is unaware of investigations or anecdotal reports of habitat or work design effects on the emergence of subgroups in exotic environments, it seems reasonable to speculate that these factors could impact subgroup formation, particularly in physically tight environments that may not allow the entire crew to meet together in the same physical space. For example, assignment of personnel to particular modules with little opportunity for interaction with personnel in other modules might encourage subgroup formation, as could shift work designs and crew rotations.

Crew rotations and integration of new personnel with on-duty personnel must also be considered. Although it may be stretching the analogy, the rotation methods used in Vietnam have been questioned, particularly in light of readjustment problems the soldiers encountered when returning home alone. One intergroup conflict that manifested itself due to this rotation was the short timers' (veterans with very little time left before rotating back home) aversion to so-called FNG's (newcomers). An FNG's inexperience was perceived by short timers as increasing the risk to the entire group during a mission. Attention to the integration of newcomers to existing groups in space seems warranted.

In long missions to distant environments (e.g., Mars), for many sound reasons, the use of multiple independent vehicles may be advisable. Intergroup conflict between the crews of these vehicles may emerge. Distinct group cultures may develop in each vehicle, and interactions among the different cultures on arrival at the destination or port could be conflictual. Attention to intergroup dynamics between vehicles during training and throughout this type of mission could be critical to the safety of the crews and the success of the mission.

Teleconferencing Technology

The technologies used to communicate with groups in space may also contribute to intergroup conflict. During a mission, teleconferencing is the only viable method of communication between space-based crews and their Earth-based support team.[40,42] While there evidently has been no systematic investigation of different forms of teleconferencing media with groups in exotic environments, a review of the psychological literature reveals some significant differences between various teleconferencing methods.[42,43]

Research by Weston and Kristen[44,45] suggested that greater intergroup conflict occurs in audio-only teleconferences than in audio/video teleconferences. Also, in a study of audio-only teleconferencing using only two subjects at each site, in-group bias was evident at each site.[46] Audio-only teleconferences appear to contribute to the emergence or exacerbation of intergroup conflict. Weston and Kristen's research also suggests that task performance was significantly worse in audio-only teleconference than in the audio/video teleconferences or in face-to-face meetings.

An implication of these studies is that the medium itself may contribute to the development of intergroup conflict. Soviet efforts using two-way video may reflect their awareness of these and other problems with audio-only teleconferences.[40] There is a growing literature on the social-psychological aspects of teleconferencing that deserves critical review by space station design engineers and mission planners.[42-48]

Intergroup Relationships Within the Aerospace Industry

The intergroup relationships between vendors and suppliers within the larger aerospace industry as a whole are a very complex. Intergroup competition among the numerous companies that must work together, as well as with NASA, to make the American space program work effectively is worth investigation. NASA's competition with other government agencies for funds is another form of intergroup competition that affects human spaceflight operations. The Challenger accident might usefully be conceptualized as at least partially attributable to a series of decisions made in the context of these two different sources of intergroup conflict.

Of course, intergroup competition within NASA must have an influence on determining which missions get priority. Competition from different interest groups also has affected mission priorities. Some obvious special interest groups include the military, the scientific community, and the communications industry.

International Relations

Finally, it is worth noting that human spaceflight operations are increasingly an international endeavor. Although the competition between the U.S. and Soviet Union has led to the U.S. putting men on the moon in 1969, it has been argued that a negative effect of this so-called space race was a distortion of priorities, which effectively led American's space efforts down an inappropriate path. Some have argued that the most rational first step into space should have been a permanently staffed space station.

Intergroup collaboration between the U.S. and Soviet Union was clearly evidenced in the joint Apollo/Soyuz mission. Also, the Soviet visiting cosmonaut program generally reflects a clear effort to develop international collaboration in human spaceflight operations.

Need for Research

As human spaceflight operations expand to include a permanently staffed space station, a permanent moon base, and three-year-long missions to Mars, the consequences of an array of human factors will become more critical to mission success than they are today. Currently, social scientists in the U.S. are working with mere scraps of data to understand the difficulties of human adaptation to space-based environments.

Social scientists are just one of the many groups competing for limited funds allocated to space research endeavors, and this intergroup competition is fierce and relentless. However, competition for funding is not the only competition standing in the way of progress in this area. Other evident intergroup conflicts exist between the "hard" sciences and "soft" sciences, between flight personnel and social scientists.[40]

In the near future, the social scientist may find it beneficial to pursue other sources of data that might enhance understanding of human spaceflight operations. The use of analogs, such as isolated drilling rigs, supertankers, submarines, and the Antarctic, deserves further attention. For example, interactions between crews from different submarines that rendezvous at some isolated station might provide insight into missions where more than one space vehicle is to deliver personnel to a lunar or Mars base. The ongoing, systematic investigation of naval experience with intergroup dynamics may prove insightful. Documentation of conflict intervention strategies, successful and unsuccessful, used by Navy commanders at sea and in foreign ports might provide data on types of intergroup conflict and associated interventions. Deep-sea oil rigs may prove to be a good analog for studies of the intergroup dynamics of crew rotation and for the experimental application of techniques to reduce intergroup conflict.

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