Studies of Isolation and Confinement

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ISOLATION and confinement have received increasing attention during the last few years. Reports of survival experiences, behavior in prison camps and experimental studies of isolation have demonstrated the significance of these problems.[3,4] The conditions under which crews of future aircraft and space vehicles are expected to function make both isolation and confinement important areas for research in aerospace medicine.

As the duration of flight is extended, increasing emphasis must be placed on the environment provided for crew members. Future vehicles will require effective functioning for long periods of time in settings which are limited in available space. Inasmuch as these will be entirely artificial, the usual means of satisfying human needs will be impaired. At the same time, men will be isolated from their accustomed surroundings and separated from their normal sources of support.

To investigate these problems, a series of studies has been carried out in this laboratory. Many aspects of isolation and confinement have been dealt with experimentally. Others, which cannot be simulated in the laboratory, have been approached indirectly. For example, information on prolonged exposure to danger or extreme states of isolation may be obtained from accounts of arctic explorers or analysis of stressful military operations. Combining such indirect approaches with controlled laboratory studies facilitates planning for future missions.

Two types of experiments have been carried out. In the first, confinement was studied under simulated operational conditions by placing groups of five men for five days in a compartment 17 feet long, 7 feet wide and 6 feet high. The interior of this facility was carefully designed to minimize physical discomfort and monotony.[1]

Behavioral measures were selected to allow observation of the group as a whole, as well as of the individuals who formed it. These permitted description of both overt behavior and less apparent, but conscious attitudes. Insofar as possible, efforts were also made to understand unconscious processes which influenced behavior. Finally, to determine the extent to which confinement affected each man, changes in central nervous system, cardiac and endocrine functions were assessed.

Measures of group behavior included.

1. *Direct observation.*—Data on both group and individual behavior were derived from direct observation, supplemented by diaries, tape recordings and motion pictures.

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2. *Bales interaction analysis.*—This is a standardized method for analyzing units of behavior according to their functions in the inter-personal activity of the group. For example, one statement by a subject might be listed under the heading "gives suggestion," another categorized as "shows tension."

3. *Ranking scale.*—To determine conscious attitudes toward other crew members, subjects ranked each other daily on the following traits: "friendly," "keeps trying," "calm," "confident," "is a leader," "liked you," "patient," "thoughtful," "frank," "careful," "easy going," "liked by others," "modest," "co-operative," "cheerful," "efficient."

4. *Interpersonal projection test.*—Each day subjects arranged photographs of the other crew members and of five non-crew members, according to their appearance of being "relaxed," "upset," "angry," "sad," and "pleasant." This test was designed by Dr. Donald Glad as a measure of feelings which might remain unexpressed on the ranking scale.

5. *Draw-a-group test.*—Before and after the run, each subject was requested to draw a picture of a five-man group. Next he was asked to draw an ideal group. This provided another projective method for studying reactions to group living.

Measures of individual behavior included:

1. *Psychiatric examinations.*—Each subject was examined by two psychiatrists before and after the experiment. During the run, behavior was observed continuously by either a psychiatrist or a clinical psychologist.

2. *Projective tests.*—The Rorschach (ink-blot) Test, Thematic Apperception Test, Minnesota Multiphasic Personality Inventory, Blacky Test, Draw-A-Person Test and Sentence Completion Test were employed to assess personality structure, the presence of conflict, effectiveness of psychological defenses and the nature of unconscious dynamics.

3. *Intelligence tests.*—Measures of intellectual functions were administered before and after the experiment.

4. *Performance tests.*—During duty periods, subjects carried out tests of vigilance, counting ability and reaction time.

5. *Bender-Gestalt.*—By having the subject copy a series of eight figures before and after the runs, perceptual and motor ability were determined.

Physiological measures included:

1. *Electroencephalogram.*—This measure of the brain's electrical activity was used primarily as an index of the subject's state of consciousness.

2. *Electrocardiogram.*—The EKG was used to give a continuous record of pulse rate.

3. *Skin resistance.*—By recording changes in skin resistance, variations in sweat gland activity can be determined. This measure reflected changes in activity of the autonomic system during the experiment and was useful for indicating the subject's state of consciousness.[2]

Biochemical measures included:

1. *Urinary pepsinogen.* — Excretion of uropepsin is related both to intensity of oral needs and to adrenal steroid excretion. Determinations were carried out on 24-hour pooled urine specimens collected before, during and after the run.

2. *Adrenal steroids.*—Increased output of hormones by the adrenal cortex is a characteristic sign of stress. Measuresments of 17-hydroxycorticoids, 17-ketosteroids and 11-oxysteroids were thus carried out for 24-hour specimens from two pre-experimental days and each experimental day.

3. *Sodium, chloride, potassium.*—Total excretion of these ions was measured before, during and after the run.

4. *Hippuric acid.*—Excretion of hippuric acid is positively correlated with clinical estimates of free floating anxiety. It was thus measured during the pre-experimental period as an extension of the general personality assessment.

Measures of medical status included:

1. Recent flight physical examinations.

2. *Hematology.*—To assist in evaluating each subject's general physical condition, the red count, white count, differential, hemoglobin, hematocrit and sedimentation rate were determined before and after the experiment.

3. *Urinalysis.*—As a part of the medical evaluation, urinalyses were done during pre- and post-experimental periods and on all experimental days.

Although reactions of the three groups studied will not be discussed in detail, certain features of their behavior can be summarized. Crew members began with a positive attitude toward each other and tended to maintain it throughout the experiment. Each group seemed to have a characteristic "personality." For example the second crew, a group of volunteers, became highly involved in the mission. Responses were vigorous and intense. The third group, mostly non-volunteers, accepted the experiment as a duty. They performed efficiently, but without the high spirits of the second crew.

Although increased interest in food was noted in all experiments, this was more pronounced in the first two runs. These crews emphasized preparation of meals and engaged in incessant conversation about food. The second group, for example, ate 1700 calories more per day than the third group. This suggested that since their involvement in the experiment was greater, channels available for drive gratification were utilized more intensively.

Analysis of projective tests, which were self-administered during the run, revealed a trend toward regressive behavior. The "Blacky" stories, in particular, showed evidence of oral deprivation and aggression. For example, one subject wrote: "Blacky is hungry, so he goes to dig up a bone he had buried, but he can't find it. Then he goes to suckle his mother, but there is no milk. So he gets mad and chews on a belt."

Transient signs of ego impairment were occasionally noted. These were most common during periods of maximum fatigue—early in the mission where day-night cycles of some subjects were reversed, and near the end, when an increased work load disrupted sleep. On the other hand, subjects often appeared capable of more mature and flexible handling of certain conflict areas after the experiment than before it began. This may have represented a "therapeutic" effect of group support during a stressful experience. It probably also represented enhancement of the sense of personal adequacy resulting from accomplishment of a difficult task.

In general, each subject used effectively his characteristic methods of adaptation to handle conflicts which appeared during the run. The most common problem was arousal of hostile feelings toward fellow crew members. This was usually dealt with by the defense mechanisms of suppression, denial and undoing. Anger was seldom expressed directly, although it often appeared as sarcasm, comments in diaries, or in the choice of stories and figures for projective tests.

On the whole, it appeared that the experience was no more than moderately stressful. Physiologic and biochemical measures support this conclusion. Individual variations from day to day were common, but did not follow any overall pattern. Blood and urine studies remained within normal limits, except for signs of dehydration in some crew members during the immediate post-run period.

In the second type of experiments the objective has been to find how different individuals react to unusual situations. This can be studied through experimental isolation. By removing as many features of a man's accustomed surroundings as possible, we hope to achieve better understanding of which aspects of the environment are essential for effective functioning. A second objective is to determine which variables influence reactions to isolation.

In trying to reach these goals, no attempt is made to simulate a specific mission. Although details of the experimental conditions vary, each study has involved placing subjects alone in a soundproof room containing a bed, refrigerator and toilet facilities. Subjects have been volunteers and nonvolunteers, drawn from civilian and military populations.

Before each procedure, the subject is given a battery of psychologic tests similar to that used in the group confinement studies. During isolation, skin resistance is recorded continuously to indicate the state of consciousness and level of autonomic activity. Urine is collected for determinations of uropepsinogen, 17-hydroxycorticoids, adrenaline and noradrenaline. After the run, two additional interviews are obtained and selected psychologic tests are re-administered.

Using these tools, nine experiments have been carried out. These have involved more than 100 separate runs, ranging from three hours to seven days in duration. Experimental conditions have been determined by the nature of the variables under study. Thus, in some experiments, the subject is kept in total darkness and silence. In others, he is exposed to continuous white noise and can see only a homogenous field of light admitted through goggles with frosted lenses. Physical activity has been restricted in varying degrees.

Although results of these experiments again cannot be presented in detail, our most significant findings can be summarized. First, it is apparent that we have been dealing with a complex series of phenomena. At least eight groups of variables have been found to influence behavior during isolation. The first group is associated with the circumstances surrounding the isolation experience. The second category of variables is related to the subject, because such factors as personality, motivation, and background have been found to be important determinants of behavior during isolation.

The third category includes the quantity, modality and pattern of sensory input. The fourth refers to enclosure or restraint, the fifth to communication between subject and experimenters, and the sixth to "aloneness." The seventh consists of four factors related to time—duration of isolation, the subject's knowledge of the duration, the degree of his control over the duration and the presence or absence of methods to measure time. The final category includes all activities the subject is instructed or permitted to carry out during the experiment.

Although individual variations are striking, a characteristic pattern of behavior is often observed. Immediately after the chamber door closes a brief period of anxiety occurs. This has progressed to panic in a few subjects, but usually subsides as defense mechanisms become effective. During the second phase, the subject structures the experience according to his needs. An obsessive-compulsive person, for example, adopts a repetitive pattern of thought or activity. The passive-aggressive individual may view the experiment as a battle and try to "beat" the experimenters. Many subjects enjoy this phase, and show no changes except for slight exaggeration of customary defenses and inability to engage in constructive mental activity. Perceptual changes, although often reported in other isolation studies, are not common in our subjects.

If the experiment continues long enough, the third stage is reached. Anxiety reappears and thoughts become disorganized. As unconscious material threatens to erupt, defenses become more primitive. The subject may then request that the experiment be ended or abruptly walk out. The grounds for termination given at first are often irrational and may subsequently be described by the subject as different from the "real reason I came out."

These studies have implications both for the design of space vehicles and for selection of crew members. The reactions of subjects in our experiments suggest that although quantity and variety of sensory input are essential for optimal functioning, it is not enough for the environment merely to provide physical stimuli. Men must also have information which means something to them, holds their interest and enables them to maintain a sense of continuity with previous existence. Without such information, they have no links to their accustomed world. Loss of these bonds leads to anxiety and impairment of performance.

The capacity to withstand isolation depends on the integrity of the subject's personality. Those who rely too strongly on external cues to maintain psychologic equilibrium do poorly in our experiments. Schizophrenics, for example, are seldom able to adjust to such a situation. It thus appears that individuals with a minimum of emotional problems adapt most easily to an unstructured environment.

It has also been found that stress in isolation increases with time. Although the quantity and variety of inputs provided by vehicles now under consideration should be adequate for many days or weeks, they may not be sufficient for missions of months or years duration. Even slight reductions in information content and variability of stimuli may eventually become stressful. Inasmuch as it will be difficult to build all the richness of life on earth into an artificial environment, the effects of monotony and staleness may be serious problems during prolonged expeditions.

The group confinement studies suggest that some of these effects may be mitigated by emphasis on whatever channels are available for the gratification of drives. When cut off from many of their usual outlets, these subjects emphasized eating and activities associated with food. Plans to use algae for a nutrition, should thus take into account the advisability of making the product as tasty as possible. Man will function best if space flight is more than a grim struggle for survival.

In conclusion it should be re-emphasized that experimental studies of isolation and confinement are primarily a source of inferences about what to expect in space flight. Prolonged separation from earth, exposure to unusual environments and the inescapable presence of danger cannot be simulated in the laboratory. On the other hand, these studies show us what variables can be expected to influence reactions to isolation and offer clues on the kinds of men who are likely to do well in space missions.

Fortunately, many steps lie between the isolation chamber and an interplanetary expedition. By supplementing experimental data with knowledge of military operations in the past, survival experiences and studies like the *Manhigh* flights, we have a reasonable basis for predicting behavior during 24-hour satellite experiments. Armed with data from these, we should have an idea of what to expect on lunar missions.

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Star Gazer in the Cockpit

Flying is certainly one of the most relaxing activities a man can pursue. But irrevocably associated with the pure pleasure of flying is the obligation to *see* and to exercise caution in flight. The star gazer, the dreamer, the hypnotized pilot who stares out from his cockpit window into a blank emptiness and sees nothing more than the extension of his own reverie, this man has surrendered his right to fly and deserves to be treated like other contagious individuals or subjects—he should be isolated, if he survives his next flight.—John A. Nammack: Cruise Blindness. *Air Facts,* March, 1958.