*THE EFFECTS OF A COOPERATION CONTINGENCY
ON BEHAVIOR IN A CONTINUOUS
THREE-PERSON ENVIRONMENT¹*

HENRY H. EMURIAN, CLEEVE S. EMURIAN,
GEORGE E. BIGELOW, AND JOSEPH V. BRADY

THE JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

Five groups of three subjects resided for 10 or 15 days within a continuously programmed environment. Subjects followed a programmatic arrangement of required and optional private and social activities that determined the individual and group baseline behaviors into which experimental operations were introduced and withdrawn. A cooperation condition was in effect when all three subjects were required to select simultaneous access to a group area before it became available for use. A noncooperation condition was in effect when access to a group area could be selected by individual subjects, without regard to the other subjects' selections. For all groups, the effects of these two conditions on individual and group behaviors were investigated in reversal designs where several successive days occurred under each condition. Groups 1, 4, and 5 had the noncooperation condition interposed between cooperation conditions. Groups 2 and 3 had the cooperation condition interposed between noncooperation conditions. Durations of triadic activities, per cent of time in triadic activities, intercom use, and intersubject program synchronization were greater during cooperation conditions than during noncooperation conditions. These data show that a cooperation contingency within the behavioral program affected both social behavior and the collateral individual behavior necessary to execute the cooperation response.

Key words: cooperation contingency, social behavior, behavioral program, continuously programmed environment, social systems, humans

Findley (1966) suggested the scientific merits of subjecting human multi-operant individual and social repertoires to study within a continuously programmed environment, and he documented a single subject's residence within such a setting throughout a five-month period. During that period, resources were provided for a comprehensive range of work and recreation tasks, but access to them was restricted by design features of the environment. For example, electronic locks prevented free access

to drawers and cabinets containing materials for various tasks. Resources were provided according to a behavioral program that determined the sequences of their availability. Required and optional activity sequences were presented; more desirable activities followed less desirable ones; and a greater number of options occurred late in the sequence. Requirements for one activity had to be completed before the next became available. These procedures successfully supported the subject's behavior, and they provided measures of component properties of a complex individual repertoire.

A continuously programmed environment containing separate rooms for individual and social activities recently has been completed (Brady, Bigelow, Emurian, and Williams, 1975). A behavioral program incorporating both individual and social activities has been evaluated for a pair of subjects throughout a 10-day period (Emurian, Bigelow, Brady, and Emurian, 1975). In that program, a "forced cooperation" contingency (Hake and Vukelich, 1972) governed access to either of two social activities that occurred within separate

¹The authors gratefully acknowledge the assistance of Florence R. Schmier and Jerry Locklee who participated in all phases of the research. Recognition is also extended to the following individuals who contributed to the experiments: Peter S. Bigham, Janet R. Brice, Leonard Daley, Christopher J. Danielewski, Cheryl A. Davis, Murray A. Friedman, Charles H. Gaskins, Jr., Robn Hargrove, Lisa Richenbach, Anthony F. Rock, Margaret C. Ross, and Sandra Rossie. The laboratory facility was designed in collaboration with D. Michael Williams and Jack D. Findley. This investigation was supported by grant No. NGR 21-001-111 to Joseph V. Brady from the National Aeronautics and Space Administration. Reprints may be obtained from Henry H. Emurian, The Johns Hopkins University School of Medicine, Phipps Clinic 261, 601 N. Broadway, Baltimore, Maryland 21205.

group areas. That is, entrance to a group area was permitted only after *both* subjects had arrived at the proper location in the behavioral program and had selected the corresponding social activity from among individual options. This cooperation contingency within the behavioral program appeared to influence individual behavior that preceded a social activity. An intercom was used to monitor one another's location in the program and to plan the social activity to be selected. When subjects had decided to select a particular social activity, they would pace their individual activities in synchrony to arrive at the social option at approximately the same time. If one subject arrived at the social option early, he would have to wait for the other to catch up before entrance to the group area was permitted. The occurrence of such individual behavior that regularly preceded the selection of a social activity seems sufficiently robust to warrant experimental evaluation of similar cooperation contingencies on individual and group behaviors under controlled laboratory conditions.

The present experiment investigated the effects of a cooperation contingency on the behavior of small groups of human volunteers. Throughout extended residencies by five groups of three subjects within a continuously

programmed environment, multi-operant baseline states of individual and social performances were generated and sustained by behavioral programming procedures. A cooperation condition was in effect when all three subjects were required to select one of two social activities before the corresponding group area could be entered simultaneously. In contrast, a noncooperation condition was in effect when entrance to a group area was permitted to individual subjects, without regard to the other subjects' activity selections. The study investigated the effects of these two program conditions on individual and group behaviors.

METHOD

Subjects

Five groups of three male subjects were recruited from local college-student communities. Members comprising each group were acquainted, and 13 were enrolled in undergraduate programs. Each subject received psychometric and interview assessment by a staff psychiatrist before being accepted. Subjects were informed that they would each receive \$5 per day if an experiment were terminated prematurely by their choice and \$25 per day if all three subjects completed the period agreed on beforehand.

Fig. 1. Schematic diagram of the programmed environment.

Apparatus

As displayed in Figure 1, the programmed environment was composed of three private living rooms, a recreation room, a workshop, and a hall joining the rooms. The unlabelled area at the recreation end of the hall is a "transition cube" through which subjects progressed one at a time as they entered or left the recreation room or workshop. Each private room was similar to a small efficiency apartment containing kitchen, bed, bathroom, desk, and other furnishings. The recreation room contained table, chairs, and sofas. A complete kitchen facility was located there, and a storage cabinet contained solitary, dyadic, and triadic games. Meals were delivered through a cabinet accessible from the periphery of the environment. The workshop contained washer and dryer, workbench, tools, and storage compartments for hobby projects and supplies. A common bath served the recreation room and the workshop. A clock was present in each room.

An intercom for intersubject communications was mounted on a work panel in each private room. No communications were exchanged between subjects and experimenters, other than an occasional written message presented in a drawer that informed subjects of an equipment problem.

Resources in the private rooms for individual tasks were electronically locked in various storage compartments and were made available by remote control according to the behavioral program. Remotely controlled door locks regulated subject movement between rooms within the environment, but each room contained an unlocked emergency exit that a subject could use at any time to terminate the experiment. Except for certain private spaces, all rooms were under continuous audio and video surveillance.

The design and operational characteristics of this environment are described in detail elsewhere (Bigelow, Emurian, and Brady, 1975; Brady *et al.*, 1975).

²Throughout the period of residence for Group 2, an additional pleasure-reading activity was available as an option in the last column of optional activities, and the RD activity required completing a fixed number of programmed instruction frames. All other conditions were identical to the behavioral program described below.

Behavioral Program

Figure 2 presents a diagrammatic representation of the behavioral program governing the sequential and contingent relationships of activities. This program was employed throughout the series of five experiments, although one group experienced a slightly modified version.² Each box within the diagram represents a distinct behavioral unit and response requirement. Subjects progressed through the program sequentially from left to right. This progression involved program branches composed of a fixed activity sequence and optional activity sequences. Regardless of the sequence selected, the diagram indicates that all behavioral units were scheduled on a contingent basis such that access to a succeeding activity demanded satisfaction of the requirements for the preceding unit.

Beginning at the far left, the fixed activity sequence was composed of all activities between and including Health Check (H_v) and Food One (FD1). The Health Check activity required the subject to determine his temperature, pulse, and weight, and to fill out subjective status questionnaires. He then completed the following activities in the order displayed: Physical Exercise (PE), requiring 300 correct responses on an automated exercise task; Toilet Operations (TO), providing access to the private-room bathroom and drawers containing towels, toiletries, and a vacuum cleaner; Autogenic Behavior (AB), in which the subject followed taped relaxation instructions; and Food One (FD1), in which the subject was permitted to select two items from a presented list of 10 light foods such as coffee, tea, soup, cereal, *etc.*

When Food One was completed, the subject was eligible to select *one* of the following two activities: Arithmetic Problems (AP), requiring 100 correct solutions on a series of arithmetic problems presented on a cathode-ray display screen and keyboard; and Sleep (SLP), providing access to the bed for an unlimited time period of at least 30 min. If the subject selected Sleep, he was required to return to the Health Check activity and the fixed activity sequence at the completion of Sleep. This minimum recycling sequence was designed to maintain and assess the subject's health if he were otherwise indisposed to engage in the broader selection of opportunities.

The optional activity sequence commenced with the choice of Arithmetic Problems instead of Sleep. At the completion of Arithmetic Problems, the subject was eligible to select one of the following two activities: Reading (RD), providing at least 30-min access to books contained within a drawer; and Work Two (WK2), in which the subject completed in private various problems, experiments, or assembly projects presented in a drawer. When

the selected activity was completed, the subject was eligible to select one of the following three activities: Puzzle Assembly (PA), requiring the subject to assemble a puzzle presented in a drawer; Manual Behavior (MB), providing at least 30-min access to art supplies contained in a drawer; and Requisition (REQ), allowing the subject to press a lever to earn at least one but not more than 20 points exchangeable for treats, such as soft drinks and

INVENTORY OF ACTIVITIES

NOTATION	FULL NAME	BRIEF DESCRIPTION
H/	HEALTH CHECK	TEMPERATURE, PULSE, WEIGHT, STATUS REPORT
PE	PHYSICAL EXERCISE	300 CORRECT PRESSES ON AUTOMATED TASK
TO	TOILET OPERATIONS	USE OF PRIVATE BATHROOM AND CONTENTS OF DRAWER CONTAINING TOILETRIES, CLEAN CLOTHING
AB	AUTOGENIC BEHAVIOR	RELAXATION EXERCISES ON TAPE
FD1	FOOD ONE	TWO SELECTIONS FROM A LIST OF LIGHT FOODS
SLP	SLEEP	UNLIMITED USE OF BED
AP	ARITHMETIC PROBLEMS	100 CORRECT SOLUTIONS OF ARITHMETIC PROBLEMS
RD	READING	ACCESS TO BOOK
WK2	WORK TWO	PROBLEMS, EXPERIMENTS, ASSEMBLY PROJECTS
PA	PUZZLE ASSEMBLY	ASSEMBLE A PUZZLE
MB	MANUAL BEHAVIOR	ACCESS TO ART MATERIALS
REQ	REQUISITION	EARN DELAYED DELIVERY OF TREATS OR REPLENISHMENT OF CONSUMABLES
WK3	WORK THREE	SOCIAL, ACCESS TO COMMUNAL WORKSHOP
FD2	FOOD TWO	PRIVATE MAJOR MEAL
FD3	FOOD THREE	SOCIAL, MAJOR MEAL IN RECREATION ROOM, GAMES
MU	MUSIC	5000 LEVER PRESSES TO EARN A CASSETTE TAPE
COM	COMMUNICATION	ACCESS TO INTERCOM
LTO	LIMITED TOILET OPERATIONS	ACCESS TO ESSENTIAL TOILET FACILITIES
CON B	CONDITION B	CHANGE IN PROGRAM CONDITION

Fig. 2. Diagrammatic representation of the behavioral program governing the sequential and contingent relationships of activities.

pastries, or for consumables, such as soap and toothpaste. On completion of the selected activity, the subject was eligible to select one of the following four activities: Work Three (WK3), providing at least 30 min in the workshop by one, two, or three subjects or only by all three subjects together, depending on the program condition to be described, to complete assembly projects and maintenance chores; Food Two (FD2), requiring at least 30 min and providing the subject with a major meal to consume in the private room; Food Three (FD3), providing at least 30 min in the recreation room by one, two, or three subjects or only by all three subjects together, depending on the program condition to be described, to consume a major meal and to play games; and Music (MU), allowing the subject to press a lever to earn a cassette tape that could be played at any time. Once a subject had completed his choice among those four activities, he returned to Health Check and resumed the fixed activity, indicated by the dotted line. The optional activity sequence allowed the subject flexibility in the selection and arrangement of activities, both individual and social.

At the bottom of the diagram are two activities with more general rules. The Limited Toilet Operations (LTO) activity, which allowed access to essential toilet facilities, was the only activity that could be selected at any time. The Communication (COM) activity allowed access to the intercom for intersubject communications. A subject was permitted to use the intercom to initiate or answer a communication only if he were between any two program activities. Although the Communication activity was available between any activities, an actual conversation required at least two subjects' simultaneous presence within the Communication activity. Conversing subjects, however, whether in pairs or all three at once, could be located at different sequential positions within the behavioral program. For example, a Communication and conversation might have occurred when one subject was between Autogenic Behavior and Food One, and another subject was between Manual Behavior and the last column of activities, and so on.

Activity Selection

Each activity within the behavioral program had a card portraying an abbreviated

activity notation that a subject was required to display whenever that activity was selected. These cards were stored within a small file box on the desk in each private room. To select an activity, a subject displayed the card corresponding to that activity on a hook mounted on a bed cabinet. When an activity card was displayed, environmental events and response requirements related to that activity were in effect. Only one card was displayed on the hook at a time, with the exception of the LTO card. When a subject selected Limited Toilet Operations, he hung that card over whatever activity card was currently displayed. The LTO card was removed when the subject completed Limited Toilet Operations and returned to the activity in which he was previously engaged. Whenever a subject displayed a new activity card, he was required to return the previously displayed card to the file. An activity card was always displayed, and it was readily visible on a closed-circuit television monitor.

The CON B notation at the bottom of the diagram refers to a program change that determined rules of access to FD3 and WK3. If an experiment began with FD3 and WK3 instructions stipulating that all three subjects were required to select the respective activity together before they could enter the corresponding group area, a change in condition to CON B allowed FD3 and WK3 to be selected singly, without regard to the other subjects' selections. Conversely, if an experiment began with FD3 and WK3 instructions stipulating that the respective activity could be selected singly, without regard to the other subjects' selections, a change in condition to CON B required all three subjects to select the respective activity together before they could enter the corresponding group area. CON B was signalled by a light on the private work panel, and subjects were required to respond to its illumination and extinction to ensure recognition of program condition changes.

A manual of instructions detailing the program and use of environmental resources was contained in each room of the environment. An error in following the behavioral program caused a 5-sec blackout.

Procedure

Subjects followed the behavioral program continuously throughout the periods of resi-

dence. Additionally, rules of access to FD3 and WK3 were varied to permit evaluation of the effects of a cooperation contingency on individual and group behaviors.

A cooperation condition (C) was in effect when either of two activities within group areas, *i.e.*, FD3 and WK3, was accessible only when all three subjects selected it together. For example, when all three FD3 or WK3 cards were finally displayed, subjects were permitted to leave their private rooms one at a time and to enter the respective group area. Typically, subjects would use the intercom several activities in advance to plan subsequent selection of a social activity. They would then pace their individual schedules accordingly to arrive at the choice point in the program at approximately the same time. Subjects almost always used the intercom immediately before displaying their FD3 or WK3 cards to ensure that their schedules and choices were synchronized. Under the cooperation condition, subjects were also required to leave the group area at the same time, returning to their private rooms one after another.

In contrast to the cooperation condition, a noncooperation condition (NC) was in effect when FD3 and WK3 were accessible singly, without regard to the other subjects' activity selections. For example, a single subject could display his FD3 or WK3 card at the choice point. He could then leave his private room immediately and enter the chosen group area, even though the other subjects were engaged in private activities. Of course, the other subjects could also have access to the same group area at the same time, but they were not required to enter and leave together.

For Groups 1 through 5, these two conditions were investigated in the following order and number of successive days under each condition, respectively: C-NC-C (days: 4,3,3), NC-C-NC (days: 5,5,5), NC-C-NC (days: 4,3,3), C-NC-C (days: 4,3,3), and C-NC-C (days: 4,3,3).

Pairs of research assistants monitored the experimental environment continuously with audio and video equipment located, with the subject's awareness, in each room of the environment. When a subject displayed an activity card, an assistant recorded its time of presentation by writing the activity abbreviation on a prepared data form divided into 30, 1-min segments for each subject and labelled according to the time of day. Assistants also

manually activated electromechanical devices and minicomputers controlling resources and tasks associated with respective activities, and they delivered materials to the subjects through two-way drawers when necessary.

A time-sampling procedure was employed to detect occurrence of social interactions during triadic episodes, when all three subjects occupied either the recreation room (FD3) or the workshop (WK3), for Groups 3, 4, and 5. During triadic FD3 and WK3 episodes, 10-sec observational samples occurred on a variable-interval schedule averaging 8 min between samples. During each 10-sec sample, each subject was rated independently on a yes/no dichotomization reflecting the presence or absence of a social interaction. A subject was rated as having exhibited a social interaction if he engaged in any of the following four behaviors: (1) any vocal utterance, (2) participation in social games, (3) physical contact with another subject, or (4) handing materials between subjects. Measures of rater reliability were obtained for the records of Group 5.

RESULTS

Triadic activity durations. Table 1 presents mean durations per triadic FD3 and WK3 episodes, respectively, across successive program conditions for each group. With respect to FD3 durations, mean durations were less during noncooperation (NC) conditions than during cooperation (C) conditions except for an extended mean FD3 observed during the first NC condition for Group 2. Group 4 was the only group that engaged in triadic WK3 episodes during each consecutive program condition. For Group 4, mean duration of WK3 was less during the NC condition in comparison to the preceding and succeeding C-condition

Table 1
Mean Durations of Triadic Episodes (hours)

Group	FD3 Conditions ^a				WK3 Conditions ^a			
	C	NC	C	NC	C	NC	C	NC
1	3.2	2.3	5.4	—	2.6	none	3.6	—
2	—	4.8	4.6	1.2	—	none	1.4	none
3	—	4.2	5.8	4.5	—	1.8	2.3	none
4	4.7	2.7	3.4	—	2.8	1.3	1.9	—
5	3.6	1.3	5.8	—	2.2	0.4	none	—

^aC = cooperation condition, NC = noncooperation condition.

means. For Groups 3 and 5, where only one comparison between C and NC conditions was available, mean WK3 durations were less during the NC conditions than during the corresponding C conditions. These data for FD3 and WK3 durations indicate the strength of the cooperation contingency in producing relatively extended triadic episodes when the advantages to the group of access to the group areas required the simultaneous presence of all three subjects.

Triadic time. Table 2 presents per cent of total time within successive program conditions that subjects in each group were engaged in combined triadic FD3 and WK3 episodes. Per cent times were less during NC conditions than during corresponding C conditions except for the first NC condition for Group 3. These data reveal a more general effect of the cooperation contingency on triadic episodes than that revealed by the increases in their mean durations. In effect, enhanced triadic durations observed during C conditions were not compensated by an overall decline in time spent in triadic activities.

Intercom use. Table 3 presents mean daily intercom selections across successive program conditions for all subjects in each group. A comparison of subjects' difference scores, where difference = $C - (NC + NC)/2$, or $[(C + C)/2] - NC$ depending on the group (Cochran and Cox, 1957), with zeros revealed a significant effect of program condition on intercom frequency ($t = 4.94$, $df = 14$, $p < 0.001$). In effect, the Communication activity was selected significantly more frequently during C conditions than during NC conditions.

Intersubject program synchronization. Intersubject program synchronization was determined from the following time periods combined: (1) the total time that subjects were

Table 3
Mean Daily Intercom Selections

Sub- ject	Conditions*			
	C	NC	C	NC
GROUP 1				
1	9.3	5.7	6.0	—
2	5.5	0.3	2.7	—
3	9.3	5.0	5.3	—
GROUP 2				
1	—	4.0	3.4	2.2
2	—	2.4	2.2	0.8
3	—	2.8	2.4	2.0
GROUP 3				
1	—	4.0	8.3	2.3
2	—	3.8	8.0	3.7
3	—	3.5	5.3	2.3
GROUP 4				
1	6.5	1.7	5.0	—
2	5.8	3.3	4.7	—
3	5.8	2.0	4.0	—
GROUP 5				
1	2.5	1.0	1.3	—
2	2.5	1.7	1.3	—
3	2.5	1.3	1.7	—

*C = cooperation condition, NC = noncooperation condition.

simultaneously engaged in identical individual activities, (2) the total time that subjects were engaged in triadic episodes, and (3) the total time that subjects were simultaneously engaged in different individual activities within the same column of optional activities. Expressed as a per cent of total time within successive program conditions, this measure indicates the extent to which subjects were engaged in activities within the same sequential position in the behavioral program, and accordingly provides an index of the degree to which subjects' performance schedules were synchronized.

Table 4 presents per cent of total time within successive program conditions in inter-

Table 2
Per Cent of Time in Triadic Episodes

Group	Conditions*			
	C	NC	C	NC
1	25.8	12.5	34.9	—
2	—	4.0	8.8	1.9
3	—	21.2	17.9	14.1
4	28.2	13.1	21.4	—
5	19.8	5.8	24.2	—

*C = cooperation condition, NC = noncooperation condition.

Table 4
Per cent of time in intersubject program synchronization.

Group	Conditions*			
	C	NC	C	NC
1	55.5	18.6	47.4	—
2	—	24.4	27.9	20.0
3	—	35.5	48.7	54.6
4	73.8	45.7	67.8	—
5	64.6	49.3	70.8	—

*C = cooperation condition, NC = noncooperation condition.

Fig. 3. Per cent of total time within noncooperation (NC) conditions that all subjects in each group spent in triadic and dyadic episodes totalled across FD3 and WK3 activities. Where two NC conditions occurred for Groups 2 and 3, data have been combined across conditions.

subject program synchronization for each group. Within each group, program synchrony was greater during C conditions than during NC conditions except for the second NC condition for Group 3.

Group fragmentation measures. Figure 3 presents per cent of total time within NC conditions that all subjects in each group spent in triadic and dyadic episodes totalled across FD3 and WK3 activities. Where two NC conditions occurred for Groups 2 and 3, data have been combined across conditions. This figure indicates that all subjects in each group occupied the group areas (FD3 and WK3) for time periods in excess of those devoted to triadic episodes. Because direct triadic episodes did not exclusively determine group area use when they were otherwise potentially available, and because such use in dyadic form reflects subjects' disposition to select activities other than triadic episodes, this effect is considered to be an operational index of group fragmentation.

Social interaction measures. Table 5 presents proportions of observational samples, totalled for triadic FD3 episodes within successive program conditions, where a social interaction was recorded for each subject in Groups 3, 4, and 5. Too few triadic WK3 episodes occurred across conditions to warrant a similar presentation for that activity. A comparison of subjects' difference scores between condition proportions with zeros revealed no effect of program condition on proportion of samples where a social interaction was recorded ($t = 0.47$, $df = 8$, $p > 0.50$). Since mean durations of triadic FD3 episodes were greater during C conditions than during NC conditions, these data suggest that social interac-

tions continued to occur throughout those extended C-condition triadic FD3 episodes. Finally, for Group 5, where two monitors made independent judgements of social interactions during sampling periods, proportions of total samples that showed agreement between monitors for Subjects 1, 2, and 3 were 0.91, 0.90, and 0.89, respectively.

Solitary, dyadic, and triadic games were provided in the recreation room. Observations of the subjects during triadic FD3 episodes across conditions suggest that most of their time together in the recreation room was occupied by playing games as a group, although all other behaviors tallied as a social interaction were also observed.

Total social time. During the noncooperation conditions, time spent in triadic episodes combined with time spent in dyadic episodes

Table 5

Proportion of samples where social interactions occurred during triadic FD3 episodes.

Sub- ject	Conditions ^a			
	C	NC	C	NC
GROUP 3				
1	—	0.842	0.854	0.838
2	—	0.883	0.878	0.897
3	—	0.783	0.805	0.779
GROUP 4				
1	0.774	0.834	0.609	—
2	0.788	0.750	0.731	—
3	0.688	0.750	0.475	—
GROUP 5				
1	0.634	0.654	0.420	—
2	0.653	0.615	0.420	—
3	0.703	0.269	0.375	—

^aC = cooperation condition, NC = noncooperation condition.

yields a measure of total social time for each subject. During the cooperation conditions, total social time necessarily is time spent within triadic activities, because subject pairing could not occur in the group areas. No consistent trend was observed when total social time was compared between C and NC conditions in respective groups. A comparison of subjects' difference scores between condition means with zeros revealed no difference between *triadic time* during C conditions and *triadic plus dyadic time* during NC conditions ($t = 1.79$, $df = 14$, $p > 0.10$). In effect then, total social time was not differentially influenced by the C and NC program conditions.

Additional observations. Several measures of individual performance are presented that are based on means within successive program conditions. The mean wake duration for all subjects was 13.8 hr (range: 9.5 to 18.9 hr). Mean sleep duration was 9.6 hr (range: 6.1 to 12.5 hr). On the Physical Exercise task, errors progressively declined over trials. On the Arithmetic Problems task, error frequency was stable, but the latencies of correct answers progressively decreased over trials.

DISCUSSION

A continuously programmed environment provided the physical setting where control of a multi-operant individual and group repertoire was accomplished with a behavioral program. Experimental operations introduced into the resulting baseline behaviors revealed systematic changes in group area use, intercom frequencies, and intersubject program synchronization. These results show that a forced cooperation contingency within the behavioral program affected social behavior as well as collateral individual behavior necessary to execute the cooperation response.

Enhanced levels of intersubject program synchronization observed during cooperation conditions reflect subjects' correspondence in temporal pacing of individual activities during those conditions. Temporally similar pacing of individual activities was necessary to maintain synchrony for potential access to the group areas during cooperation conditions, and its occurrence suggests the strength of the group areas and extended triadic social episodes as reinforcers for synchronization of individual performance schedules. Finally, en-

hanced levels of program synchronization observed during cooperation conditions suggest the importance of the cooperation activity opportunities as the mechanism by which drift in individual performance schedules was prevented.

Because group area use was contingent on mutual subject agreement to select a social activity during cooperation conditions, intercom communications were essential to arrange subsequent triadic episodes. Changes in intercom frequencies across conditions reflect the necessity for group members to probe each others' status in the behavioral program during cooperation conditions to maintain synchrony and to arrange mutual selection of a social activity. Finally, the enhanced frequency of intercom probes during cooperation conditions further indicates the strength of the group areas and extended triadic social episodes as reinforcers.

Enhanced levels of intersubject program synchronization and intercom frequencies were accompanied by similar changes in the magnitude of triadic episodes during the cooperation conditions. Not only the per cent of total time spent in triadic social activities, but the durations of triadic episodes were significantly increased when the cooperation contingency was in effect. This latter effect upon the *durations* of triadic episodes combined with corresponding social interaction measures suggests a potentially important consequence of cooperation contingencies in maintaining more durable social interactions when continued access to the group areas accrued primarily as a result of the *frequency* of social interactions.

Cooperation contingency effects on triadic durations would seem to be of particular significance when considered in light of group fragmentation effects observed during noncooperation conditions. For Groups 1, 2, and 3, dyadic combinations presented in Figure 3 graphically show two "high-pairing" subjects, whose dyadic times are similar and elevated, in contrast to the remaining "low-pairing" subject, whose dyadic time is comparatively low. These relationships are weaker in Groups 4 and 5 where Subjects 3 and 2, respectively, exhibit the least amount of dyadic time, and high-pairing subjects are not as conspicuous as in other groups. Taken together, however, the distributions of dyadic per cent times into

two high-pairing and one low-pairing subjects within most groups suggest the development of a two-man in-group and a relative social isolate during the noncooperation conditions. More importantly perhaps, the data in Tables 1 and 5, when taken together with the data presented in Figure 3, indicate that a potential isolate or "social fragmentor" could be maintained within the group for significantly longer and potentially productive time periods during cooperation conditions than during noncooperation conditions, which consistently showed lower triadic durations.

In addition to revealing the effects of a specific experimental operation on individual and group behaviors, the procedures of the present investigation extend the generality of fundamental behavioral technologies and methodologies to the experimental analysis of small-scale human social systems. A behavioral program was adopted deliberately to create individual and group behaviors that could be measured with precision and regularity over time. The fact that notable performance disruption was infrequently observed, waking and sleeping patterns were not disturbed, no subject aborted an experiment prematurely, and complex individual performance progressively improved over time indicate that the present behavioral program sustained human performance under conditions of isola-

tion and confinement with no evidence of severe stress.

REFERENCES

- Bigelow, G. E., Emurian, H. H., and Brady, J. V. A programmed environment for the experimental analysis of individual and small-group behavior. In C. G. Miles (Ed.) *Experimentation in controlled environments and its implications for economic behavior and social policy-making*. Addiction Research Foundation, Toronto, Canada, 1975.
- Brady, J. V., Bigelow, G. E., Emurian, H. H., and Williams, D. M. Design of a programmed environment for the experimental analysis of social behavior. In D. H. Carson (Ed.) *Man-environment interactions: evaluations and applications. 7: Social Ecology*. Milwaukee, Wisconsin: Environmental Design Research Association, Inc., 1975. Pp. 187-208.
- Cochran, W. G. and Cox, G. M. *Experimental design*. New York: John Wiley and Sons, 1957.
- Emurian, H. H., Bigelow, G. E., Brady, J. V., and Emurian, C. S. Small-group performance maintenance in a continuously programmed environment. *JSAS Catalog of Selected Documents in Psychology*, 1975, 5, 187.
- Findley, J. D. Programmed environments for the experimental analysis of human behavior. In W. K. Honig (Ed.), *Operant behavior: areas of research and application*. New York: Appleton-Century-Crofts, 1966. Pp. 827-848.
- Hake, D. F. and Vukelich, R. A. A classification and review of cooperation procedures. *Journal of the Experimental Analysis of Behavior*, 1972, 18, 333-343.

Received 16 June 1975.

(Final Acceptance 12 December 1975.)