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PRELIMINARY REPORT ON

SMALL GROUP FACTORS IN
LONG DURATION SPACE FLIGHTS:

Review and Directions for Future Research

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September, 1979

Ames Research Center
National Aeronautics and Space Administration
Contract No.: NASA NCA 2-0R180-803
SMALL GROUP FACTORS

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SMALL GROUP FACTORS IN
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Apart from communications between ground control personnel and the astronaut, social variables were of little or no consequence in the earliest manned space flights. But as solitary missions gave way to group missions, flight time increased from minutes to weeks, and technological advances provided personnel some liberation from monitoring instruments and operating controls, social variables gained prominence within the space capsule environment. Each of these trends which promotes social life in space is expected to continue. The space shuttle will make three to six person, month-long orbital missions relatively common, and interplanetary missions which will occupy five to eight persons for the better part of two years (Sells & Gunderson, 1972) are possible within the foreseeable future. Huge orbital laboratories and settlements involving thousands of people have received serious discussion (Maruyama, 1976; O'Neill, 1976) and there appears to be a growing reluctance to dismiss, out of hand, those visionaries who foresee large-scale outward migrations. Accompanying increases in crew size, mission length and leisure time will be increased needs to understand the emotional, behavioral, and social dimensions of life in space.

The purpose of this chapter is to examine how peoples' relationships with one another may affect the psychological functioning and welfare of the individual astronaut and the performance and morale of the crew. The primary focus is on crews that are "small" in the sense that each crew member has the opportunity to interact with each and every other crew member on a face-to-face basis.
Large crews of 20-30 members or more require additional analyses (Chapter 00).

Moving into space was and is a staggering task involving tremendous research and engineering accomplishments. Necessarily and understandably, attention was first focused on the immense technological problems associated with launching and recovering a space vehicle capable of sustaining life under incredibly harsh conditions. The chief psychological interests centered around the effects of weightlessness on performance, and upon man-machine engineering (Gerathewohl, 1959). By the mid 1960's, however, interests had expanded to include social psychological variables. Over the following decade, a number of theoretical papers and reviews appeared, the most salient including those by Haythorn, McGrath, Hollander, Latané, Helmreich and Radloff (1972), Kanas and Tedderson (1971), Kubis (1972), Rawls, McGaffey, Trego and Sells (1968), Sells (1966), and Sells and Gunderson (1972). These reviews firmly established that social psychological variables will be important determinants of human performance and well being in space.

I. Crew Composition

The size of the crew and the characteristics of the individual crew members are expected to have profound effects on performance and morale. In this section we shall consider some of the ways that variations in crew size, crew background, and social compatibility factors may affect individual satisfaction and group success.

A. Size

Most U.S. missions completed thus far have involved primarily two person groups (dyads) or three person groups (triads), but crews of six members or so
are seen as appropriate for the space shuttle and interplanetary missions and it is considered technologically feasible to establish orbital or lunar bases involving 10-20 people. Most of the experimental literature involving "groups" uses dyads or triads; subject availability and other practical considerations have discouraged laboratory studies of groups larger than four. However, naturalistic studies in underwater and polar environments in fallout shelters, and in organizational environments provide some bases for forecasting some of the effects of size variation within the small group range.

1. Size and Performance

Among others, Steiner (1972, 1976) and Kleinhans and Taylor (1976) have reviewed the effects of group size on problem solving and other measures of performance. Increasing group size has three general effects which in turn influence performance. These are pooling effects, motivational effects, and organizational effects.

**Pooling effects** refer to the aggregation of knowledge, abilities, and skills within a group. Adding additional members to the group increases the number and range of cognitive and manual resources that are available thereby boosting the group's potential. Pooling effects are not unlimited, however, because there is an increasing likelihood that some abilities and skills will become overrepresented within the pool. Although larger groups have more potential than smaller groups, motivational and organizational effects may make it difficult for this potential to be realized.

**Motivational effects** refer to the impact of group membership on individual involvement and motivation to pursue group goals. This is a complex array of effects which is, in balance, likely to hurt performance (Kleinhans & Taylor, 1976).
First, the larger the group, the less responsible each member may feel for the group's actions, with the result that ego involvement is low (Darley & Latané, 1968; Wallach, Kogan & Ben, 1962). Second, the larger the group, the less visible individual performance, with the result that good performance may go unrecognized and poor performance unpunished (Wicker, 1969). Third, the larger the group, the more thinly distributed social recognition and other rewards that may follow from good performance (Radloff & Helmreich, 1968). Fourth, the larger the group, the less likely the individual member can deepen commitment by making meaningful inputs into the decision making processes (Kleinhans & Taylor, 1976). Finally, large groups may encourage conditions such as anonymity which in turn gives rise to horsing-around and even destructive behavior (Diener, Dineen, Endresen, Beaman & Fraser, 1975; Diener, Westford, Diener & Beaman, 1973; Festinger, Pepitone & Newcomb, 1952).

Organizational effects refer to pre-performance activities which become increasingly burdensome as the group increases in size. The larger the group, the more time and effort required for it to "get its act together" so that it can effectively perform. As in the case of motivational effects, organizational effects are seen as basically adverse.

As the size of the space crew increases, one might hypothesize decelerating benefits due to pooling, but accelerating losses due to motivational and organizational decline (Steiner, 1976). The overall rates of change should be such that performance first improves and then deteriorates with increasing size. Maximal performance should come thus from intermediate sized crews. However, this should not discourage large missions, because steps can be taken to promote the beneficial effects of pooling and retard motivational and organizational loss.
First, further research should make it increasingly possible for crew members to be chosen, in part, on the basis of complementary skills and interests (Haythorn et al., 1972). A careful analysis of mission requirements and of the people who might satisfy them could result in a fairly large crew which is not characterized by a pool which is overstocked with certain abilities and skills.

Second, procedures might be found to combat the motivational losses associated with relatively large groups. Strong norms of personal responsibility might be established to help offset diffusion of responsibility. Behavior can be carefully monitored to ensure that individual performance is appropriately recognized. Individual incentives and systems rewards can be set at such a level that continuing with the group is a highly attractive alternative. Selecting people whose personal values are already congruent with group goals may lessen the need for participative decision making procedures. The frequent use of names and the encouragement of harmless idiosyncratic behaviors may help prevent anonymity.

Finally, through careful selection and training, organization may be imposed prior to the mission's departure. Unanticipated problems may arise in flight which require an immediate response and for which the crew, as a whole, is ill prepared. In this case, individuals or specially trained subgroups may be in the best position to take effective action (Chapter 00). All of these remedies proposed for group ills, however, are to some extent based on conjecture, and require careful research.
2. Size and Social Stability

On the basis of work by Bales and others (e.g., Bales, 1950, 1953, 1958), Kanas and Fedderson (1971) concluded that within the parameters of small groups, increased size should lead to greater social stability. Dyads experience tensions because of an inability to form a majority. Triads are unstable, because of shifting coalitions which involve two persons pitted against the third. Kanas and Fedderson recommend as large a small group as possible, but add that an odd-numbered crew would have the advantage of being able to break a tie in democratic decision-making situations.

3. Size and Satisfaction

Increasing crew size increases the number of possible dyadic relationships within the crew according to formula \( \frac{n^2 - n}{2} \) where \( n \) is the number of people in the crew (Sells & Gunderson, 1972). Thus, while a three person crew could generate only 3 dyadic relationships, a six person crew could generate 15 dyadic relationships, and a 12 person crew, 66 dyadic relationships. Increasing crew size, through increasing the number of possible relationships, increases (1) options for social stimulation, (2) options for developing friendships and (3) options for exercising varied role behaviors.

The evidence is a bit sketchy, and complicated by the problem that relatively large groups may be stationed in a relatively comfortable main base while relatively small groups are located in primitive quarters which offer few of the main base's amenities. However, Smith's (1969) review suggests fewer emotional and interpersonal problems in relatively large isolated and confined groups. In one study, Doll and Gunderson (1969) found that Antarctic parties varying in size from 8-10 reported less in the way of compatibility and accomplishment than
parties ranging in size from 20-30. In another study, these same authors (1971) found that military personnel stationed at small bases were more hostile than their counterparts at more heavily populated bases. Although cross-study comparisons are difficult, it is interesting to note that the Georgia Fallout Shelter Studies (Hammes, Ahearn & Keith, 1965; Hammes & Osborne, 1965; Hammes & Watson, 1965), which imposed very Spartan conditions on unselected but unusually large groups, had very low defection rates. Smith and Haythorn (1972) found triads more harmonious than dyads in a simulation study.

In sum, crew size is expected to affect how astronauts perform and how they get along with one another. In the first instance, crew size affects the pool of skills and abilities, motivation, and organization. In the second instance, crew size affects the level of social stimulation, number of friendship options, and opportunity to exercise role-related behaviors. However, not all of these effects are well understood, and (because few studies have involved varying group size while holding other variables constant) we lack the necessary bearings for making reliable predictions. Does a given size effect occur incrementally, by leaps and bounds, or at a varying rate? Does it continue indefinately, or reach an asymptote or plateau? Clearly such knowledge would prove of use for planning multiperson missions.

B. Individual Characteristics and Crew Compatibility

may be considered compatible to the extent that each member shows qualities and emits behaviors that the other crew members consider desirable and appropriate under the conditions. The research task is identifying patterns of personal attributes which, in the aggregate, will promote group harmony and encourage a high level performance. The problem is not merely finding people with good or positive qualities, but finding people whose qualities intermesh in a good or positive way. The issue is exceedingly complex, because so many variables need to be entertained. As Kubis (1972) notes:

...even with consideration restricted to personality-related variables (interests, attitudes, traits) alone, the number is so great that the analysis of distinguishable patterns becomes an insurmountable task.

There are, for example, \(2^n\) different patterns in a group if each of the \(n\) characteristics were to be categorized on the minimal high-low dichotomy...

The search for crew compatibility, then is likely to be limited only by the number of dimensions upon which people can be meaningfully compared. But the search must continue. Social compatibility emerged as the foremost factor in analyses of supervisory ratings and peer nominations at polar stations and compatibility has been related to whether or not the antarctic adventurers had a "good year" or a "bad year" (Gunderson, 1963, 1968; Gunderson & Mahan, 1966; Gunderson & Nelson, 1963, 1965, 1966; Nelson, 1965). In simulation research by Altman and Haythorn and their colleagues, isolated and confined groups who had incompatible needs showed increased stress, withdrawal, and territorial behaviors. In addition, they made more attempts to withdraw from the study (Altman & Haythorn, 1965, 1967a, 1967b; Haythorn, 1965, 1970, 1973; Haythorn & Altman, 1967; Haythorn et al., 1966, 1972).
In the discussion to follow, compatibility factors are organized into three categories. The first category, class factors, includes those qualities or attributes associated with membership in a biological class, social category, or demographic group. The second category, general appeal factors, consists of those qualities or attributes expected to make an astronaut attractive to, and compatible with, a wide range of other people. These are the personal qualities that are expected to be valued by anyone (or just about anyone) who is with the astronaut in an isolated and confined group. The third category, limited appeal factors, encompasses those personal attributes or qualities expected to vary in desirability depending on the attributes or qualities of the other people in the group. These are the qualities that are likely to be valued by some people who might be with the astronaut in an isolated and confined group.

1. Class Factors

To some extent, crew compatibility will depend on the biological and social groups from which the crew members are drawn. Important variables include sex, age bracket, and race or ethnicity.

a. Sex

Space travel has been a male dominated enterprise, but women astronauts are in training and it is recognized that in the long run some sort of sexual parity is likely to be achieved (Shurley, Natani & Sempel, 1977). Extremely little is known about women in space. Women have visited polar stations, lived in underwater habitats, and participated in fallout shelter studies but the vast bulk of the data come from all male preserves. Those few studies which have involved women have not focused sharply on sex or gender variables.
Several issues are involved when we consider women entering space. The least of these is whether or not women are equipped for the rigors of life in space. Early doubts seem to be giving way to a conviction that women can do the job and have the right to be there. This conviction seems to reflect, in part, an increasing recognition of women's capabilities outside of the traditionally feminine sphere, and in part a growing recognition that technical systems are as easily engineered to meet women's needs as men's needs.

More pressing are issues concerning the social dynamics within all female and mixed-sex crews. At the conjectural level, one can forecast both advantages and disadvantages with a mixed-sex crew. On the one hand, inclusion of members of the opposite sex can create diversity and help reinstate otherwise relinquished role behaviors. On the other hand, jealousies may arise as the result of crew members "pairing off." A terminated relationship could prove devastating. Then, too, there may be a certain awkwardness dealing with the opposite sex under conditions of isolation and confinement, and at least some people are worried about society's perceptions of possible goings-on in the capsule.

At least two forces will militate against the formation of potentially disruptive heterosexual bonds. First, sexual needs during space flight may not be similar to those on earth (Chapter 06). In times of crisis, change, or even distraction, sexual needs may be considered of minor or no importance. It is at least possible that the space environment will be sufficiently artificial to the space traveler that sex will not be perceived as a pressing need for a very extended period of time, even a year or more.

Second, there is at least some suggestion that people within small, relatively closed social systems tend to choose, as partners, people from outside that system. They seem to recognize that endogamous choices can fum jealousies and
reduce privacy to a dangerously low level. The findings are tentative, however, and come from kibbutzim (Talmon, 1964) and residential colleges (DeLamater, 1974) which maintain relatively permeable boundaries.

Finally, there are the related problems of feeling at ease around members of the opposite sex and societal misgivings about the space party. Berry (1973) suggests that natural processes of social change may ease these latter problems:

...The issue of mixing of sexes in space crews in the future may not be the delicate one it has been traditionally expected to be. Sexual mores have changed significantly in the U.S. and throughout the world. As a consequence, living in close proximity with persons of the opposite sex may seem to future space crews a comfortable and natural thing. The population from which astronauts will be drawn in future years will more than likely have spent their years in university training, studying and working in mixed groups, and living in sexually unsegregated dormitories. Indeed, many universities throughout the U.S. now feature such arrangements...

Researchers, planners and managers are thus confronted with the following issues:

1. How do isolation and confinement affect all-female and mixed-sex groups?

2. What can be done to minimize the problems that are expected to result from overt and covert heterosexual pairings?
Although polar camps, subaquatic dwellings, and space simulators have tended to be male preserves, inhabitants have varied appreciably in terms of age. The groups thus far studied have contained subjects varying in age from their late teens to middle age. Subjects who have deviated noticeably from the group's mean age have, like other members, been physically and mentally fit to stand the environmental rigors and make positive contributions to the group. Within the ranges studied, age has not emerged as an appreciable source of friction. However, the ranges studied have seldom extended beyond one third of the normal life span. There is a substantial pool of potential astronauts in the 20's to 40's age bracket, but, with an eye to the future, it is necessary to identify the conditions under which a person is likely to be "too young" or "too old" for a mission. Approaching this task researchers should recognize that for most purposes calendar age per se is less relevant than variables which are loosely correlated with calendar age. That is, whereas capacities and skills are first acquired and then lost in a fairly set sequence, the rate of maturation and decline varies from individual to individual. In most cases it is preferable to refer to age-related variables rather than to age itself.

Once an appropriate age-range has been identified planners and managers are confronted with selecting astronauts from within that range. The evidence is limited, but suggests certain advantages to having an appreciable age mix within a crew. A mature individual may serve as a parent-surrrogate and thereby satisfy important emotional needs of the other crew members (Radloff and Helmreich, 1968). In addition, one might hypothesize that the intellectual flexibility of youth (fluid intelligence) coupled with the storehouse of facts which develops with age (crystallized intelligence) can enhance a group's problem solving.
potential (Kalish, 1975).

One other source of concern is the changes that astronauts may undergo during truly extended missions. Thus far, even the longest studies of isolated and confined individuals have involved but a very small segment of the participants' life spans. But developmental changes which are undetectable on short missions may become prominent during missions measured in years. Work in the emerging field of adult developmental psychology suggests people undergo fairly pronounced changes at several points during their adulthood (Vander Zanden, 1978). On a two year mission, for example, someone approaching 40 might have a major change of interests and goals. These changes might reduce the person's fitness for the technical side of the mission, and also his or her social compatibility. At present, missions are not measured in years, our knowledge of adult development is modest, and it may well be that commitment to a mission may present major changes of interests and identity. However, age-related changes require consideration when planning a truly extended mission.

c. Race or Ethnicity

US-USSR missions and missions involving crew members drawn from traditionally rivalrous Eastern bloc nations have been proclaimed resounding successes, yet there is always the chance that prolonged isolation and confinement will bring long-standing prejudices to the fore. Although Karas and Fedderson (1971) have discussed some of the implications of ethnically mixed missions, race or ethnicity have not been major variables in studies of isolated and confined groups. The race relations literature, however, provides some basis for optimism. Specifically, three conditions associated with life in space may minimize traditional prejudices.
First, some prejudice appears to be the result of an assumption that people from other ethnic groups maintain attitudes which are different from one's own (Stein, Hardyck & Smith, 1969). In fact, astronauts are likely to discover that they have many interests and values in common (for example, those centering around the mission). Such similarities should militate against prejudice.

Second, some prejudice flows from the perception of low social status rather than the perception of race or ethnicity per se (Allport, 1954; Amir, 1969). Since space voyagers are likely to come from a highly select population in terms of ability, education, and health, pre-mission status is unlikely to contribute to prejudice.

Third, under certain kinds of conditions, interaction is likely to lead to a reduction of prejudice (Allport, 1954; Amir, 1969). Two of the most important conditions -- cooperation and the pursuit of common goals -- are likely to be found in space missions.

The race relations literature thus suggests that selection procedures which favor competent, high status individuals and the imposition of tasks which require the coordination of efforts in pursuit of common goals should strongly militate against prejudice and discrimination. Nonetheless, we must explore the possibility that certain kinds of subcultural differences could generate severe incompatibilities, and that truly prolonged isolation and confinement may cause otherwise suppressed hostilities to rise to the fore. Identifying such differences and finding ways to eliminate or contain prejudicial attitudes and discriminatory acts must be given greater priority in future research.

2. General Appeal Factors

Certain characteristics are likely to make a person a generally desirable
partner under conditions of isolation, confinement, and stress. These we have
categorized as general appeal factors because there is a high degree of con-
sensus concerning their value. They include attractiveness, competence,
cooperativeness, emotional stability, and social versatility.

a. Attractiveness

Rawls, Hopper, and Rawls (1969) instructed college students to "List as many
things as you can possibly think of that would determine how closely you would
be willing to interact with another individual." The other person's attractiveness
in terms of such things as cleanliness, appearance, dress, and general
demeanor emerged as a major consideration.

The search for complex bases for social compatibility should not cause per-
sonal attractiveness to be overlooked. Given that the need to staff large missions
or to simultaneously staff a number of different missions will necessarily result
in decreased selectivity and increased crew heterogeneity, it is necessary to
learn more about the attributes which make an individual personally appealing
in light of space crew norms. It might be useful, in this regard, to devise and
validate an instrument for identifying personal characteristics which crew members
are likely to find distasteful or annoying. This might involve a listing of
personal characteristics to be rated in terms of irritation value (unkempt hair,
dirty fingernails, a squeaky voice, etc.). Once perfected this scale could be
used in two ways. First, norms could be established which could provide a basis
for eliminating "unattractive" space crew candidates. Second, the instrument
could be used for weeding out "finicky" individuals who find too many human
frailties aversive.
b. Competence

Sustained and effective task performance will be essential for mission success. Poor or incompetent performance under conditions of danger is likely to have a disruptive effect because of recognition that it jeopardizes everyone's welfare. Gunderson and Nelson (1965) found that "task motivation" related to "good years" and "bad years" in the Antarctic, and Shears and Gunderson (1966) reported that both personal motivation and perceptions of the group's achievements were related to satisfaction with the Antarctic assignment. Studies undertaken by the Alaskan Air Command also suggest that marginal performance is correlated with poor adjustment and dissatisfaction (SCD, 1974) and Day (1969) has discussed the adverse reactions generated by crew members who failed to fulfill their performance requirements in the days of sailing ships. The goof-off or slouch poses an unacceptable threat to group harmony, particularly in the case of relatively small missions where each crew member has an essential part to play.

Discussions of competence have generally focused on task competence; that is, the person's technical skills and work motivation. However, competence research might be extended to include interpersonal or socioemotional competence as well. Along with studies of competence involving performance measures, we need additional studies involving peer perceptions and ratings. For some purposes, actual competence may be less important than perceived competence. For example, a competent crew member who is not seen as such may have as adverse an effect on performance and morale as an incompetent crew member whose inadequacies are correctly identified. Alternatively, an incompetent person who is able to convey an impression of knowledge and skill may have a calming effect on the rest of the crew.
c. **Cooperativeness**

Space voyagers are embarked on a highly interdependent venture which requires utmost cooperation for success. According to McClintock (1972, 1978), people vary in terms of their interests in coordinating their efforts for mutual gains. He identifies three types of motivation or motives:

**Own gain motivation** refers to a preference for doing as well as one can for oneself regardless of how one's choices affect other people. If it is in one's personal interest to choose a course which happens to benefit someone else, it is this course which is chosen. If, however, the greatest personal gains come from actions harmful to someone else, knowledge of the likely harm has little deterrent effect.

**Relative gain motivation** prompts one to receive a higher level of rewards than the other people in the relationship. The important consideration for the person governed by relative-gain motivation is to "best" other people by always "coming out on top."

**Joint gain motivation** refers to preferences for courses of action which produce benefits for other people, as well as for oneself. Joint gain motivation involves both a sensitivity to other peoples' needs and a concern for their welfare.

McClintock and his associates view each individual as more or less consistently governed by one of these three motives (Maki, Thorngate & McClintock, 1979; McClintock, 1972, 1978). Each stems from early childhood socialization and reflects both familial and cultural values. A better understanding of these motives may prove of use in the flight personnel selection process, or for establishing the most effective reward structures in the space capsule microsociety.
Relevant to both competence and cooperativeness is Helmreich's work on the achievement orientation or need achievement (Helmreich, 1978; Helmreich, Wilhelm & Runge, 1979). Classically, need achievement has been defined as a persistent preference for engaging in success-related activities (Atkinson, 1958). People with high need achievement have many admirable qualities, but problems may arise on board a space vehicle if attaining standards of excellence involves "prima donna" behaviors or a put down of other members of the crew. According to Helmreich, need achievement can be reconceptualized as subsuming three independent factors. Work orientation refers to motivation to work hard because work is a valuable activity in and of itself. Mastery orientation refers to a desire to continually improve one's own best performance. Competition refers to an attempt to do better than other people. Helmreich hypothesizes that the combined interests of task accomplishment and social compatibility will be best served if crew members show a strong work and mastery orientation but relatively little competitiveness. Additional research is required to perfect ways of assessing work orientation, mastery orientation and competition, and to test Helmreich's important hypothesis.

d. Emotional Stability

A high emotional or uncontrolled individual poses an unacceptable threat in any hazardous environment. Accordingly, it has been noted that Antarctic personnel place high premium on having calm, even-tempered, emotionally mature companions (Doll & Gunderson, 1971; Law, 1960; Lugg, 1973).

Many of the research questions surrounding emotional stability are questions of selection. Much more is known about how to exclude people who are liable to react badly than how to choose people of exceptional psychological health (Perry, 1965; 1967). Whatever the ultimate screening procedures, there is no getting
around the fact that as more and more people are chosen for space missions a few "high risk" individuals will inadvertently be chosen. We need to know more about the kinds of supports or props that can be used to help people preserve or restore their emotional stability under conditions of isolation and confinement.

As in the case of competence, crew perceptions may be as important as facts when it comes to the effects of emotional instability. Acts which result in the inference that the performer is emotionally unstable (whether or not that inference is correct) may demoralize the crew. Of particular interest is identifying those conditions under which undue significance is read into an outburst or other act, with the result that a functioning crew member is considered no longer a member of the team.

c. Social Versatility

As noted earlier (Chapter 00) space flight affords restricted opportunity to perform varied social roles. Persons who can easily engage in a wide range of role-related behaviors in flight can help reinstate for one another some of the lost opportunities. The value of such versatility is expected to be inversely proportional to crew size and directly proportional to mission duration.

There are many types of versatility which might be studied, but the one which is receiving the most attention is versatility in enacting behaviors associated, in Western society, with masculine and feminine roles. Men are expected to adopt the task-oriented instrumental role and women are expected to adopt the socioemotionally oriented expressive role. Men are expected to be autonomous, independent, somewhat dominating and aggressive, and emotionally inhibited. Women are expected to be warm and nurturant and openly display their feelings.
Research by Helmreich and Spence (Spence, Helmreich & Stapp, 1975; Helmreich, 1978; Helmreich, Wilhelm & Runge, 1979) suggests that whereas people tend to adopt the attitudes and behaviors commonly associated with their sex, some people are adept at performing both the instrumental and the expressive roles. Such people, who are referred to as androgynous, appear able to strive towards goals while remaining sensitive to other peoples' needs and concerns. They have a flexibility which should yield benefits for themselves and for the people with whom they interact. The androgyny research represents an important attempt to learn how people may reinstate, for one another, otherwise lost behavioral opportunities. This kind of research must be continued and extended beyond the sex role area.

3. Limited Appeal Factors

Finally, there are those personal qualities and attributes whose effects can be gauged only while simultaneously considering the qualities and attributes of the other people in the group. In some cases it is peoples' similarities that make for compatibility; in other cases, peoples' differences intermesh. Limited appeal factors include attitude and value homogeneity, skill complementarity, and need compatibility.

a. Attitude and Value Homogeneity

Conflict of social, moral and ethical values has proven to be a problem in some of the fallout shelter studies (SCB, 1974) and almost all reviewers have tended to accept the position that homogeneous attitudes, values and interests will militate against intragroup conflict. The expectation that crews composed of individuals with shared attitudes and values will tend to be compatible is certainly supported by studies in other contexts. Results from the field and
from the laboratory have been spectacularly consistent: attitudinal similarity is a powerful determinant of mutual attraction. It has been repeatedly found that the proportion of shared attitudes determines the extent to which people find each other attractive (Byron et al., 1971). Attitudes also vary in terms of their relevance to the group. Whereas a group may allow considerable latitude for differences of opinion in areas unrelated to the group's purposes and tasks, dissimilarity on issues closer to home can spark spirited reactions (Schachter, 1951).

A superabundance of research points to the conclusion that attitude and value similarity should be a powerful determinant of interpersonal attraction. On the other hand, one would hope to find, within a given crew, sufficient attitudinal variability to generate interaction and provide new ideas during problem-solving sessions. What is the appropriate balance between similarity and differences in attitudes, opinions and beliefs? One hypothesis is that it is essential to share certain general values, but to show variability in terms of the ways these values are expressed. Selection and indoctrination procedures can encourage shared values. However, value homogeneity will necessarily decline as crew size is increased.

b. Complementary Abilities

As noted by Haythorn and his associates, interlocking or complementary abilities should also enhance group compatibility (Haythorn et al., 1972). One type is skill complementarity which exists when one person is skilled in an area where the other person is unskilled. Another is cognitive complementarity which exists when people have nonoverlapping knowledge and must learn from or rely upon each other. Complementary abilities should allow each crew member to contribute
to the crew's welfare, sensitize each to the importance of the other's contributions, and in consequence promote solidarity and morale. However, there is little or no research characterized by systematic efforts to relate complementary and overlapping abilities to compatibility within isolated and confined groups.

c. **Compatible Needs**

A recurrent theme in the interpersonal attraction literature is that peoples' needs may fit together in such a way as to affect group compatibility. Particularly important for present purposes is Haythorn's version (1968, 1970, 1973) which has been tested under conditions of isolation and confinement.

This involves three patterns of needs:

a. **Congruent needs** are similarly appearing needs of such a nature that the satisfaction of one person's needs results in the satisfaction of the other person's needs. For example, two people who have needs to affiliate could find mutual satisfaction by affiliating with one another.

b. **Complementary needs** are different appearing needs of such a nature that the satisfaction of one person's need results in the satisfaction of the other person's need. For example, a person who has a need to dominate might establish a satisfying relationship with a person who has a need to be submissive.

c. **Competitive needs** are of such a nature that the satisfaction of one person's need results in the frustration or aggravation of the other person's need. This might occur, for example, in a group of people each of whom is striving for dominance.

In some cases, then, similar needs will provide a basis for compatibility; in other cases, different needs will serve these ends. For example, Berman and
Miller (1967) found that people who liked each other were similar in terms of need for achievement but dissimilar in terms of needs for dominance. Also, it should be noted that different types of incompatibilities are likely to lead to different kinds of responses. In the Altman and Haythorn studies, some kinds of incompatibilities led to withdrawal and other kinds to increased territoriality.

Two other findings are of note. First, as the Altman and Haythorn research shows, incompatibilities which are inconsequential under normal conditions are magnified under conditions of prolonged isolation and confinement. Second, there is some evidence that need compatibility may gain in importance as a relationship progresses from the acquaintance stage to intimacy (Kerckhoff & Davis, 1962). Thus, we might hypothesize that need compatibility may gain salience on long term missions where voyagers are likely to become very intimately acquainted.

Research to date thus suggests that it would be both useful and desirable to mount a massive effort aimed at better understanding of need compatibility. Such a program should attempt to (1) identify relevant needs; (2) show how they fit together; and (3) spell out the consequences of compatibility and incompatibility. Ultimately, screening procedures may be devised for weeding-out candidates whose needs are too likely to conflict, or ways found for keeping competitive needs under control. Researchers involved in such a program should remain sensitive to the possibility that incompatibility may not be a problem if conditions conspire to prevent crew members from detecting their differences, and that incompatibilities that disrupt one group may not affect another.
II. Interpersonal Dynamics

In the present section, our focus turns to some social processes that are likely to occur within small crews. We shall consider the specific topics of leadership, conformity, cohesiveness, and conflict.

A. Leadership

Organizations (such as NASA) which sponsor space missions can influence activities on board by investing certain people with the right to exert influence, awarding tokens of rank and status to remind others of this right, and giving this person control of available sanctions. In effect, the sponsor delegates its own authority to the crew leader in the hopes that he or she will manage the material and human resources in such a way that the sponsor's goals are achieved.

Heavy demands are likely to be placed upon people performing leadership functions in space capsule microsocieties. These demands are expected to become increasingly burdensome as the mission continues.

First, there will be incredible technical requirements. For a long time to come, astronauts will be expected to safely operate what is tantamount to an experimental craft in a hostile environment. Although there will be advance preparation, and some degree of communication with resource people on Earth, supplies will steadily deplete and as distance increases it will become increasingly difficult to maintain good communication with Earth. For all intents and purposes, all problems will have to be solved using the highly limited resources available in the closed environment of the space capsule.

Second, the demands on leaders' interpersonal skills are likely to be equally or even more formidable. Nobody really knows how people will relate under condi-
tions of months or years of isolation and confinement, but expectations tend to be grim (Chapter 00). People in leadership roles will have to be consummate in interpersonal relationships.

A failure to fulfill the requirements of leadership can lead to severe penalties for the group. In the 1959-1960 fallout shelter studies (Strope et al., 1960a, 1960b) a deliberately passive role on the part of the shelter commander was credited with a general lowering of standards of behavior and a loss of interest in matters of civil defense. The Georgia Fallout Shelter Studies also found that mismanagement led to increased friction and decreased morale (Hammes et al., 1965; Hammes & Osborne, 1965; Hammes & Watson, 1965). Competent leaders, on the other hand, may serve as models whose enthusiasm and even temper are emulated by the crew. They can prevent factionalism, and ease group members through troubled relationships.

How can we ensure good leadership on extended duration space flights? One possibility is to create positions with intense social power and then find the best possible persons to fill them. Underlying prescriptions for strong and well-defined leadership roles are (1) a conviction that there must be a strong advocate of the sponsor's interests on board; (2) an assumption that only a single individual's decision can be fast enough to stave off certain dangers; (3) an assumption that crew members will feel at home because they are used to functioning in hierarchical structures; and (4) presumed benefits from maintaining a form of organization similar to one commonly found on Earth. Certain components of this rationale, however, are open to question. For example, not all potential crew members will be used to functioning around the clock in formal hierarchical structures, and it has not been proven that a space capsule micro-society has much to gain from mimicking a form of organization prevalent on Earth.
Furthermore, prolonged separation from Earth may undermine Earth's authority (Chapter 00).

Influence structures, leadership activities, and decision making processes have received a fair amount of attention (SCD, 1974), but the general area of leadership remains "wide open" for future research. Certain forms of leadership have received little attention, and many studies have treated as incompatible alternatives which might in fact complement and supplement one another. Investigators in this area would do well to entertain a wide range of decision making alternatives, and remain sensitive to the possibility that a given type of leadership structure is not likely to be equally suitable for all kinds of groups.

1. Task and Socioemotional Leadership Activities

Repeatedly, distinctions have been made between task activities (also known as initiation of structure and concern for production) which help the group get the job done or move towards its goals, and socioemotional activities (also known as showing consideration and concern for people) which promote harmonious relations within the group. Group functioning requires people who take the initiative in each of these areas. Socioemotional leadership is seen as at least as important as task leadership, and perhaps more so judging by some of the research.

It is not clear that the same individual can satisfactorily fill both task and socioemotional leadership roles. The pioneering research by Bales and his associates (Bales, 1950, 1953, 1958, 1970) found that some people engaged in more task and socioemotional activities than others, and as a result were offered leadership status. But it was also found that the person who engaged in the most task activities was not the same person who performed the most socioemotional activities. There were, in effect, two leaders; the task leader, who was rated as having the best ideas, offering the most guidance, and being most influential
in forming the group's opinions, and the socioemotional leader, who was the best liked. The usual explanation for the emergence of the second leader is that a task leader's sense of purpose gives rise to heavy-handed activities (unpopular orders, sharp criticism, etc.) which hurt peoples' feelings. The second leader emerges to smooth things over and restore equilibrium to the group.

But it should be noted that the initial studies involved emergent group structures. That is, unacquainted individuals joined a discussion, and social structure emerged as interaction progressed. The task leader took a role of power and influence, and it may have been his presumptuousness that caused the internal conflicts. According to Burke (1972), when a leader is designated by a higher authority and is hence perceived as "legitimate," group members are more accepting of heavy-handed task acts and the need for a second leader diminishes. The issue, however, is far from resolved, as Katz and Kahn (1978) have recently concluded that only under rare conditions are task and socioemotional leadership roles best filled by the same individual.

Researchers, planners and managers are thus confronted with the problem of ensuring the optimal distribution of leadership behaviors within the group. Specifically, to what extent should various task and socioemotional leadership behaviors be concentrated in the hands of a specific leader as compared to distributed among different people within the group? Of particular interest in light of Burke's arguments is determining the extent to which a given individual should attempt to manage both task and socioemotional leadership roles.

2. The Contingency Theory of Leadership Effectiveness

A prevalent theme is that certain kinds of people will make better leaders than other kinds of people. Summarizing the results of scores of studies, Mann
(1959) reported that intelligence, adjustment, and extraversion bear a substantial relationship to leadership, and that dominance, masculinity, and interpersonal sensitivity are somewhat less closely related to leadership. Observations of Sealab II led Radloff and Helmreich (1968) to suggest that people under stress in isolation and confinement may not need a young, action-oriented leader as much as a mature individual who inspires identification and provides reassurance. Citing work by Misumi and Shirakashi (1966) and Cooper (1966), Kubis (1972) derived the following composite picture of the effective space crew leader:

...he elicits the best from his men... is himself personally competent... is interested primarily in results and achievement...

but is always aware of the normal human needs of the group and attempts to provide opportunity for their satisfaction...

A person who can lead competently under one set of conditions may prove ineffective under other conditions. Properties of the situation and properties of the leader will combine to yield a given level of performance (Cartwright & Zander, 1968; Fiedler, 1967, 1971; Katz & Kahn, 1978; Mann, 1959). Perhaps the most promising theory which simultaneously considers situational and personality factors is Fiedler's (1967, 1971) contingency theory of leadership. Concerned with predicting performance rather than satisfaction or morale, contingency theory has been tested successfully in many military and civilian settings, and deserves close attention from space mission planners. The independent variables are situational favorableness and leadership style, and the dependent variable is leadership effectiveness.

Situational favorableness refers to structural and social climate variables which make a group "easy" or "difficult" to lead. These include (1) the extent
to which the leader is accepted and respected by the group; (2) the extent to which the group's goals are clear and structured; and (3) the extent to which the leader has been invested with the power to reward and punish group members.

Leadership style refers to the leader's orientation towards tasks and people. This is determined by asking the leader to evaluate the least preferred co-worker (LPC) with whom he or she has ever worked. High scorers, who tend to give favorable ratings to the least preferred co-worker, are relatively socioemotional in outlook. Low scorers, that is, people who assign harsh ratings to their least preferred co-worker, have more of a no-nonsense task orientation.

Leadership effectiveness, the dependent variable, is operationalized by any objective measure of task accomplishment.

According to contingency theory, different degrees of situational favorableness require different types of leaders. Under conditions of very high or very low situational favorableness, the task-oriented low LPC leader is likely to prove most effective. As Jacobs so aptly puts it, the leader can afford to be firm when accepted by the group, pursuing clear goals, and invested with power to reward and punish. He or she must be firm when rejected by the group, grappling with ambiguous goals, and lacking the power to reward or punish. Under conditions of intermediate favorableness, the interpersonal sensitivity of the high LPC leader is likely to be of use for working through the moderately troubled relations within the group, thereby freeing the group to continue toward its goal.

Careful planning may be able to create and maintain a high degree of situational favorableness on short term missions, but such conditions may be difficult to sustain on prolonged flights. For example, it may be relatively easy to link the leader's evaluation of crew members to the latter's continuation and advancement within the space program. But as noted in the discussions of isolation and
confinement (Chapter 00) and organization and management (Chapter 00) as the link with Earth becomes tenuous, traditional bribes and threats may lose force. Thus, whereas task-oriented, low LPC leaders may do best on carefully planned short flights, socioemotionally oriented, high LPC leaders may have an edge on longer flights. This is assuming, of course, that on long distance flights conditions do not deteriorate beyond repair.

From Fiedler's contingency theory of leadership flow many lines for future research. Efforts must extend beyond assessing the situational favorableness of a given mission and then choosing the leader with the most promising style. First, it should be recognized that situational favorableness may fluctuate over time. Second, the possibility that leadership style is neither inflexible nor firmly ingrained must be explored. Further research is required to discover if space crew leaders could learn to identify shifts in situational favorableness, and adapt their styles accordingly.

B. Cohesiveness

Some groups show more sparkle and verve than do others. In some groups, interaction is spirited and lively and members are highly involved, both with each other, and with group activities. Cohesiveness refers to the solidarity or "groupiness" of a group. Since cohesive groups are considered "better" groups, and since cohesiveness has implications for group functioning, both the antecedents and consequences of cohesiveness are of interest. Although originally intended to be a unitary construct, cohesiveness sometimes designates a group with energy, drive, and a strong sense of purpose, and other times a group characterized by interpersonal harmony. Whereas drive and amiability often covary, it is possible for a group to be characterized by one of these attributes but not by the other.
1. Causes of Cohesiveness

In some cases, adverse conditions and suffering seem to increase cohesiveness (Gerard & Mathewson, 1966). In effect, undergoing a trying initiation encourages people to rationalize the discomfort by telling themselves that membership in the group is extremely desirable. However, most discussions focus on the rewards or satisfactions of group membership as the major cause of cohesiveness. Cartwright (1968), for example, has defined cohesiveness as the sum of the satisfactions which membership accords all the members of the group. Satisfaction is likely to be high to the extent that the group (1) engages in activities that the members find intrinsically satisfying; (2) pursues goals of importance to the members; (3) provides social support and emotional gratifications; and (4) serves ulterior motives. Thus, a crew might be expected to be cohesive when the crew members (1) enjoy flight and adventure; (2) subscribe to the mission's overall goals; (3) encourage each other; and (4) provide welcome relief from alternative activities.

Group goals are likely to have a major impact on the tone of interpersonal relations within the group. The isolation and confinement literature, for example, suggests that individuals may be able to suppress their differences in the interests of group goals. In Sealab II, for example, some aquanauts commented that teammates who didn't always see eye-to-eye were able to get along for the period of the mission (Radloff & Helmreich, 1968). Group goals deserve careful attention when planning a mission.

First, it should be useful to identify goals of superordinate status. As noted in Chapter 00, a superordinate goal is one which is (1) shared by all group members, and (2) overrides individual goals which, if pursued, might encourage behaviors detrimental to the mission. Such goals (1) must be accepted
rather than imposed; (2) require cooperative activity; and (3) represent more
than glowing slogans.

Second, steps might be taken to ensure that group goals are clear and well
understood. Discussing antarctic groups, Natani and Shurley (1974) have noted
that scientists are given a brief introduction to the "big picture" at an orienta-
tion conference, but that their goals remain basically individualistic. Navy
personnel are given only a minimal understanding of their science support role,
with the result that they find it difficult to become firmly committed to the
overall mission. When goals are ambiguous, socioemotional activities are likely
to take precedence over task activities.

Third, means must be found to maintain astronauts' interest in distant
goals over prolonged periods of time. It may thus be desirable to have a number
of interim goals which can be pursued and savored. Perhaps this has been best
expressed by Sells and Gunderson (1972):

"...To maintain group integrity and motivation of group members, the void
between initiation of a mission and final attainment of its goals must be
filled with richly detailed programs of activities that permit achievement
of meaningful interim goals. It is also important that both the ultimate
and intermediate goals be expressed in a manner that permits assessment of
success in such a way that it is compatible with supervisory controls,
available rewards, and individual career growth..."

Finally, as noted in Chapter 00, Radloff and Helmreich's work suggests that
with each successive mission the rewards for participation are likely to dwindle,
with the result that cohesiveness may also decline (Radloff & Helmreich, 1968;
Helmreich et al., 1979). As noted earlier, both the costs of space travel
(risk, discomfort, and so forth) and the rewards (increased feelings of competence, social recognition, and so forth) may be expected to decrease as technological and other factors conspire to make space travel safer and more routine. However, the rate at which the costs may be expected to decline is not likely to be as fast as the rate at which the rewards will decline. For a while, at least, the risks and discomforts of space travel are likely to become increasingly less justified by the benefits, and this is likely to adversely affect crew morale.

Many rewards are associated with the attainment (or expected attainment) of group goals. Mission planners and managers must find ways to encourage crew members to endorse goals which require cooperative activity to attain and which are superordinate, in the sense that they override potentially conflicting individual goals. Of particular interest is discovering how to establish goals which can sustain enthusiasm over prolonged uneventful periods. Finally, ways must be sought to prevent or retard a decrease in the level of rewards (relative to costs) which is expected as space travel becomes commonplace. Some possibilities have been offered in Chapter 00.

2. Consequences of Cohesiveness

Cohesive groups are often efficient and effective (Lott & Lott, 1971). However, the relationship between cohesiveness and performance is not entirely straightforward. First, successful performance can be a cause, rather than an effect, of cohesiveness. Second, social norms mediate the relationship between cohesiveness and performance. If the normative structure supports performance-related activities, then cohesiveness is likely to improve performance. If, on the other hand, norms support limiting output or "goofing off," cohesiveness may undermine performance.
C. Conformity

A certain amount of social activity aimed at eliciting conformity to group norms is generally regarded as beneficial, because it promotes coordination of efforts and a sharing of values within the group. However, such influence processes have certain potentially adverse effects which may become pronounced under conditions of isolation and confinement.

1. Groupthink

Some problems that confront groups require novel solutions. Strong conformity pressures can inhibit the flow of creative ideas, particularly in a cohesive group. Individuals may fear that unorthodox suggestions will undermine morale or yield personal rejection. Special "brainstorming" instructions, which discourage censorship, do spur creativity, but there remains an inhibiting effect due to group membership, especially in military groups.

Janis has coined the term groupthink to refer to conditions under which efforts to maintain group harmony undermine critical thought and lead to poor decisions (Janis, 1971, 1974; Janis & Mann, 1977). Space crews appear to be quite vulnerable, since groupthink becomes likely when (1) the group is concerned with maintaining amiability, (2) there is little or no communication with people outside of the group, and (3) the group is confronted with a threatening situation. Among the most important characteristics of groupthink are:

a. false optimism and a lack of caution,

b. direct pressures on nonconformers,

c. a fear of disapproval for expressing new alternatives,

d. an illusion of unanimity,

e. the emergence of "mind guards" who protect the leader from criticism, and
Safeguards against groupthink include (1) soliciting external inputs during the decision-making process; (2) appointing a devil's advocate to challenge majority views and (3) reconsidering decisions before action is taken. It is not clear that all of these safeguards are effective; for example, Dennis (1976) argues that a devil's advocate is ignored because the group recognizes that he or she is merely playing a social role. Those which are effective under "normal" conditions may or may not be workable under conditions of isolation and confinement. Specifically, some of the remedies proposed for groupthink presuppose a social system with a relatively permeable boundary. More research is needed on the emergence and control of groupthink under conditions of isolation and confinement.

2. The "Long Eye" Syndrome

A second general problem in the area of conformity is that strong conformity pressures can include a form of ostracism which is unacceptable under space flight conditions. A person who operates outside of the group's norms is likely to trigger a specific series of events (Schachter, 1951). The initial reaction is an increase in communications intended to bring that person back into line. If these attempts are unsuccessful, communication ceases and the deviant is ignored. Under normal conditions, such ostracism may simply result in the deviant leaving the group.

Under conditions of isolation and confinement, the deviant cannot leave the group. The isolate may display pathological characteristics associated with the "long eye" syndrome (sometimes described as the result of a "twelve foot stare in a ten foot room") (Haggard, 1964; Rohrer, 1961). Noted primarily in
polar camps, this syndrome may involve hallucinations, tears, loss of appetite, silence, suspiciousness, and sloth. This is not only extremely punishing to the rejected individual; it penalizes the group by robbing it of the services of one of its members. This can be a major problem in small crews which begin the mission only minimally staffed. Ways must be found to prevent or cure the "long eye" syndrome.

D. Interpersonal Conflict

Discussions of intragroup conflict tend to stress conflict's adverse or deleterious effects. Certainly, conflict which destroys morale, or makes it difficult or impossible to reach group goals, must be averted. However, conflict is natural and inevitable, and has some functional as well as dysfunctional consequences (Rawls et al., 1968).

First, conflict is necessary for establishing group norms. Subsequent conflict tends to arouse norms, and in this way contribute to cohesiveness or solidarity.

Second, conflict is a requirement for change. A certain amount of deviation and controversy surrounds innovative ideas and the clarification or altering of goals.

Third, several theories of personality, predominately the psychodynamic theories, suggest that conflict has a cathartic effect of drawing-off tensions and restoring equilibrium. Thus, conflicts should retard rising tensions within the group. Furthermore, it is believed that conflict on a small scale can avert conflict on a large scale. That is, minor conflicts can prevent tensions, mounting to the point that there is likely to be a major "blow up."
A certain amount of conflict is not only inevitable, then, it may be of some advantage to the group. The question is how to set limits and manage conflicts in such a way that they do not become destructive. To some extent, almost everything that we have touched upon thus far relates to this issue. For example, crews may be composed in such a way as to minimize initial incompatibilities, and leaders chosen in part on the basis of ability to maintain equilibrium within the group. Here we shall thus consider the additional factors of human relations training and the use of pre-formed or established groups.

1. Human Relations Training

Both task and socioemotional training can be expected to help reduce interpersonal conflicts. First, people who don't know what to expect and don't know how to do their jobs are likely to frustrate and annoy one another. In addition, people who are unskilled may respond to a poor overall level of performance by acting towards one another in negative ways (Shurley, Katani & Sengel, 1974).

Second, both Kubis (1972) and Berry (1973) have advocated direct training in human relations. Such training may involve the entire crew, or, if this is impossible, crew members who are in managerial roles or who are to be personnel support specialists. Training in interpersonal relations was considered valuable by subjects in the Douglas simulation study (SCD, 1974).

To devise adequate training programs, more must be learned about the on-board diagnosis and management of interpersonal frictions and conflicts. Such research would be aimed at uncovering techniques that astronauts might use to identify and combat the underlying sources of interpersonal stress. It might address ways of recognizing and managing one's own rising tensions, as well as tensions in other people. One possibility is that some sort of "socioemotional
buddy system" might prove of use. For example, each person might be assigned
two other crew members who are expected to provide emotional support and inter-
vene before minor squabbles get out of hand. (Two buddies are suggested in case
the person gets into a conflict with one of them.) Satisfactory experiential
training in interpersonal relations may require an authentic setting characterized
by isolation, confinement and stress.

2. The Use of Established Groups

The use of established (as compared to newly formed) groups may help mini-
mize interpersonal frictions. First, assembling the group well before the
mission provides an opportunity to actively observe the separate personalities
in interaction and to take remedial action if the necessary degree of compatibil-
ity is not achieved. Studying the group as a group would provide a back-up to
the initial selection process (Perry, 1965, 1967). Second, group formation
involves a number of stages, one of which is characterized by interpersonal con-
ict ("storming"). There is some question as to whether this stage precedes or
follows coordination in pursuit of task goals (Raythorn et al., 1972; Smith,
1966), but there is agreement that at some point group development requires
thrashing out norms, testing limits, and reconciling interpersonal differences.
Use of a well established group which has already passed through the "storming"
phase would keep some of these conflicts out of the spacecraft.

Not all microsocieties in space will be closed systems. There is likely to
be some turnover in orbiting laboratories or settlements. This raises the prob-
lem of introducing and assimilating newcomers into the group. According to a
recent review by Crandall (1978), because newcomers don't share the continuing
members' knowledge and attitudes, they are likely to unintentionally act in
disruptive ways and to be seen as disloyal to the group. Aware of this problem, newcomers themselves are likely to be anxious and prone to conform. Crandall and Moreland (1978) found that groups of newcomers are likely to treat each other preferentially, and view themselves as a "group within a group," a perception which would seem to only aggravate the assimilation problem.

Crandall describes several methods for easing the integration of newcomers into on-going groups. First, there is pre-entry therapy, which encourages anxiety control and reduces the need to conform. Second, newcomers can be presented models in the form of current or former group members prior to their entry. Third, newcomers may be given candid and realistic (as compared to guarded and idealistic) information about the group. Finally, newcomers can be sponsored; that is, an established group member can introduce and tutor each newcomer. All of these procedures are expected to reduce conflict and attrition.

In the area of personnel rotation there are many topics for future research. One hypothesis is that there is an advantage to using, as newcomers, people selected and trained along with those who have already entered space. Another possibility is that there is an advantage to letting the crew help select its own new members. Still another possibility is that assimilation is enhanced as a result of telecommunication with the newcomer prior to the newcomer's departure from Earth. Finally, it would be useful to know more about the kinds of conditions which will result in newcomers being given an extended period of grace.

How many people should be rotated or replaced at one time? In the military, piecemeal replacement has not been particularly successful. On the other hand, introducing large groups of newcomers means that (1) many people have to be socialized simultaneously and (2) old timers may feel particularly threatened. We also need to know who should be replaced during a given personnel exchange.
For example, it may be desirable to rotate a small number of individuals from each role category (Chapter 00) rather than simultaneously replace several people who perform similar functions.

III. Summary of Principal Planning and Research Issues

1. At what rates are pooling, motivational and organizational effects likely to occur?

2. What is the optimal skill pool given mission requirements?

3. What steps can be taken to minimize the motivational losses that are expected to accompany increasing crew size?

4. What are the dynamics within all-female and mixed-sex isolated and confined groups?

5. What can be done to minimize the problems that are expected to result from overt and covert heterosexual pairings?

6. What is the appropriate age range for crew members given mission specifications?

7. What is the appropriate age mix for a crew given mission specifications?

8. What is the likely impact of developmental changes on extended duration missions?

9. What types of subcultural differences are likely to generate conflict on extended duration missions?

10. What personal characteristics and mannerisms are likely to prove distasteful and annoying to other crew members on extended duration missions?

11. What screening devices can minimize the chances that easily annoyed and highly critical individuals will serve on space crews?
12. What screening devices can minimize the chances that "goof offs" or "slouches" will serve on space crews?

13. How can interpersonal or socioemotional competence be assessed?

14. What factors determine peer perceptions of competence?

15. What types of social motives (own gain motivation, relative gain motivation and joint gain motivation) are desirable given mission specifications?

16. What types of achievement motives (work orientation, mastery orientation and competition) are desirable given mission specifications?

17. What procedures can be devised for "selecting in" persons of exceptional psychological health?

18. What factors determine peer perceptions of emotional stability?

19. What types of social versatility can help reinstate behavioral optimism?

20. What attitude and value mix promotes harmony without interfering with the generation of innovative ideas?

21. How do complementary or overlapping abilities affect group compatibility?

22. What factors (in addition to those studied by Haythorn and Altman) determine need compatibility?

23. What types of decision-making procedures are desirable given mission specifications?

24. What is the optimal distribution of leadership behavior within a space crew?

25. To what extent can formally-designated mission leaders assume both task and socioemotional leadership roles?

26. What is the likely situational favorableness given mission specifications?

27. Can mission leaders identify shifts in situational favorableness and adapt their styles accordingly?
28. What superordinate goals are likely to prove effective for small crews?

29. What steps can be taken to ensure that mission goals are clear and well understood?

30. What steps can be taken to maintain astronauts' interest in truly distant goals?

31. What steps can be taken to prevent or retard the expected decreases in rewards (relative to costs) as missions become routine?

32. What steps can be taken to minimize inbreeding of thought within encapsulated microsocieties?

33. How can the severity of social rejection be limited in isolated and confined groups?

34. What techniques might astronauts use to identify and combat interpersonal conflict?

35. What kinds of human relations training programs are likely to prove useful to astronauts?

36. What selection and training procedures can be used to achieve group solidarity prior to mission departure?

37. What techniques will facilitate the assimilation of newcomers into crews?

38. How should personnel rotation proceed?
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