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TRAINING PROCEDURE FOR PRIMATE EQUILIBRIUM PLATFORM.(U)  
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Report SAM-TR-82-24

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# TRAINING PROCEDURE FOR PRIMATE EQUILIBRIUM PLATFORM

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August 1982

Final Report for Period January 1982 - March 1982

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USAF SCHOOL OF AEROSPACE MEDICINE  
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NOTICES

This final report was submitted by personnel of the Weapons Effects Branch, Radiation Sciences Division, USAF School of Aerospace Medicine, Aerospace Medical Division, AFSC, Brooks Air Force Base, Texas, under job order 7757-05-52.

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The animals involved in this study were procured, maintained, and used in accordance with the Animal Welfare Act of 1970 and the "Guide for the Care and Use of Laboratory Animals" prepared by the Institute of Laboratory Animal Resources - National Research Council.

The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER SAM-TR-82-24	2. GOVT ACCESSION NO. AD-A119 978	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) TRAINING PROCEDURE FOR PRIMATE EQUILIBRIUM PLATFORM	5. TYPE OF REPORT & PERIOD COVERED Final report Jan 1982 - Mar 1982	
	6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s) Danny Burke, Airman First Class, USAF C. Thomas Bennett, Major, MSC, USA	8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS USAF School of Aerospace Medicine (RZW) Aerospace Medical Division (AFSC) Brooks Air Force Base, Texas 78235	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62202F 7757-05-52	
11. CONTROLLING OFFICE NAME AND ADDRESS USAF School of Aerospace Medicine (RZW) Aerospace Medical Division (AFSC) Brooks Air Force Base, Texas 78235	12. REPORT DATE August 1982	
	13. NUMBER OF PAGES 7	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) Unclassified	
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Equilibrium Primate Equilibrium Platform (PEP) Behavioral Shaping Rhesus Monkeys		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Rhesus monkeys (M. Mulatta) were trained to maintain a primate equilibrium platform in a relatively horizontal position by a control stick. Training procedure consisted of seven phases. Progression from one phase to the next was contingent on successful completion of the current phase. Criterion for success was defined for each phase.		

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# TRAINING PROCEDURE FOR PRIMATE EQUILIBRIUM PLATFORM<sup>1</sup>

## INTRODUCTION

The primate equilibrium platform (PEP) (Fig. 1) has been used in the Weapons Effects Branch of the Radiation Sciences Division, USAF School of Aerospace Medicine (USAFSAM), to study behavioral effects of both ionizing radiation and chemical defense agents (1,2,3) in nonhuman primates. The primary purpose of this apparatus is to record changes in equilibrium performance under conditions that simulate manual control of an aircraft. The PEP has a small restraining chair gimballed in a "pitch" axis and a small platform with a control stick, attached directly in front of the subject.

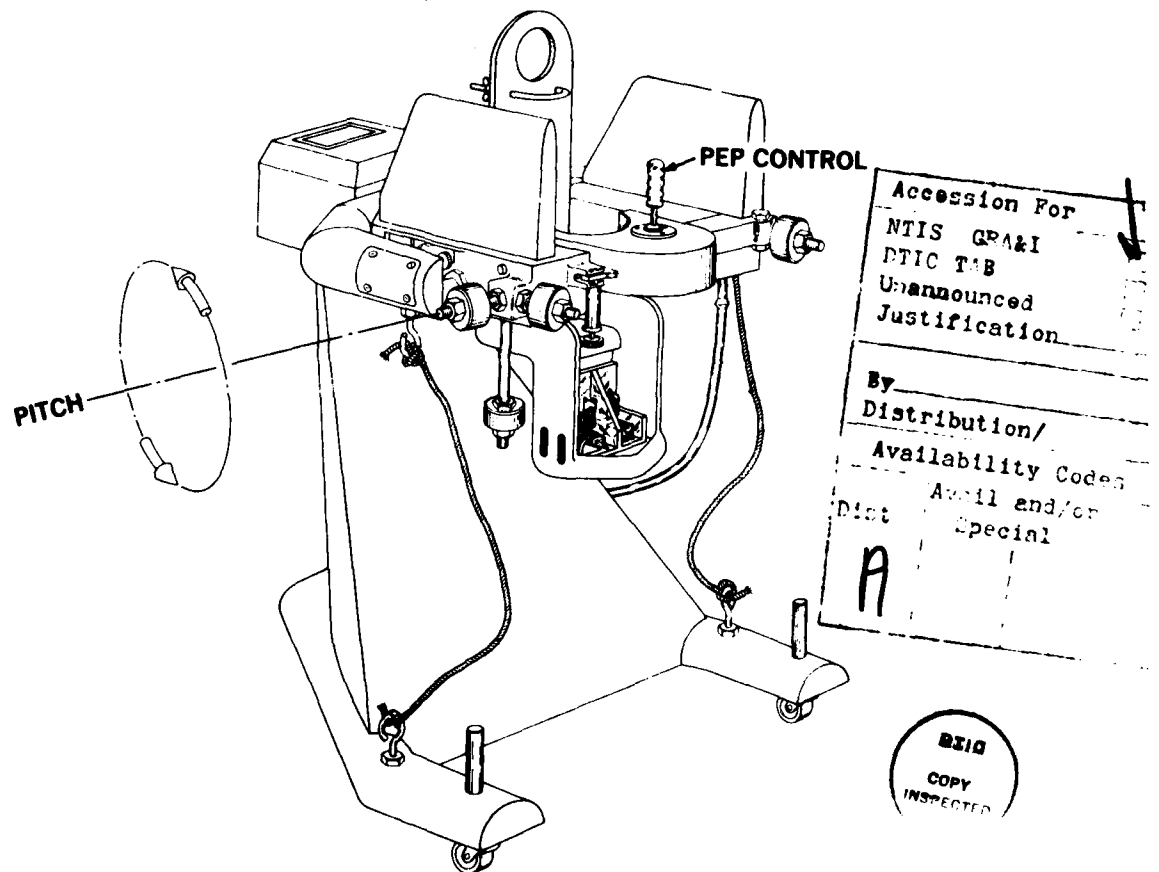


Figure 1. Primate equilibrium platform.

<sup>1</sup>A film on the training procedure described in this technical report is on file in the USAFSAM/RZW (Weapons Effects Branch).

A random input signal drives the chair from the horizontal. Both pitch and roll modes are available, but each mode can be operated alone. By means of compensatory tracking with the control stick, the animal can maintain a nearly level position. This report describes a procedure for training rhesus monkeys (Macaca mulatta) to operate the PEP.

## MATERIAL AND METHOD

### Subjects

M. mulatta weighing 5.6 to 9.8 kg were used in this training protocol.<sup>2</sup>

### Apparatus

The equipment used in this training procedure has been described in detail (1-3). Briefly, it consists of a Hewlett Packard Model 3722A noise generator and a Wavetek Model 111 function generator. The output signal from the PEP is digitized and analyzed for signal characteristics by a DEC 11/03 computer. During a training session, data were stored on a disk and then printed out after the session.

### Procedure

The procedure for training subjects for the PEP is broken down into several phases, each of which must be completed before continuing to the next phase. These phases are depicted in Figure 2.

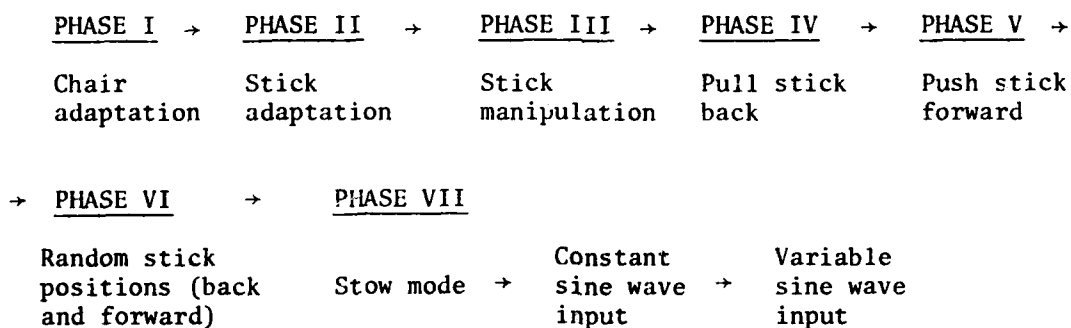


Figure 2. Flowchart of training procedures.

Phase I. Chair adaptation consists of restraining the subject in the PEP chair for 1 hour per day for 5 days. The animal is restrained in a PEP chair in the colony room for the first 2 days, then both are moved to the training

<sup>2</sup>M. fascicularis has also been trained using this procedure. Past experience has shown no significant difference in task acquisition.

facility for the next 3 days. This phase is necessary because movement of the animal from the caging facility to the training facility may be a sufficiently disruptive procedure to interfere with initial training. Criterion for advancing to Phase II is subjective. That is, if the animal sits quietly for most of the hour on the 5th day, it is ready to be advanced to the next stage.

Phase II. In the stick-adaptation phase, the goal is to train the animal to merely touch the control stick. Each daily session consists of 100 ten-second trials. In each trial the chair is tilted down (forward)  $25^{\circ}$  from the horizontal position by putting the PEP in manual mode and turning the pitch knob toward the down position (Fig. 3). The subject receives 2-4-mA shocks, each of which lasts 0.5 second. Initially, the trainer uses a gloved hand to direct the subject's attention toward the control stick. The control stick is not operational at this time. The animal may turn in the chair or bite the platform as a response to the mild shocks. This behavior is redirected toward the gloved hand which is placed directly above the control stick. The animal's behavior consists of slapping or grabbing the hand. At this point, the subject is reinforced for merely slapping or grabbing. Reinforcement is defined as returning the chair to the horizontal, shock-free position and giving the subject a raisin. To insure that the raisin functions as a positive reinforcer, regular feeding (Purina monkey chow and fruit) is delayed until after the training session. Once this begins, the trainer positions his hand closer and closer to the stick. After grabbing or slapping of the hand occurs in the vicinity of the stick, the trainer gradually fades the cuing by moving the hand farther away from the stick and platform. If at this point the subject quits responding, the hand is moved in closer to the stick and platform to prompt the slapping or grabbing response again. The purpose of the cuing is to get the subject's hand closer and closer to the stick until it actually touches the stick. Reinforcement is given on successive trials only as the subject more closely approximates this response. After contact is made, approximate responses are no longer reinforced unless correct behavior totally ceases (total extinction). A trial may last less than 10 seconds, if a correct response occurs, but not more than 10 seconds. Criterion for completion of this stage is touching the stick on 80% of the trials in two consecutive sessions or on 100% of the trials in one session.

Phase III. Manipulation of the stick is the goal of this stage. Each session consists of 100 ten-second trials, with the shock set at 2-4-mA for 0.5 second. Merely touching the stick does not terminate the trial. Instead, the subject must pull the inoperational stick back when the chair is angled down (forward)  $25^{\circ}$ ; then the trainer returns the chair to the horizontal position and reinforces the subject with a raisin. In the beginning, movements approximating the correct response (i.e., moving the stick back a short distance) terminates the trial; but as training progresses, a more complete response must be made. Criterion for termination of this phase is pulling the stick back on 80% of the trials in two consecutive sessions or on 100% of the trials in one session.

Phases IV and V. After the subject meets the criterion for pulling the stick back when the chair is tilted down  $25^{\circ}$ , training progresses to pushing the stick forward when the chair is tilted up (backward)  $25^{\circ}$ . The shaping procedure for this behavior is the same as for training to pull the stick back. Criterion is pushing the stick forward when the chair is tilted up  $25^{\circ}$ .



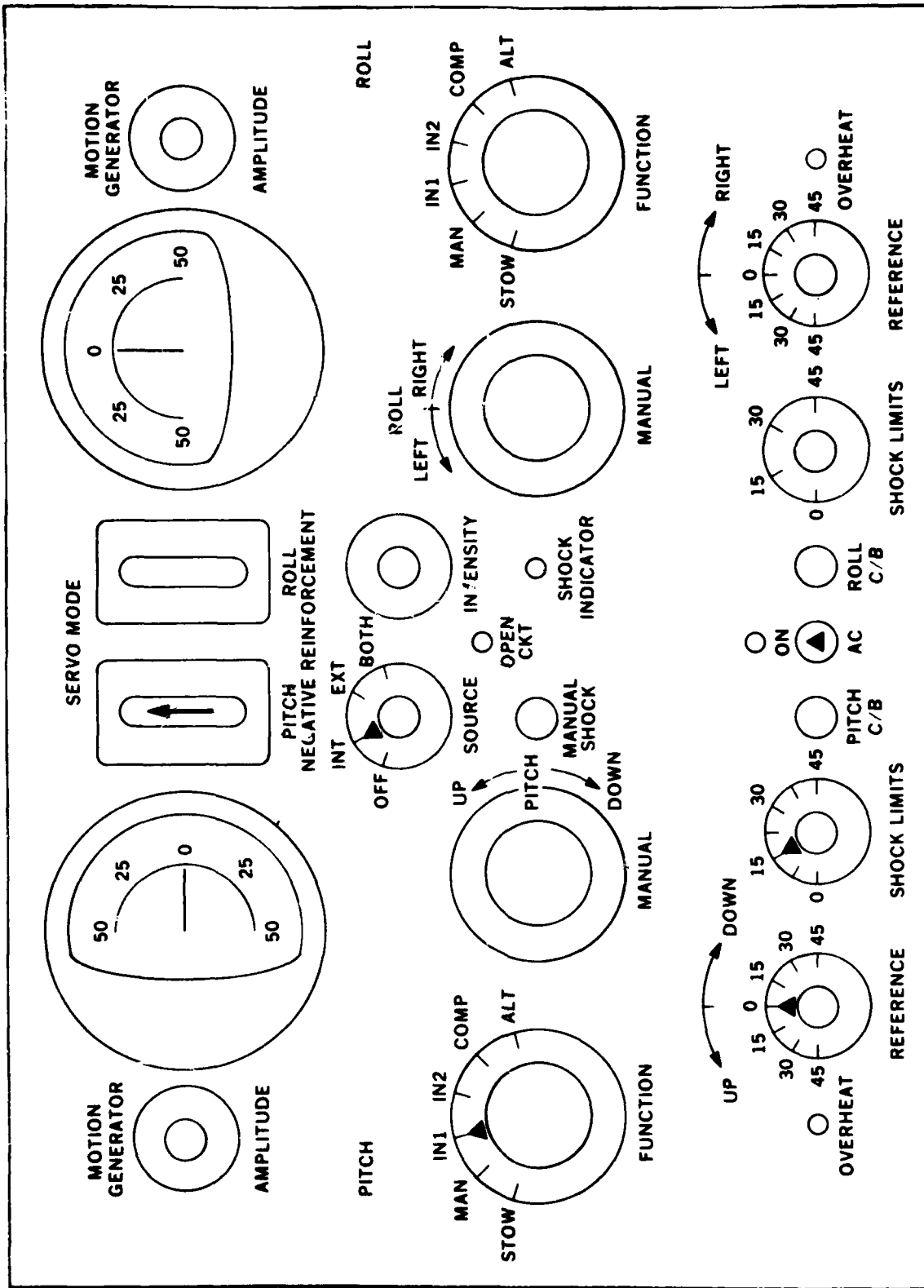


Figure 3. Advanced simulator for primate research.

on 80% of the trials in two consecutive sessions or on 100% of the trials in one session.

When this criterion is met for both chair and stick positions, 50 trials with the chair in the down position and 50 trials with the chair in the up position are randomly alternated in each session. In other words, the first session can have 50 trials with the chair put in the down position followed by 50 trials with the chair put in the up position. The next session can have the reverse order of presentation of the 50 trial blocks. Criterion is 80% correct responses in two consecutive sessions or 100% correct responses in one session.

Phase VI. Trials with random down and up chair positions are presented during this phase. A random number is used to assure that the subject is responding to chair position rather than to a pattern of trials the trainer might establish (4). Criterion is 80% correct in two consecutive sessions or 100% correct in one session.

Phase VII. The next step is to put the PEP in the "stow" mode and turn on the control stick to give control of the chair to the subject. There is no signal input in this mode. First the subject is allowed to level the chair horizontally to reinforce that behavior. After the subject initially levels the chair, the trainer moves the stick forward or backward to allow subject practice putting the chair in a horizontal position. This behavior is reinforced by a time-out with no shocks. Giving raisins during this phase may disrupt correct behavior because the subject may take his hand off the stick and orient toward the trainer. When PEP is in the stow mode the automatic shocker does not function. Shocks are manually give. at approximately every 3-4 seconds for 0.5-second duration. This is at a slower rate than were the automatic shocks presented by the console, to insure correct behavior is not extinguished. If extinction does occur, return to phase VI. Behavioral criterion is maintaining a nearly horizontal position and avoiding shocks for approximately 80% of the hour session. Next, an input signal of 0.01 Hz is started using a sine wave generator. Adjusted root mean squares (ARMS) for 1-minute epochs are calculated by the 11/03 during this period. (A discussion of the metrics in assessing PEP performance is found in Yochmowitz et al. (6-8).) The input signal is increased by 0.01 Hz on the next session. If the difference (decrement) in ARMS between the two sessions is not significant, the input is increased by 0.01 Hz; if the difference is significant, training is continued at the same level. A significant difference in performance ( $p=.05$ ) is measured by comparing the ARMS values with a repeated-measures t-test (5). After subject has met the criterion for 0.2 Hz with the sine wave signal, a random-noise input signal of 0.01 Hz is started. Criterion for increasing this signal is the same as for the sine wave input signal. See Appendix A for time required in USAFSAM/RZW to train six rhesus monkeys.

## DISCUSSION

The PEP is used to measure decrement in performance after chemical or ionizing radiation insult. M. mulatta are trained in seven phases to operate the PEP. First the subject becomes adapted to the chair and then learns to touch the control stick. After completing these basic phases, the subject

learns to pull the stick back when the chair is manually tilted down 25° and push the stick forward when the chair is manually tilted up 25°. When criteria for these behaviors have been met, the subject is given control of the chair--first in the stow mode, followed by the sine wave input signal, and finally, by the random-noise input signal. Each phase has a criterion that must be met before going to the next phase.

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APPENDIX A

TRAINING TIME (HOURS) FOR SIX RHESUS MONKEYS

<u>Monkey No.</u>	<u>Chair Adaptation</u> (Phase I)	<u>To Touch Stick</u> (Phase II)	<u>Stick Manipulation</u> (Phases III-VII)	<u>Sine Wave</u>
902C	5	6	10	20
918C	5	8	10	20
272D	5	8	12	20
280D	5	8	12	20
276D	5	7	12	20
274D	5	5	10	20

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