Observations in the SAM Two-Man Space Cabin Simulator

IV. Behavioral Factors in Selection and Performance

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WHEN extended space flights of more than a few days' duration are undertaken, multiple crew members will be necessary since a single astronaut will be unable to perform the continuous control and monitor functions which will be required. It becomes necessary, therefore, to consider the ways in which crew interaction may be effected by the conditions of prolonged space flight. Among the factors which will impose some degree of psychological stress upon the astronaut are severe confinement and limitation of mobility, a relatively monotonous and unvarying environment with limited diversions, prolonged commitment to exacting duties, and the continual threat of external hazards. If in addition, crew members must tolerate interpersonal disagreements and resentments, the result may be distraction from important tasks, impaired morale and motivation, and an increased possibility of errors or faulty judgment. Obviously, many of the psychological stresses mentioned cannot be simulated, but the SAM Space Cabin Simulator does afford an excellent opportunity for observing the effects of prolonged confinement on the interaction of a two-man crew.

There is some pertinent literature which provides a basis for speculation about the possible effect of prolonged confinement on interpersonal behavior. This includes reports of experimental isolation and sensory deprivation, observations on psychological stress among submariners, and autobiographical accounts of explorers. The first of these, experimental isolation studies, is concerned with sensory isolation of individuals under conditions of varying severity. This has been found to result in "hallucinations" and other mental aberrations.[9] In the one-man space cabin simulator, such reactions have also been seen, and on rare occasions have been of sufficient intensity to cause termination of the flight.[3] However, the presence of another crew member helps mitigate the unvarying or reduced sensory input and makes it possible to consensually validate one's perceptions with another person. Thus our experimental conditions are different from those in isolation and sensory deprivation studies. It seems likely that in two-man flights, disturbances in perception will be less of a problem than gradual changes in morale and attitude, and problems in interpersonal relations.

The other two sources of information are somewhat more relevant for our purpose. Years of submarine experience have amply demonstrated that selected volunteers can tolerate conditions of marked confinement and remain effective for prolonged periods.[5,8] However, submarines have a larger crew and offer more diversionary activities than will be possible during space flight. Closely monitored groups exposed to restrictive conditions, on an experimental basis in a submarine environment, have confirmed the absence of gross behavioral effects, but have demonstrated significant levels of interpersonal friction, monotony, and lowered morale

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and motivation.[4] Despite these problems, performance has generally remained at high levels, and gives cause for optimism about the psychological adaptability of man under severe confinement. However, the conditions have been sufficiently different from space flight that conclusions cannot be adopted uncritically.

Finally, autobiographical literature contains accounts of the experiences of explorers who have been isolated for long periods, either alone or in groups of various sizes. So far as isolation of an individual is concerned, suffice it to say that all accounts stress the pervasive psychological impact of aloneness as a major obstacle to rational thinking and behavior. For our purposes, only the examples of isolation of two-man groups will be considered. From available accounts, this would not seem to be a desirable number from a psychological standpoint.

The occurrence of irrational antagonisms is described by a French anthropologist who spent four months with a Hudson's Bay Post trader in the Central Arctic.[2] He writes:

"I liked Gibson as soon as I saw him, and from the moment of my arrival we got on exceedingly well. He was a man of poise and order; he took life calmly and philosophically; he had an endless budget of good stories. In the beginning we could sit for hours, . . . discussing with warmth and friendliness every topic that suggested itself, and I soon felt a real affection for him. But as winter closed in around us, and week after week our world narrowed until it was reduced . . . to the dimensions of a trap, I went from impatience to restlessness, and from restlessness finally to monomania. I began to rage inwardly and the very traits in my friend . . . which had struck me in the beginning as admirable, ultimately seemed to me detestable. The time came when I could no longer bear the sight of this man who was unfailingly kind to me. That calm which I had once admired I now called laziness; that philosophic imperturbability became in my eyes insensitiveness. The meticulous organization of his existence was maniacal old-maidenliness . . . I could have murdered him."

Admiral Byrd, in justifying his determination to remain alone for four and one-half months at Bolling Advance Weather Base in the Antarctic, a decision which almost cost him his life, cited his reluctance to face the prospect of "hating or being hated by a man you couldn't avoid."[1] He went on to say:

"My idea was that three men . . . should man the Base. . . . The risks, especially, those of a psychological order, argued forcefully against less than three. With three men as compared to two, the chances for temperamental harmony seemed infinitely increased, since, . . . one man would constantly be present in the stabilizing role of a neutral judge. . . . Instead of hearing one voice everlastingly and seeing one face and being confronted with one pattern of habits and idiosyncrasies, a man would have two aspects and personalities constantly facing him. Under such conditions, it doesn't take two men long to find each other out. . . . the time comes when one has nothing left to reveal to the other; when even his unformed thoughts can be anticipated, his pet ideas become a meaningless drool, and the way he blows out a pressure lamp or drops his boots on the floor or eats his food becomes a rasping annoyance. And this could happen between the best of friends. Men who have lived in the Canadian bush know well what happens when trappers are paired off in this way; and . . . I resolved from the beginning not to have Advance Base a two-man project."

On the other hand, experts in small group research have long held that a three-man group is basically unstable, since two members frequently form an alliance which excludes the third and disrupts the unity of the group.[6]

On the basis of these accounts, it seems safe to speculate that prolonged confinement of small groups may lead to disruptive behavior. The establishment of careful selection techniques and preventive measures depends on an understanding of the dynamic forces at work in such situations. The space cabin simulator offers a unique opportunity to observe and study these forces in operation. Some of the stresses of space flight, such as weightlessness and the severe potential hazard, cannot, of course, be duplicated. Nevertheless, the space cabin simulator does provide many comparable stresses such as confinement, restriction of activity, exposure to a relatively unvarying and monotonous environment, prolonged commitment to an operator task, and the necessity to interact with and adapt to another crew member under these conditions.

METHOD

The goal of our behavioral studies in the simulator is threefold: (1) to observe the patterns of behavior which emerge under these unique circumstances and identify any disruptive emotional reactions which may occur, (2) to anticipate ways to minimize the stresses leading to those undesirable responses, and (3) to select individuals better able to cope with the inherent stresses of such a mission.

This requires, first of all, a reasonably consistent and objective means of evaluating subjects and of observing their behavior. The method to be described consists of preflight psychiatric and psychologic assessment of the subjects, inflight observation of their behavior, and postflight debriefings and psychologic testing. The volunteer subjects are psychiatrically selected only to the extent that they have no overt evidence of emotional instability. So far no effort has been made to select or match subjects on the basis of their personality traits.

In our assessment, each subject has a total of four hours of standard psychiatric interviews by two observers. In order to objectify the evaluations based on these interviews as much as possible for later comparison, an attempt has been made to identify, define and rate the basic personality variables which seem to be most useful in making clinical judgments about personality resources. Ratings are made independently by the two observers, and the items rated have been defined and discussed by the raters. They include such variables as dependency, dominance, hostility, self-concept, emotional control and various psychological defense mechanisms. In addition, ratings are made on a number of more complex task oriented items such as motivation, emotional stability, impulsivity, and social adjustment. These ratings will not be reported on further at this time, since too few subjects have been involved to make meaningful interpretation possible.

The psychologic assessment consists of a battery of objective and projective tests. Testing is done before and after the flight. The preflight battery includes the Rorschach, Wechsler Adult Intelligence Scale, Thematic Apperception Test, and several objective measures. In the post testing, the Rorschach is repeated and another form of the Wechsler Intelligence Test is given to measure any mental deterioration that might occur.

Inflight observations are made in several ways. Subjects are continuously monitored on a closed circuit television system and observers make and record regular periodic observations. To provide an objective measure of interpersonal interaction, behavior is scored twice daily for a period of one hour using the Bales Interpersonal Process Analysis. Each interaction between the subjects is rated in one of twelve categories (Fig. 1). Since this method has been used in observing other types of groups, it is possible to compare the interaction of our two-man groups with that seen in other settings.

In addition to these observations, each subject is asked to keep a diary. They are asked to report particularly upon mood fluctuation during the flight, their attitudes toward the flight and toward each other, toward monitoring personnel outside the chamber, and upon any other aspects of the experiment. They are, assured, of course, that their diaries will be handled confidentially, and in particular will not be shown to the other subject.

Postflight observations are made by means of unstructured interviews in which the subjects are asked to discuss their subjective experiences during the flight. They are specifically asked to amplify the comments which they had made in diaries.

RESULTS AND DISCUSSION

To date, four flights have been made. The first was a two-week flight at an altitude of 18,000 feet designed primarily to check out the mechanical aspects of the chamber. The second and fourth were 30-day flights at an altitude of 18,000 feet, and the third was a 17-day flight at an altitude of 33,000 feet. Because of the small number of flights to date, only a few subjects have been involved. For the purposes of reporting this presents a problem, since the need to

protect the anonymity of subjects precludes a detailed discussion of behavorial observations at this time. Further, these subjects do not provide a large enough experimental population to permit the formulation of reliable predictions.

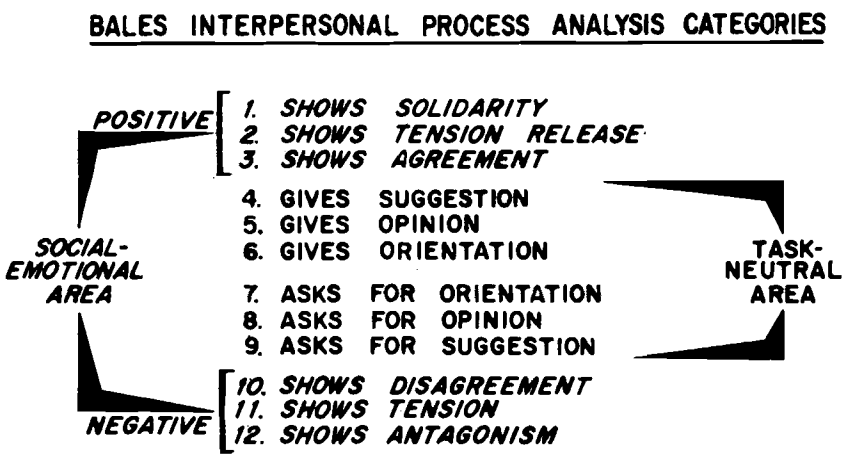

Fig. 1. Categories of behavior that are rated in the Bales Interpersonal Process Analysis.

Nevertheless, certain tentative generalizations can be made about the effects of this unique experience upon the subjects of the first four flights.

In general, the subjects have maintained surprisingly high morale and motivation during these prolonged flights and have experienced very little boredom despite the seeming monotony of their routine. They have not shown any emotional changes which have significantly interfered with interpersonal accord and performance. Although infrequent auditory illusions have occurred, there has been no evidence of gross perceptual aberrations of the type seen in the One-Man Space Cabin Simulator.

In each flight, some feelings of resentment have occurred due to differing behavorial characteristics of the two subjects which were readily identified in the preflight assessment. For example, a taciturn individual may be irritated by the continual conversation of a talkative crewmate, while the latter feels rebuffed when his comments are ignored. In like manner, a meticulous, methodical subject may be irritated by the disorganization and untidiness of his crewmate, while he is considered by the latter to be needlessly slow and obstinate. During such prolonged and inescapable contact with another person, seemingly innocuous habits and mannerisms may eventually become irritating. Such trivialities as one's noisy manner of eating, frequent clearing of the throat, or a minor omission in personal cleanliness, in time, can provoke resentment.

During these flights, neither of the subjects has been openly designated as the leader, and it has been left to the subjects to structure their duties in any way they see fit. This also has resulted in covert antagonisms, when for example, a higher ranking subject may feel his prerogatives usurped by a more aggressive crewmate, while refraining from an authoritarian role himself in order to maintain harmony. Scheduling and division of duties have been an occasional source of irritation. This is in accord with experience in small polar groups in which disagreements often center around work responsibilities.[7] Friction has also arisen between subjects based on differing degrees of cautiousness. For example, one subject may engage in considerable smoking despite the closed environmental

conditions, while the other signifies his apprehension only through indirect comments. Often the subjects have failed to realize the extent or source of irritation displayed by their crewmate. For example, Subject A may assume that his overtly with one another, in spite of underlying conflicts that might be present. Figure 2 shows the over-all percentage in the 12 interaction categories from one 30-day flight as compared with the average of 21 other small group studies

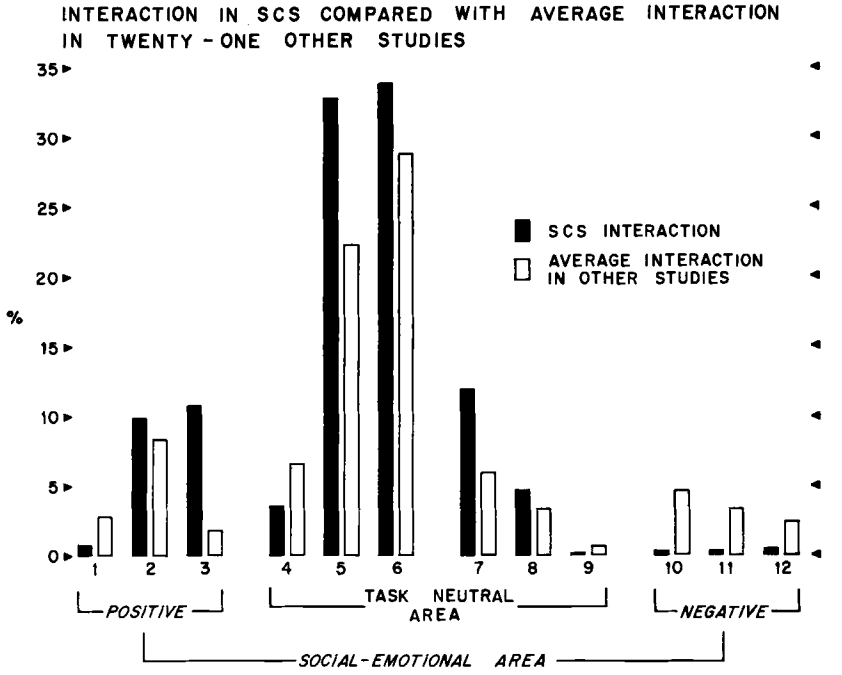

Fig. 2. Comparison of interactions in the Space Cabin Simulator with average interaction in 21 other studies, showing a larger percentage of interactions in the task-neutral area, and a corresponding reduction in the more emotional categories.

crewmate is short tempered and irritable because of his annoyance with monitors outside the chamber, while actually Subject B's growing irritation is the result of dislike or disgust toward some mannerism of Subject A himself. Postflight debriefings and diaries confirmed the presence of these covert antagonisms. It should be emphasized, however, that the success of the mission was sufficiently important to the subjects that they consciously refrained from any behavior which might have had a disruptive effect and were able to continue working together without open anatagonism.

Scoring of behavior by means of the Interaction Process Analysis made it possible to assess systematically how the subjects were relating which have been reported in the last decade. Comparing these, certain significant differences will be noted. In the space cabin study, the more neutral categories in the middle, particularly acts of asking for information and suggestion, dominate the profile, while the extreme, more emotionally tinged categories are not well represented. This was consistent with subjective observations during the flight that the relationship between the subjects was quite formal and polite. They consciously refrained from expressing very much negative feeling for fear of disrupting their relationship. Much of the negative feeling expressed was displaced and directed toward monitoring personnel outside the chamber. This has been particularly evident during

malfunctions, requiring a change in routine and cooperative efforts between those inside and outside the chamber. In such circumstances, subjects are quite sensitive to any evidence that monitors are indifferent, careless, or in some other way failing to give adequate support. On one occasion, a subject became so incensed at what he considered to be condescending instructions being given to him by an outside monitor that he conspicuously placed his fingers in his ears to show that he wasn't listening, while he defiantly stuck out his tongue toward the television camera.

On the basis of the few flights to date, preliminary conclusions only can be drawn. Future flights, with various combinations of personality types, will be required before confident predictions can be made about the effects of prolonged confinement on a two-man crew. To date, it appears that subjects with rather marked personality differences can remain effective under the conditions imposed by the two-man space cabin simulator for periods up to 30 days, and with adequate motivation can maintain a satisfactory working relationship. These observations of course must remain tentative until further experience is accumulated with the Space Cabin Simulator and, eventually, with manned space flight.

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Landlocked Oceanography

Those who are decently thrilled with the familiar concept of their country as stretching with its fields of amber grain from sea to shining sea should be equally excited by the first Symposium on Oceanography held in the Midwest, last May, at the University of Wisconsin, in Madison. Madison, about a third of the way from the Atlantic Ocean to the Pacific, is in the general region that contains the Great Lakes Naval Training Station and possibly other nautical installations.

The Great Lakes are presumed to be puddles, not yet entirely dried up, that were left after the last ice cap melted. The site of Madison was probably at one time beneath the great inland ocean that covered so much of the continent, so there is every reason for considering it as a logical city in which to hold the first Symposium on Oceanography. Other cities, recently discovered, have reversed the process, having become submerged as a later episode in their history.

These facts are, of course, known to Professor Robert A. Ragotzkie, University of Wisconsin meteorologist and oceanographer and chairman of the program committee, who has made the statement that "We know more about the face of the moon than we do about the bottom of the sea." It is a candid admission from one who is an actual inhabitant of a former ocean's bottom.—From the *New England Journal of Medicine*, June, 1961.