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A Context for Science with a Commitment to Behavior Change

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TABLE OF CONTENTS

Behavior Analysis In The Space Age

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Fifty years ago in the mid-1950's, the first behavior analysis laboratory primates participated in the earliest National Aeronautics and Space Administration (NASA) animal pretest flights for Project Mercury. The successful in-flight performances of the chimpanzees Ham and Enos set the stage for the historic spaceflight accomplishments of Astronauts Alan Sheppard and John Glenn. Preparation of the animals for spaceflight involved living continuously in research chambers and obtaining all their sustenance as components of a scheduled program that provided for the study of more complete repertoires of behavior and the methodological rationale for combining the conceptual framework of an experimental analysis with the naturalistic goals of ethological observation. Extensions of the continuously programmed environment methodology to human studies followed the animal pretest flights of Project Mercury and NASA's commitment to a human presence in extraterrestrial environments. Over the past several decades, a range of behavior analysis investigative initiatives including experimental studies of social contingencies, motivational processes, and work productivity, among others have used the continuously programmed environment approach. In addition, an experimental study of human crewmember behavioral performance before, during, and after spaceflight was completed and published in the Journal for the Experimental Analysis of Behavior during the early years of the present 21st Century. The current focus on long-duration expeditionary missions beyond Earth orbit present new challenges and exciting opportunities for both experimental and applied behavior analysis.
Keywords*:* primates, NASA, spaceflight, Project Mercury, continuously programmed environment, JEAB, experimental and applied behavior analysis

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Introduction

The year 2006 marks the 50th anniversary of the earliest space flight research initiatives with living organisms and the first behavior analysis laboratory invitation to participate in the animal pretest flight of the United States space program. There was, at this early date, a rumor abroad that the Soviet Union was planning to initiate the Russian Sputnik spaceflight program by launching a dog and the U.S. Army Ballistic Missile Agency was to prepare a 'one-ups-manship' response with a monkey. And indeed, the Russian Sputnik II experiment with the dog Laika in 1956 did provide the first live organism activity data telemetered from space. Failure of the life support system however, made it impossible for the animal to survive more than a few days of the extended 5-month orbital expedition (Dickson, 2001).

Early Primate Spaceflight Experiments

It was these mid-1950 events that set the occasion for the first two Sidman-avoidance-trained primates, Able and Baker, to initiate the U.S. 'live organism' spaceflight program launched in the nose-cone of a rocket (**FIGURE 1, APPENDIX**). It is of some significance that these early behavioral experiments occurred several years before the National Aeronautics and Space Administration (NASA) actually came into existence in 1960. This first U.S. suborbital space flight with the monkeys was undertaken on the initiative of Dr. Wernher von Braun of the U.S. Army Ballistic Missile Agency in collaboration with the Experimental Analysis of Behavior Laboratories at the Walter Reed Army Medical Center (Brady, 1990; 2005). Not only did the two rhesus monkeys endure launch in their insulated restraining couches (**FIGURE 2, APPENDIX**) and meet the pre-launch avoidance performance training requirements before experiencing the 300+mile trajectory at speeds approximating 10,000 miles per hour, but they survived reentry as well with no compromise of either their behavioral or physiological integrity (**FIGURE 3,APPENDIX**).

Animal Pretest Flights for 'Project Mercury'

The early contribution of experimental analysis of behavior to the study of spaceflight effects was perhaps most prominently represented in the NASA formally designated animal pretest flights for Project Mercury. These were the space flight experiments with the chimpanzees Ham and Enos that preceded Astronauts Alan Sheppard and John Glenn in the early 1960's following the establishment of the National Aeronautics and Space Administration (NASA). Responsibility for these animal pretest flights was relegated to the military services of the Department of Defense since had few resources available for such an undertaking at this early stage of its existence. At the early planning meetings, it was readily apparent that both the Navy and the Air Force were enthusiastically receptive to the prospect of participating and indeed 'taking charge' of this obviously futuristic initiative. It was agreed however, that behavioral performance measures would be essential in these animal pretest flights and the behavior analysis laboratory at the Army's Walter Reed Medical Center was the only Defense Department facility with an established record of successful animal space flight with the Able and Baker experiments of the late 1950's. Moreover, it was decided, with strong input from the White House, that the organism of choice for these animal pretest flights would be the chimpanzee (**FIGURE 4, APPENDIX**) – phylogenetic closeness and physical resemblance to the human astronaut successors ruled – and the Walter Reed group through its collaborative interactions with the Institutes for Behavior Research (IBR) at the University of Maryland was one of the few facilities with experienced behavior analysts (Charles Ferster and Jack Findley) in the 'large primate' domain!

At a specially constructed chimpanzee training facility provided by the United States Air Force in New Mexico, the soon-to-be-famous 'space chimps' Ham and Enos, spent the better part of a year with behavior analysts from Walter Reed and from the Institutes for Behavior Research of the University of Maryland College Park campus mastering a 'matching-to-sample' performance on a work panel. The panel was mounted within an insulated couch (**FIGURE 5, APPENDIX**) secured for flight inside a Mercury space capsule propelled on a Saturn rocket launch vehicle. Ham and Enos returned safely from their space flights after an ocean 'splash-down' and brief helicopter ride to the deck of a recovery ship to make history as the American primates that provided the required behavior analysis pretests for Project Mercury. It was from the subsequent pioneering human suborbital and Earth-orbiting space flights however, that Alan Sheppard and John Glenn returned as heroes to 'ticker-tape parade' welcomes. And when the 'First Space Chimp' Ham died some 20 years later in the 1980's after surviving for two decades following what was at the time considered a dangerous and potentially lethal mission, his obituary in the New York Times (**FIGURE 6, APPENDIX**) provided ample testimony to the long and productive retirement he had enjoyed after his perilous 1961 adventure!

Ground-based Space Research

Despite what might have been expected on the basis of these early behavior analysis successes at the very beginning of the space age, the decades following John Glenn's historic Earth-orbiting space flight were characterized by the virtual absence of experiments on the behavioral effects of space flight in humans. It is perhaps not surprising that there was little enthusiasm on the part of the early astronauts selected predominantly from a military fighter and test pilot population to expose themselves to anything that appeared even remotely like performance testing. In their view, they 'had already passed the test' and had long since established their qualifications for the special 'flight pay' incentives provided. And indeed, it must be acknowledged that the range of biomedical; and behavioral challenges accompanying the increasing frequency and duration of space flight missions and human habitation in the space environment over that period were met with remarkable success, often under adverse if not aversive behavioral conditions. There were no documented behavioral problems of sufficient magnitude to compromise mission objectives for the late 1960's, early 1970's Apollo Moon Landings, the mid-1970's Skylab Orbiting Laboratory, the early to mid-1980's Shuttle Earth Orbits/Untethered Spacewalks, and the recurrent Shuttle/Space Station docking exchanges throughout the 1990's. Strong arguments for the apparent urgency to address the host of space behavior analysis research questions that remained unanswered 'in-flight' were difficult to make during this busy and demonstrably successful spaceflight era.

By the early 1960's however, the procedures that had been developed with non-human laboratory primates living continuously in research chambers and training for the Animal Pretest Flights for Spaceflight Project Mercury (Findley, 1962) were extended to ground-based research with human volunteer participants in response to the National Aeronautics and Space Administration commitment to human habitation in extraterrestrial environments (Brady, 1992). The first reported laboratory study (Findley, Migler and Brady, 1963) involved a single research volunteer participant who lived continuously in the residential programmed environment for the better part of 6 months (Findley, 1966). The single subject worked through a sequence of choices between activities that followed the branching patterns developed with the laboratory primates. The first part of the sequence was a fixed set of activities that monitored and maintained the participants health throughout the extended duration of the experiment. A series of choices among classes of activities including one of several psychomotor work tasks was followed by the availability of intellectual activity options such as reading. After selection, engagement and completion of an activity from any given class, a range of leisure activities (games, music, etc) became available. Completion of a selected leisure activity unit ended the cycle and the participant had to again complete the health check sequence. As programmed, a complete cycle lasted between 2 and 3 hours with intermittent 'food' options available and sleep functioning as an intermittent alternative to work activities. The residential laboratory was fully automated for both programming and recording of activities and no constraints were put on the participant's distribution of activity cycles and sleep periods.

It is important to recognize the clear continuity between the original behavior analysis procedures used with laboratory animals and space primate training on the one hand, and the single human volunteer participant in this seminal continuously programmed environment study. The cycles of human activities were modeled after the programmed sequences developed with the laboratory primates, and much of the success in both instances can be attributed to the structure it provided for the ongoing lives of the participants. In a very real sense, these continuously programmed procedures approximate a workable resolution of the ever-present conflict between ethological validity and the rigorous requirements of experimental research. Breaking down complex behavior sequences into component segments for analytic purposes is certainly not new or unique, but such fragmented experiments - and the theories they generate – seldom provide an adequate account of the richness and complexity of the behavior to which the results are generalized. The continuously programmed environment research strategy by contrast, synthesizes complex repertoires by contingencies on longer sequences of naturalistic performance activities rather than transplanting existing molar behaviors into a laboratory setting.

Continuously Programmed Laboratory Environments

The laboratory in which the NASA-supported ground research was conducted over the ensuing decades was designed as a residential programmed environment to simulate 'spaceflight crews' in 'confined microsociety' settings. The experimental facility accommodated small groups of 3 to 6 volunteer participants working thru structured sequences of choices between activity cycles while living continuously '24/7' for extended periods in the residential complex (**FIGURE 7, APPENDIX**). The laboratory consisted of five rooms connected by a common corridor. Three identical private rooms were similar to small efficiency apartments with kitchen (stove, refrigerator, sink, food preparation counter), bathroom facilities, bed, desk, chair and other incidental furnishings. The social area was equipped with tables, chairs, sofa beds, storage cabinets a complete kitchen and a range of exercise and recreational facilities. The workshop contained benches, stools, storage cabinets, tools and miscellaneous computerized work equipment. A common bathroom facility with a clothing washer and dryer was shared by the workshop and social area. Access to the exterior walls of the laboratory complex was provided by an encircling corridor between the experimental chambers and the exterior building shell to permit transfer of supplies through inner-wall draws and cabinets under automated program control (**FIGURE 8, APPENDIX**).

The performance repertoires were created on conceptual grounds to approximate behaviors involved in living outside the laboratory and the full range of the participants responses were recorded automatically This broad behavioral record allowed for the assessment of subtle or indirect effects upon performances not directly involved in contingencies. Continuous long-term residence in the laboratory provided additional control over irrelevant extraneous influences and extended duration of the assessment for both baseline performances and the effects of experimental interventions. In addition to the obvious enhancement of experimental control, the continuously programmed environment was more manageable in providing the required structured routine that were regarded critical in making it possible for volunteers to function productively over extended periods of experimental participation.

Computer systems located in a control center (**FIGURE 9, APPENDIX**) adjoining the residential facility provided for all experimental monitoring, programming, recording and data analysis. Video display terminals in each of the residential laboratory areas allowed for communication between volunteer experimental participants and 'control room' staff personnel. Exchanges among volunteer participants was facilitated when appropriate by telephone intercoms in the various laboratory areas equipped as well with audio and video monitors of each participant activities throughout the experiment. Private space around the bunk beds and the bathroom area however, were not observable by the control center monitors continuously 'on duty' whenever volunteer research participants were 'in residence'. In addition, a computerized observation program provided for continuous recording and categorization of each participant's behavior.

The initial small group studies carried out in the programmed environment laboratory were designed to evaluate and optimize the temporal, sequential, and contingent relationships that enhance habitability and performance productivity among simulated 'spaceflight crews' of over periods of continuous residence up to at least several weeks (Emurian, Emurian, Bigelow, & Brady, 1976; Emurian, Emurian, & Brady, 1978; Brady & Emurian, 1979). These initial experiments with three-person groups demonstrated convincingly that the baseline individual and social behaviors observed within the 'confined microsociety' were indeed sensitive to changes in environmental contingencies. The results of these studies showed clearly the practical feasibility of contingency management and measurement of complex individual and social behaviors in small isolated groups over extended intervals of continuous residence in a programmed environment. Explicitly programmed social contingencies were demonstratively effective in maintaining group cohesion and preventing performance deterioration under conditions of group fragmentation affecting individual performance productivity.

Subsequent studies addressed the motivational factors that affected the performance effectiveness and morale of small isolated groups in such 'confined microsocieties (Brady & Emurian, 1979; Emurian, Emurian & Brady, 1982). With groups of volunteer participants under aversive control (i.e. an avoidance schedule), changes in work performance were accompanied by idiosyncratic expressions of displeasure and aggression. Appetitive scheduling contingencies were shown to be free of such aversive control by-products even when the participant performances were characterized by extremely high work output. These early studies showed clearly that social interactions contributed importantly to the overall performance effectiveness status of the confined microsociety. Group participants were observed to interact socially under cooperative contingencies and appetitive performance schedules, and to withdraw from such interactions under pairing contingencies and avoidance performance schedules.

The studies that followed in the early 1980's were undertaken to analyze experimentally the effects on individual and group productivity of introducing into and subsequently withdrawing a novitiate participant from a stable two-person social system (Emurian, Brady, Meyerhoff & Mougey, 1983; Brady & Emurian, 1983). Two performance tasks were incorporated into the behavioral program and physiological measures of urinary androgens were monitored. The sensitivity of testosterone levels to changes in group composition were observed to be most pronounced in groups whose work routines and/or sleep/wake schedules were disrupted for some individual members of the group but remained stable for others in the group. Decreases in testosterone levels were associated with changes in group composition that occasioned shifts to less than optimal work and/or sleep schedules. Conversely, changes in group composition less disruptive of established sleep/work routines were generally associated with testosterone level increases. These findings extended the range of continuously programmed environment experimental capabilities to the multidimensional analysis of behavioral and biological interactions that determine the adaptations and adjustments of small groups in confined microsocieties. Subsequent studies, for example, confirmed the sensitivity of changes in hormonal levels to shifts in work and sleep schedules under conditions involving individual and group performance changes following replacement of members of an established group (Emurian, Brady, Meyerhoff, Ray & Mougey, 1984). Autocorrelational analyses of mean vocal utterance per minute for all participant pairs revealed alterations in communication patterns associated with crewmember replacement and suggest that such embedded inter-member speech measures may provide 'early warning signs' of interactive difficulties and compromised group operational effectiveness.

Confined Microsocieties and the Experimental Analysis of Motivational Processes

The special conditions of extended isolation and confinement in the course of anticipated long-duration spaceflight exploratory expeditions beyond Earth orbit will doubtless require the development of more refined behavior analytic procedures to maintain performance effectiveness and social habitability in such remote and progressively autonomous microsocieties. Conceptually, the experimental approach to the motivational processes associated with human productivity under such conditions appealed to natural behavioral dispositions as the basic determinant. In that regard, the laboratory studies directed attention to those 'intrinsically' valuable activities characterizing the ordinary human repertoire rather than conventional 'extrinsically' defined motivational reward processes. The experimental structuring and/or patterning of these 'intrinsic 'activities was designed to optimize autonomous individual productivity and cooperative crew interactions.

The experimental procedure developed for investigating the effects on work productivity of such intrinsically directed motivational interventions involved simulated spaceflight crews of three individuals each living continuously in the programmed environment laboratory over extended periods of 3 to 4 weeks and engaging in a range of behavioral interactions (Brady, Bernstein, Foltin and Nellis, 1988). Each day was divided into a work period and a social access /choice period. During the work period, each of the crewmembers remained alone in their individual room engaged in four designated and required work activities including two computer terminal monitoring tasks, a routine sorting task, and a repetitive manual operation.

The crewmembers were required to be engaged in one or another of these tasks during the entire work period but there were initially no constraints on decisions regarding task selection or duration of individual task engagement. During the social access/choice period each day, participants had access to individual activities of their own choosing (e.g. reading, games, music, etc.) as well as access to group interactions and activities in the common social areas of the residential laboratory.

The simulated spaceflight crews lived in the continuously programmed environment for periods up to a month with the crewmembers alone in their individual room for 6 hours per day and with access to the common social area that all subjects could use simultaneously for 9 hours per day. The first 7 days provided a non-restrictive baseline as the functional equivalent of a work place in which individuals were required to engage in the designated performance tasks. The percentage of time devoted to the individual work tasks during this initial baseline period was used to select responses for ensuing contingency conditions. This work-alone baseline was also compared with a baseline during the private sessions including both the work activities and the preferred activities brought into the residential laboratory environment by each crewmember. Under such conditions, the individual crewmembers spent little or no time on the synthetic work activities confirming that the work activities were without significant inherent value. The level of performance on the work activities did increase dramatically however, when the competing self-selected activities were no longer available. Such 'work-activities-alone' baselines were used to select activities for which there was a stable preference order with a high probability activity (i.e. % time in baseline) as the contingent response ("reward") and a low probability activity as the instrumental response required to gain access to the contingent activity.

The amount of time available for the contingent activity was a constant proportion of the time devoted to the instrumental performance with the proportionate relationship learned from experience with the contingency, not instructions. Performance on the instrumental response requirement turned off a red restriction light and gained access to the contingent response with the option of engaging in the contingent activity at several different times for short durations or using the time all at once (no 'limited hold'). There was no limit on the amount of time that could be accumulated for the contingent activity as long as the total time did not exceed the credit earned by instrumental performances. When the earned time was exhausted, the red restriction light reappeared and the instrumental performance was again required. These conditions were in effect for the 6-hour period beginning at 9;30 AM each morning in crewmembers individual activity areas.

The effects of the reinforcement contingencies were straightforward and consistent. Both the designated work activities (instrumental responses) and the 'rewarding' activities (contingent responses) were affected in the same way as highly valued self-selected activities. The amount of time devoted to the designated instrumental performances was greatly increased during the contingency periods. It is also significant that the simulated spaceflight crewmembers participating in this experiment consistently did more than the amount of instrumental work activity required to restore the restricted work activity so that their 'bank accounts' never went to zero. These results showed clearly that a time-based model of value applies equally well to both work-like performances and self-selected or preferred recreational activities. Moreover, the outcome of these studies generally confirmed the potential for application of this contingency management approach to the maintenance of required performance effectiveness and productivity requirements in the course of extended spaceflight exploratory missions beyond Earth orbit.

Spaceflight Experiments with Humans

As the turn of the century approached in the late 1990's, the fruits of our labor in the ground-based space research 'vineyard' had begun to yield behavior analytic methodologies for studying the performance of space-dwelling individuals and groups (Brady, 1990;1992) as well as brief computerized tests to examine a range of environmental effects on human behavior during space flight (Kelly, Taylor, Heishman & Couch, 1998). Under these circumstances, it was timely to revisit the spaceflight scene and take advantage of an opportunity to participate in a NASA 10-day space shuttle mission (STS-89) to the Russian Mir space station. Four adult astronauts (3 males and 1 female) who served as crewmembers on the mission participated in the experiment. The behavioral tasks were presented on a flight-qualified Macintosh Powerbook 170 with an attached Kensington Keypad. Logbooks maintained by the astronauts before, during and after the flight mission provided a record of daily food and fluid intake, medication usage, and sleep duration.

The six tasks composing the behavioral test battery were chosen on the basis of previous research showing that performance on each of the tasks remained stable over repeated testing following minimal training, required only a brief amount of time to complete and was sensitive to a range of experimental manipulations including drug administration and changes in nutrition (Kelly, Foltin, Rolls & Fischman, 1994; Kelly, Foltin, Serpick & Fischman, 1997). During each experimental session, the performance tasks presented in order required less than 20 minutes and were followed by a 15 sec. Screen display providing feedback on performance effectiveness for each task.

The behavioral performance battery included:

Profile of Mood States (POMS) – a self-report questionnaire designed to measure mood (Approx. 2 min.).

Visual Analogue Scale (VAS) - a self-report questionnaire designed to measure current interoceptive conditions – (Approx. 2 min).

Differential-reinforcement-of-low-response-rate (DRL) – designed to measure the consistency and accuracy of time estimation – (Approx. 3 min).

Repeated acquisition of response sequences (RA) – designed to measure the process by which new behavior is learned – (Approx. 3 min).

Number recognition (NR) – designed as a modified delayed matching-to-sample task to measure memory – (Approx. 5 min).

Digit-symbol substitution task (DSST) – designed to measure psychomotor performance – (Approx. 2 min).

Procedurally, the experiment was conducted in four phases:

Orientation, Instruction and Training – beginning several months prior to the spaceflight mission.

Preflight- baseline performance levels during a10-day quarantine interval immediately prior to the flight.

Inflight- conducted in the course of the 10-day STS-89 spaceflight mission to the Russian MIR space station.

Postflight- conducted over a 10-day interval beginning 3 days after the space shuttle Endeavor return landing.

The results of this experiment showed clearly the feasibility of using a behavior analytic approach for assessing human performance during space flight. Both the rate and accuracy of performance were sustained or enhanced across the study with only the Digit Symbol Substitution Task (DSST) and the Number Recognition (NR) task showing even the slightest alterations during the actual space flight. All other dimensions of performance remained essentially unchanged over the course of the study. Self-report ratings of Fatigue increased slightly during space flight and decreased during the postflight sessions. No other consistent changes in self-report measures were observed over the course of the study. Astronaut crewmembers completed all mission requirements in an efficient manner with no indication of clinically significant behavioral impairment during the 10-day spaceflight mission. This finding supports the feasibility and utility of computerized task performances and self-report rating scales for repeated measurement of behavior during space flight.

Long-duration Expeditionary Missions Beyond Earth Orbit

The imperatives of human health and performance effectiveness associated with planned missions beyond Earth orbit will require a quantum increase in behavior analytic research and development to meet the major challenges presented by extended travel distances and time spent in space environments (Ball & Evans, 2001).

Of primary concern must be the organization of work and living conditions in considering the essential operational requirements for such bold endeavors. The initial structuring of such expeditionary ventures will doubtless be characteristically authoritarian because of the limits on provisioning as well as the uncertainties and hazards involved. The original "senders" of the expedition will program the activity, pay explicit fees, and demand absolute control. As the distance traveled and the time spent in space habitats increases however, the needs and aspirations of the "sent" will become progressively more influential than those of the "senders". This change in the dynamic relationship between "senders" and "sent", known to develop even in the course of limited duration missions, creates the well-recognized tension between Earth-bound control and spaceflight operations. The emergent autonomous changes that develop under such conditions are the fountainhead for the evolution of social structure and governmental policy manifest in empire, colony, and sovereign states. The process has filled history books with a major portion of human activity, suffering, and bloodshed throughout recorded time. Understanding the behavioral factors that influence and control this process of social and organizational structure must provide a major focus for space-related behavior analytic research and development.

At issue are the conceptual and methodological problems associated with the design, establishment, and maintenance of a functional ecological system for long-term human habitation in space environments. Under such conditions of extended duration isolation and confinement, the obvious loss of high-valued familiar and supportive activities will require dynamic restructuring of otherwise tolerable living and work schedules. Journeying in a spacecraft on extended expeditionary missions beyond Earth orbit does not constitute an ecological setting to which familiar pre-flight routines of living are easily applied. Such a unique ecology requires an applied behavioral engineering technology functionally relevant to inherently unfamiliar settings that provides for a comprehensive confined microsociety status assessment beyond even a fine-grained, multi-dimensional individual evaluation.

The fundamental behavioral systems integration research approach required proceeds toward increasingly complex interactions dictated by scientific and pragmatic considerations closely approximating methods and procedures of established effectiveness in other areas of natural science. Experimentally-derived principles provide the basis for development of functional behavioral engineering models with applications to a research analysis under operational conditions in programmable residential laboratory settings. Under such conditions, a broad range of complex and naturalistic features of the space habitat/behavior environment can be brought within the laboratory for experimental analysis providing for continuous monitoring, objective recording, and quantitative measurement for long-duration studies using the species of primary interest without sacrifice of methodological rigor. Such a confined microsociety 'test bed' makes it possible to develop 'countermeasure' interventions beyond the level of the individual crew member at the integrative behavioral systems engineering level.

It is of course obvious that superordinate objectives and ultimate aversive consequences are clearly less compelling under even long-duration residential confined microsociety laboratory conditions. Certainly, many organizational and sociopolitical issues of critical concern must await more advanced investigative endeavors. But the prospective benefits of obtaining evidence-based answers to at least some of the essential operational questions regarding individual and social adjustment, motivational processes and performance effectiveness, as well as group structure and function far outweigh any considerations for delaying this behavior analytic initiative as the lead time to launch shortens progressively!

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SPACE IS THE PLACE

APPENDIX

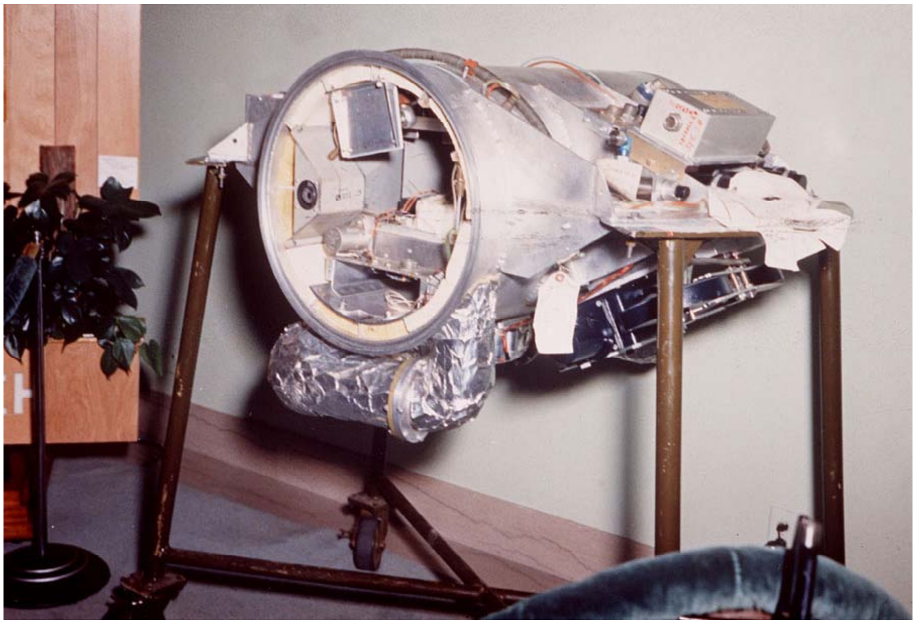


Figure 1. Nose cone of the Saturn rocket used for Abel and Baker flights.

Figure 2. Insulated restraining couch used in Abel and Baker flights.

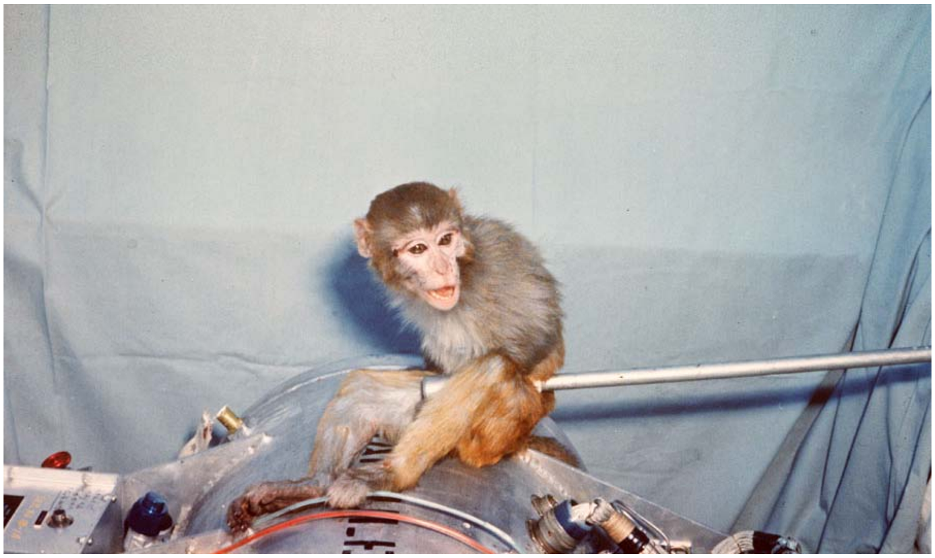


Figure 3. Postflight photograph of Abel.

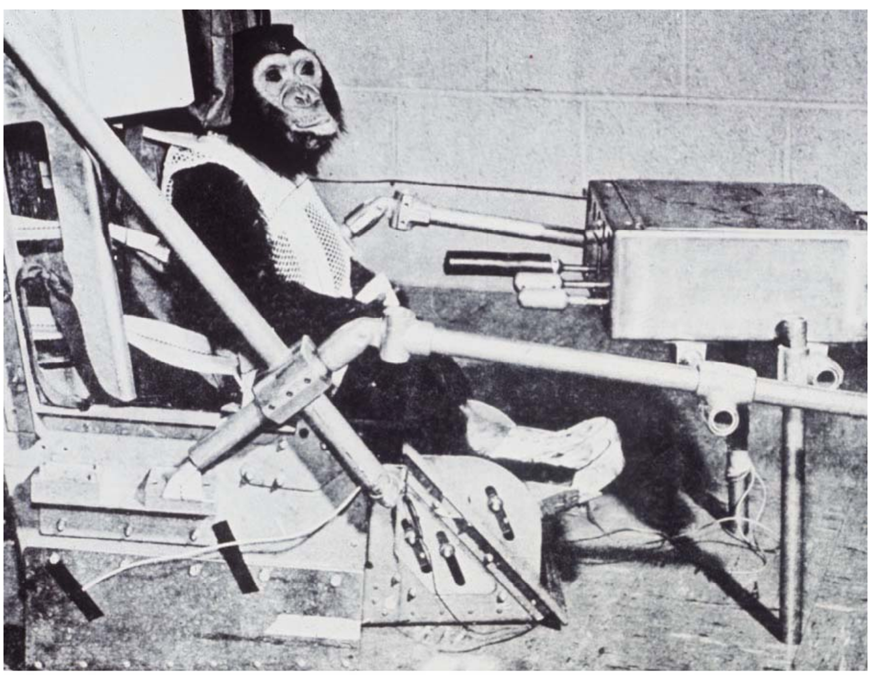


Figure 1. Subject No 44 in Restraint Chair with Stimulus Response Panel

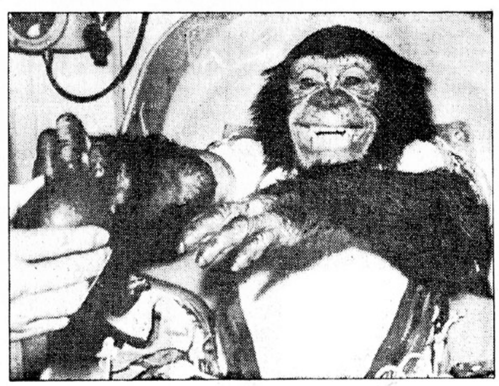
Figure 4. Chimpanzee training device for animal pretest flights of Project Mercury.

B-60-1757

Figure 3.- Pressurized animal couch with occupant looking down at psychomotor control panel.

Figure 5. Insulated flight couch and work panel for animal pretest flights of Project Mercury

The Right Stuff



ONE OF THIS country's space pioneers and a long-time resident of Washington died in North Carolina on Wednesday at the age (as his obituary put it) of "about 26." Ham the chimpanzee risked his life for his country in 1961 when he hurtled into space in what should now be regarded as a very primitive space capsule on an experimental suborbital run. Those of us who are older than about-26 well remember the excitement and suspense—even the dread—that attended his voyage. For it was not known whether the chimpanzee would survive the shocks and rigors of the trip. And it was widely supposed that even if he did survive, he would have been severely impaired emotionally, rendered a simpering idiot—scared out of his wits. There was much criticism of the mission on this cruel account.

Imagine the general astonishment, then, when the bobbing capsule, retrieved from a turbulent sea, was opened to find the beaming visage whose most famous photo we reproduce here. Never mind that the capsule, through an error, had been shot 40 miles higher than planned or that it had landed 130 miles past the target area where a fleet awaited it or that it had been traveling 5,000 miles an hour, 800 miles faster than planned. Ham rose to the occasion and took it all in stride. As a news account of the period reminds us: "During the time radio signals were received the chimp pushed various levers and performed other behavior tasks assigned him." His trip paved the way for the flights of the human astronauts.

Then what happened? Well, Ham retired to the Washington National Zoo, where he lived for the better part of the next 20 years. He moved to North Carolina in 1981. And he died the other day, as we said, at the age of about-26. Meaning no harm to Bonzo, we would say that Ham was the nation's First Chimp. He was a great American and a really swell ape.

Figure 6. Published obituary on the chimpanzee Ham.

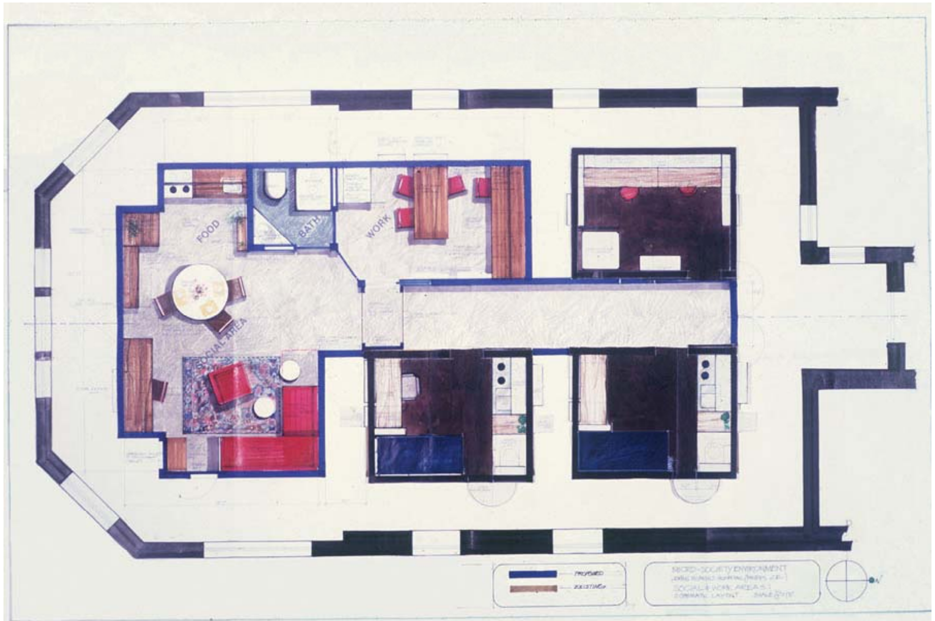


Figure 7. Continuously programmed residential laboratory.

Figure 8. Programmed residential laboratory through-wall automatically controlled supply draws.

Figure 9. Programmed residential laboratory computer control center.