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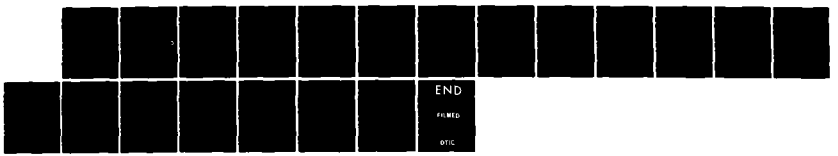

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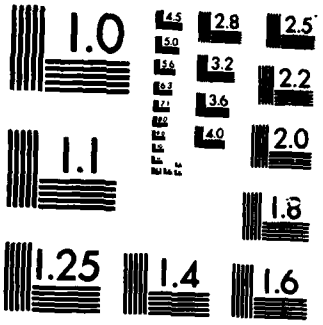

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This report summarizes fourteen residential studies devoted to analyses of incentive schedules and team turbulence on individual and small-group performance in a continuously programmed environment. During the contract period, a Team Multiple Task Performance Battery (TMTPB) was developed that required a coordinated response among members of three-person teams.

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BACKGROUND

Where the successful accomplishment of an organization's mission requires the coordinated contributions of two or more individuals collectively identified with the achievement of a common objective, the conditions for characterizing a team are operationally defined. While there has been much research on teams, functional analyses of team performance under field or simulation conditions, typically involving constant scenario environments, have been limited by the lack of opportunity to introduce experimental interventions intended to identify factors that differentially affect individual and small-group performance. A review of the extensive literature in the area suggests that research on team performance effectiveness would benefit from the development and application of an effective methodology for extended-duration analyses of such situations, under conditions that provide for operational task assessment and evaluation within the context of a comprehensive living and work setting. Of predominant importance is an understanding of factors that affect a team's ability to accomplish mission objectives.

RESEARCH OBJECTIVES

A research project was undertaken to investigate performance effectiveness within the context of a laboratory environment in which both interpersonal and work behaviors can be continuously monitored and evaluated over extended time periods (e.g., days). The project did not attempt to simulate a specific operational environment. Rather, the laboratory facility was designed to address a broad range of performance problems from the perspective of a functional analysis of performance effectiveness. It is essentially a programmed environment with design features and measure-

ment capabilities that permit the accurate assessment of relationships between antecedent conditions (e.g., incentive schedules, membership turnover, etc.), and performance effectiveness.

The specific research objectives were as follows:

(1) Development of a residential laboratory in which 2-person and 3-person teams could reside for 10-15 days under conditions of continuous observation,

(2) Development of a behavioral program to structure group members' access to laboratory resources and to generate performance baselines,

(3) Development of individual and team performance tasks, the latter requiring coordination among team members,

(4) Evaluate the effects of incentive schedules on individual and team performance, and

(5) Evaluate the effects on individual and team performance of introducing a novitiate participant into an established team and of replacing an established team member with a novitiate participant.

THE RESIDENTIAL LABORATORY FACILITY

The residential laboratory consists of five rooms and an interconnecting corridor, and it was constructed within a wing of the Henry Phipps Psychiatric Clinic at The Johns Hopkins University School of Medicine. The rooms are enclosed: they have their own walls and ceilings, but no windows, although access to an outside terrace can be granted as a research protocol may permit. Each of the three identical private living quarters (2.6 x 3.4 x 2.4 m) is similar to a small efficiency apartment. The social recreation area (4.3 x 6.7 x 2.7 m) contains a complete kitchen facility along with exercise equipment and games. The workshop (2.6 x 4.1 x 2.7 m) contains operator consoles for

individual and team performance tasks. A common bathroom serves the recreation and workshop areas. In summary, the programmed environment can accommodate at least three participants for intensive experimental analyses. More study subjects could be added to an experimental protocol by allowing them temporary residence within the recreation area along with periodic rotations to the privacy of the individual quarters when solitary members move to the recreation area.

The laboratory is 'programmed' in the sense that its resources are restricted by design features that electronically regulate access to storage compartments or to areas containing supplies necessary to accomplish a given performance unit.

A detailed description of the residential laboratory is presented in TR-ONR-6 (Experimental Analysis of Team Performance: Methodological Developments and Research Results).

THE BEHAVIORAL PROGRAM

To structure the team members' use of the laboratory's resources in a disciplined yet meaningful way, a behavioral program was developed to establish and maintain individual and team performance baselines as well as to provide the context for experimental manipulations of performance interactions during extended residential missions. A behavioral program is defined by (1) an array of activities or behavioral units and (2) the rules governing the relationships among those activities. Each activity represents a distinct behavioral unit and performance requirement, with progression through the various activities programmed sequentially. Finally, all behavioral units are scheduled on a 'contingent' basis, which means that access to a succeeding activity depends upon satisfaction of

the requirements for the preceding unit.

A description of a typical behavioral program, methods of stimulus control of component activities, and the composition of activities are presented in TR-ONR-4 (Experimental Analysis of Small-Group Performance Effectiveness: Behavioral and Biological Interactions).

The behavioral program provides a promising approach to the problem of structuring the resources available to a confined microsociety. The functional interdependencies among activities ensure that performances of value to the welfare of the individual (e.g., physical exercise), to the welfare of the team (e.g., social recreation), and to the welfare of a "mission" (e.g., sustained performance effectiveness) occur recurrently over time. These functional interdependencies reflect the "motivational" properties inherent within successive progressions through the program, and all incentives to maintain the overall operational status of the organization can reside within the behavioral schedule itself, although superordinate objectives (e.g., money, adventure, command, etc.) clearly occasion participants' presence within such a setting.

The behavioral program not only structures access to resources but also makes all corresponding activity units available for measurement. The boundaries between successive activities in the program impose rigor on the assessment of individual and group preferences and effectiveness within those activities. Additionally, the program has the advantage of providing a comprehensive range of variables for observation and measurement. For example, at one level, a subject's performance on a synthetic work task could be assessed (e.g., errors, response latency, etc.), and at another level, a subject's frequency and duration of progressions through the program could be assessed without regard to the intensive analysis of compo-

nent activities composing such progressions. Moreover, the social status of the microsociety may be assessed by observing the degree of "synchrony" among subjects in the selection and completion of similar activities at the same time. Observations of subjects' communication networks along with the frequency, duration, and quality of dyadic and triadic social episodes complement synchrony measures. All these factors, then, contribute to a method that has considerable power in the analysis of variables that impact upon individual and team performances, especially with regard to the potential interrelationships between the effectiveness of such performances and other aspects of the work environment.

PERFORMANCE ASSESSMENT

A Multiple Task Performance Battery (MTPB) served as the measure of complex human performance. The MTPB was composed of the following five subtasks that were presented simultaneously, on a CRT monitor, to an individual operator: (1) probability monitoring, (2) arithmetic operations, (3) warning light vigilance, (4) dynamic signal detection, and (5) target monitoring and recognition. Accurate operation of the subtasks produced "accuracy points" that were cumulatively displayed on the CRT.

The team performance task was an expanded version of the single-operator MTPB. The Team MTPB (TMTPB) involved three operator consoles, all of which presented the identical display of the five task components. The parameters of these tasks were modified to a difficulty level such that the concurrent inputs of three operators were required to avoid information overload and to produce maximum performance effectiveness per unit time. The "team" aspect of the task was reflected by the interlocking response demands associated with the probability monitoring subtask, and it was embedded within the context of the remaining four individually solvable

subtasks. The team subtask required the detection of a bias that was recurrently presented on any one or more of the four probability monitoring scales. To 'correct' a bias, all of the three operators were required to press the corresponding 'correct' keyboard character within 0.6 sec of the first such keyboard entry. Correction of a bias produced increments in accuracy points, and a team's failure to detect and correct a bias resulted in subtractions from accumulated points. The team task, then, required (1) processing of symbolic information (i.e., the detection of a bias), (2) sharing information by communications among team members (e.g., One operator may say 'Bias on one. Ready...Go.'), (3) coodination of a response (i.e., three response inputs within 0.6 sec), and (4) sustained vigilance to avoid loss. This team task reflected the major performance dimensions considered to be important in developing methods for quantitative analyses of the interrelationships between individual and team performance effectiveness.

Descriptions of the individual and team task are presented, respectively, in TR-ONR-2 (Appetitive and Aversive Reinforcement Schedule Effects on Team Performance) and TR-ONR-10 (Behavioral and Biological Effects of Changes in Group Size and Membership). Examples of multivariate techniques applicable to team performance effectiveness analyses are presented in TR-ONR-1 (Event Time-Series Applications to the Analysis of Behavioral Events). Finally, physiological responses to individual MTPB performance are presented in TR-ONR-5 (Sustained Blood-Pressure Responding During Synthetic Work).

PARTICIPANTS

Forty-five male and female volunteers participated in the research

program, and only one subject withdrew from an experiment before its scheduled completion. Almost all participants had a college background, and most were graduates. Acceptance into the research program followed psychological evaluation and detailed orientations to the laboratory and to the behavioral program. The research involved no elements of deception, and informed consent was an integral component of the orientation.

INCENTIVE EFFECTS

Four studies were conducted to develop a laboratory model that would allow systematic exploration of individual and social by-products of aversive incentive conditions. Under a positive incentive condition, "work units" (e.g., physical exercise, manual operations, MTPB performance) were completed by individual team members, and each such unit added a fixed amount to a group account that was divided evenly among the three subjects at the conclusion of the experiment. Under an avoidance (i.e., aversive) incentive condition, however, no money was earned. Group members were assigned a daily performance criterion to satisfy as a team, and failure to reach the criterion resulted in reductions in accumulated earnings. The two incentive conditions appeared in various orders and durations across the series of investigations.

Comparisons between conditions on a number of behavioral program measures showed the deleterious effects of the avoidance incentive condition. Disruptive by-products of that condition included (1) interpersonal confrontation and antagonism, especially by high-productivity subjects toward low-productivity subjects, (2) vociferous written and spoken complaints about the schedule, (3) writtern and spoken hostility directed toward the experimenters, and (4) dysphoric feelings. The impact on performance effectiveness during the avoidance condition was

demonstrated by one team member who refused to work further on the MTPB when another member fell somewhat behind in his share of work as agreed upon by team participants. In contrast, under the positive incentive condition, such disruptive effects did not occur even when extraordinary performance productivity was observed, and a several-day history of negative effects could be overcome by reintroducing the positive condition. These effects emphasized the interaction between heterogeneity in work productivity within an organization and member tolerance and intolerance of such heterogeneity under different incentive conditions.

Detailed analyses of these studies are presented in TR-ONR-2 (Appetitive and Aversive Reinforcement Schedule Effects on Team Performance) and TR-ONR-9 (Positive and Negative Reinforcement Effects on Behavior in a Three-Person Microsociety).

EXTRA PERSON INTRODUCTION/WITHDRAWAL

The foregoing investigations clearly established social variables as fundamental indices of the overall status of a confined microsociety, and they emphasized the sensitivity of such variables to a range of experimental manipulations having significance for real-life situations. Throughout such studies, it was observed that mission participants sought social interaction under one set of conditions (e.g., positive performance outcomes) and withdrew from such interaction under other conditions (e.g., aversive performance outcomes). Thus, the joining and leaving of a group by mission participants, under circumstances encompassing more than a single environmental condition, appeared to generate social effects that reflected important dynamic processes requiring systematic experimental analysis.

Accordingly, six team performance effectiveness studies were conducted to assess the effects on individual and group behavior of a novitiate participant's introduction into and subsequent withdrawal from a previously established and stable two-person social system. The objectives were to focus upon (1) the social mechanisms and temporal properties associated with the integration of such a participant into an established team and (2) sources of group disruption or cohesiveness fostered by his or her presence. Additionally, we began to measure changes in level of urinary testosterone as an endocrinological index of demonstrated sensitivity to social interaction effects in both animals and humans. This behavioral-biological analysis was used to provide a more comprehensive assessment of the personal and social impact generated by the introduction and withdrawal of new members with an established group.

The paradigm adopted for experimental analyses of effects of changes in group size was as follows. A two-person group resided for ten successive days within the programmed environment, and the members operated performance tasks for their earnings. During that ten-day period, a third 'novitiate' participant was introduced into the programmed environment for several successive days, increasing the group size to three members. A typical 'introduction' period with three group members lasted four days, and it usually began on Day 4 or Day 7 of a ten-day experiment.

The rule conditions associated with the novitiate's entrance into the group differed across successive investigations. In some studies, the novitiate received a per diem allowance and was not required to work for compensation, although he was permitted to contribute to the performance tasks that benefited the two established group members. In other studies,

the novitiate was required to work for compensation by competing with the other group members for access to the single MTPB console in the workshop. Finally, there was a series of investigations with both male and female novitiates and, in some cases, with novitiates and dyadic members who had previously participated in a residential study.

In studies where the novitiate's presence served primarily as additional social stimulation for the established dyad and as a source of information regarding current events outside the laboratory, the two-person group initially showed a resistance to granting the novitiate permission to work, even when such work would have provided relief from operating a demanding task. However, as the three-person condition continued over days, novitiates were observed to contribute to work productivity to a degree that was almost equivalent to the productivity of the dyadic members. Since there were no external incentives for a novitiate's work in these first introduction studies, these findings emphasized the influence of social processes alone in maintaining performance productivity, at least within these cohesive group situations. Finally, novitiates showed daily urinary testosterone at the upper and lower boundaries of the standard range, but the absence of baseline levels precluded the interpretation that active social processes had governed such effects.

Transitions between two-person and three-person conditions were not always smooth in groups where the novitiate had to work the MTPB for compensation. When a novitiate forcefully intruded himself into the dyad's customary work schedule, his testosterone levels rose or fell generally in close relationship with his success or failure, respectively, in gaining or maintaining access to the MTPB station according to a schedule that was least disruptive to his wake-sleep cycles, as determined during several

baseline days preceding his introduction into the group. When sleep discipline was imposed, and when a novitiate was cooperative in negotiating an orderly sequence of using the MTPB, there were no notable changes in testosterone observed in any team participant. Finally, when a female novitiate was introduced into a two-man group, wake-sleep cycles and work periods were erratic throughout the three-person condition. Such effects were associated with the absence of notable androgen changes, even by a dyadic member who, as a novitiate in an earlier study, had successfully maintained his wake-sleep cycles and had shown a striking increase in testosterone when he joined the group.

Detailed analyses of these studies are presented in TR-ONR-3 (Behavioral and Biological Interactions with Confined Microsocieties in a Programmed Environment) and TR-ONR-8 (Small Groups in Programmed Environments: Behavioral and Biological Interactions).

GROUP MEMBER REPLACEMENT

The next series of four experiments demonstrated the extension of the research paradigm from analyses of 'introduction' effects to the analysis of 'replacement' effects. That is, the group size was held constant to evaluate effects of replacing a member of an established three-person group with a novitiate participant.

A typical replacement investigation proceeded as follows. A three-person group resided in the programmed environment for five successive days. At the end of Day 5, one person was withdrawn and replaced by a novitiate participant who, with the remaining two original members, formed a new group for the next five successive days. Consecutive studies differed in terms of (1) the decision rule by which an original group member was withdrawn, (2) the number of baseline days that came before

group formation, and (3) the type of performance tasks that the group members operated for compensation.

For the first replacement experiment, three-person group members resided in their private rooms for a two-day baseline "alone" period (Days 1-2) during which time access to the intercom, to social activities, and to the MTPB work station was prohibited. This two-day period provided a necessary hormonal reference against which to assess endocrine responses in relationship to initial group formation. On Days 3-5, all activities previously prohibited were made available to the group, and each member was required to operate the MTPB for individual compensation. As in the introduction experiments, there was only one MTPB console located within the workshop, and subjects occupied the workshop singly on a self-determined rotational basis. This procedure, then, permitted an evaluation of the manner in which subjects occupied the work station (e.g., duration of work periods, time-of-day of work periods, etc.) as one of the principal dependent variables of the experiment.

At the end of Day 5, whoever of the three mission members had earned the fewest MTPB performance points, totalled across Days 3-5, was withdrawn from the experiment. This decision rule was known by the group members before the experiment began. The novitiate participant entered the programmed environment on Day 6, which was a solitary baseline day for all three subjects. On Day 7, the newly formed team had access to intercom communications, social activities, and the MTPB work station that continued to be available throughout Days 7-10. Thus, the two ten-day participants were required to adjust to the replacement of an original member, and the novitiate member was required to adjust to his entrance into an established unit whose members shared a history of having competed successfully to

maintain high levels of performance effectiveness.

The second replacement study was identical in procedure to the first, with the following exception. No baseline 'alone' days were programmed before initial group formation, and subjects were scheduled to compete during Days 1-5.

Team participants who failed to compete successfully to remain within the experiment showed initially diminished androgen levels or a pronounced drop in androgen levels across the first several days of a study. Although total MTPB productivity was not demonstrably changed when membership replacement occurred, negative interpersonal effects resulted when some group members were required to restructure work and sleep schedules. Changing a sleep schedule was sometimes associated with a decline in testosterone, confirming the processes observed within the introduction studies. Finally, negative interpersonal effects were associated with the absence of dyadic and triadic social recreation periods.

The final two replacement studies incorporated the TMTPB into the research protocol, and they proceeded as follows. An initial three-person team operated the TMTPB for compensation to a daily ceiling of five thousand points across Days 1-5. At the end of Day 5, an initial member was withdrawn and replaced, and on Days 6-10, the reformed team operated the TMTPB for compensation. In the first replacement study, an 'effective' team member was withdrawn, and in the second replacement study, an 'ineffective' team member was withdrawn. Team members in the last study wore voice-operated microphones during TMTPB performance, and speech patterns were analysed with time-series techniques.

Performance schedules were almost always established during the initial days of a study, and they persisted when membership replacement

occurred. Team MTPB performance accuracy decreased when an 'effective' member was replaced, and it increased when an 'ineffective' member was replaced. Intermember speech patterns changed when an ineffective member was replaced.

The results of these replacement studies suggest that interpersonal cohesiveness within a team may be compromised by a member who demands excessively high productivity or by a member who reduces productivity. A history of low team productivity may be sustained even when an ineffective team member is replaced by a competent novitiate. Intermember speech patterns may provide early warning signs of a team's inability ultimately to form an effective work unit.

A detailed description of the replacement studies is presented in TR-ONR-10 (Behavioral and Biological Effects of Changes in Group Size and Membership).

The general methodological framework for this research program is presented in TR-ONR-7 (Behavior Analysis of Confined Microsocieties in a Programmed Environment).

TECHNICAL REPORTS

R.L. Ray, Nellis, M.J., and Emurian, H.H. Event time-series applications to the analysis of behavioral events. January, 1981, AD-A094 253/2.

Emurian, H.H. and Brady, J.V. Appetitive and aversive reinforcement effects on behavior. September, 1981, AD-A103 930/4.

Emurian, H.H., Brady, J.V., Meyerhoff, J.L., and Mougey, E.H. Behavioral and biological interactions with confined microsocieties in a programmed environment. May, 1981, AD-A099 747/8.

Emurian, H.H. and Brady, J.V. Experimental analysis of small-group performance effectiveness: Behavioral and biological interactions. April, 1982, AD-A113 862/7.

Ray, R.L. and Emurian, H.H. Sustained blood pressure responding during synthetic work. June, 1982, AD-A115 733/8.

Emurian, H.H., Brady, J.V., Ray, R.L., Meyerhoff, J.L., and Mougey, E.H. Experimental analysis of team performance: Methodological developments and research results. July, 1982, AD-A116 915/0.

Emurian, H.H. and Brady, J.V. Behavior analysis of confined microsocieties in a programmed environment. February, 1983, AD-A123 878/1.

Emurian, H.H. and Brady, J.V. Small groups in programmed environments: Behavioral and biological interactions. April, 1983, AD-A127 172/5.

Emurian, H.H., Brady, J.V., Meyerhoff, J.L., and Mougey, E.H. Positive and negative reinforcement effects on behavior in a three-person microsociety. December, 1983, AD-A135 262/4.

Emurian, H.H., Brady, J.V., Ray, R.L., Meyerhoff, J.L., and Mougey, E.H. Behavioral and biological effects of changes in group size and membership. June, 1984, AD-A141 561/1.

PAPERS AND PUBLICATIONS

Ray, R.L., Emurian, H.H., and Wurster, R.M. COMOV: A program for the analysis of the relationship between two time series. Behavior Research Methods and Instrumentation. 1980, 12(4), 479-480.

Emurian, H.H., Emurian, C.S., and Brady, J.V. Appetitive and aversive reinforcement schedule effects on behavior: A systematic replication. Basic and Applied Social Psychology, 1982, 3(11), 39-52.

Ray, R.L. and Emurian, H.H. Sustained blood pressure responding during synthetic work. Psychological Record, 1982, 32(1), 19-27.

Ray, R.L., Wurster, R.M., and Emurian, H.H TMSGN: A program for testing trend against a non-random alternative. Behavior Research Methods and Instrumentation, 1982. 14(3), 355-356.

Ray, R.L. and Emurian, H.H. Repeated elicitation of the blood pressure response. Physiological Psychology, 1982, 10(3), 321-324.

Emurian, H.H., Brady, J.V., Ray, R.L., Meyerhoff, J.L., and Mougey, E.H. Experimental analysis of team performance. Naval Research Reviews, 1984, 1, 3-19.

Brady, J.V. and Emurian, H.H. Experimental studies of small groups in programmed environments. Journal of the Washington Academy of Sciences. 1983, 73(1), 1-15.

Emurian, H.H. and Brady, J.V. Small groups in programmed environments: Behavioral and biological interactions. The Pavlovian Journal of Biological Sciences. 1983, 18(4), 199-210.

Ray, R.L., Brady, J.V., and Emurian, H.H. Cardiovascular effects of noise during complex task performance. International Jounral of Psychophysiology, 1984, 1, 335-340.

Ray, R.L. and Emurian, H.H. Cardiovascular responses to synthetic work: Subtask interactions. International Journal of Psychophysiology, submitted.

Emurian, H.H., Emurian, C.S., and Brady, J.V. Positive and negative reinforcement effects on behavior in a three-person microsociety. Journal of the Experimental Analysis of Behavior, in press.

Emurian, H.H and Brady, J.V. Small group performance and the effects of contingency management in a programmed environment: Final report. JSAS Catalog of Selected Documents in Psychology, 1982, 12, 38.

Emurian, H.H., Brady, J.V., Ray, R.L., Meyerhoff, J.L., and Mougey, E.H. Experimental analysis of team performance: Methodological developments and research results. Psychological Documents, 1983, 13(1), 15.

Emurian, H.H. and Brady, J.V. Behavior analysis of confined microsocieties in a programmed environment: Technical Report TR-ONR-7. Psychological Documents. 1983, 13(2), 32.

Emurian, H.H., Brady, J.V., Meyerhoff, J.L., and Mougey, E.H. Technical Report TR-ONR-9: Positive and negative reinforcement effects on behavior in a three-person microsociety. Psychological Documents, 1984, 14(1).

Emurian, H.H., Brady, J.V., Ray, R.L., Meyerhoff, J.L., and Mougey, E.H. Technical Report TR-ONR-10: Behavioral and biological effects of changes in group size and membership. Psychological Documents, 1984, 14(2).

Emurian, H.H.. Brady, J.V., Meyerhoff, J.L., and Mougey, E.H. Testosterone responses to a change in group composition and size. Presented at the annual convention of the Eastern Psychological Association, Baltimore, MD, 1982.

Ray, R.L. and Emurian, H.H. Elicitation of tonic blood pressure responding with a synthetic work task. Presented at the annual convention of The Pavlovian Society, 1982.

Ray, R.L. and Emurian, H.H. Cardiovascular effects of sustained noise during task performance. Presented at the annual convention of the Eastern Psychological Association, Philadelphia, PA, 1983.

Emurian, H.H. and Ray, R.L. Effects of membership replacement on team performance. Presented at the annual convention of the Eastern Psychological Association, Philadelphia, PA, 1983.

Emurian, H.H., Brady, J.V., and Ray, R.L. Effects of membership replacement on team performance. Presented at the annual convention of the Eastern Psychological Association, Baltimore, MD, 1984.

Emurian, H.H. and Brady, J.V. Design of microsocieties for space-based habitats. Presented at the annual convention of the Aerospace Medical Association. San Diego, CA, 1984.

Emurian, H.H. and Brady, J.V. Analysis of confined microsocieties: By-products of aversive control. Presented at the annual convention of the Pavlovian Society, Moscow, USSR, 1984.

Emurian. H.H.. Ray, R.L., and Brady, J.V. Human productivity in confined microsocieties: effects of replacing a crew member. Accepted for presentation at the annual convention of the Aerospace Medical Association, Dallas, TX, 1985.

Emurian, H.H., Emurian, C.S., and Brady, J.V. Positive and negative reinforcement effects on behavior in a three-person microsociety. Accepted for presentation at the annual convention of the Eastern Psychological Association, Boston, MASS, 1985.

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