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**NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
NAVAL AIR STATION, PENSACOLA, FL 32508-5700**

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**LANDING CRAFT AIR CUSHION
(LCAC) CREW SELECTION
SYSTEM MANUAL**

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ABSTRACT

To meet the needs of the Navy, the Naval Aerospace Medical Research Laboratory has developed and validated a crew selection test battery for the Landing Craft Air Cushion (LCAC) vehicle. The test battery, the LCAC Crew Selection System (LCSS), has been operationally implemented. This manual provides system information and test administration procedures for the LCSS test battery. The development and validation of the LCSS, hardware configuration, and software components are delineated. It details how to access, organize, and analyze test data for LCAC crew selection purposes. Additionally, the manual includes sections on system calibration and common problems and solutions.

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INTRODUCTION

This manual is primarily intended for test administrators and system managers of the LCAC Crew Selection System (LCSS). It provides general information about LCAC mission and required crew skills to operate the LCAC. The development of the LCSS and related validation studies are documented. The manual delineates basic features of the system including hardware configuration and software components. Tests are described and instructions on test administration procedures are included. The manual specifies how to access and analyze test data. Included are sections on data preparation and selection criteria. Additionally, LCSS calibration, system documentation, test programs, common problems and their solutions are delineated.

LCAC and LCSS GENERAL INFORMATION

The LCAC is designed to transport weapons, equipment, and personnel of the assault elements of the Marine Air/Ground Task Force both from the ship to shore and across the beach. The LCAC's high-speed capability, extraordinary maneuverability, as well as its ability to fly over land and water, require a skilled crew. Operating the LCAC demands multilimb coordination, integration of perceptual information, rapid cognitive processing abilities, fine psychomotor skills, and time-sharing ability.

Prior to 1988, limited entry requirements existed for selection of LCAC operators and assistant operators. Attrition rates among LCAC operator trainees were unacceptably high (35-41%) (Eakin, 1990). As training costs escalated and projected plans called for an increased number of LCAC vehicles and crews, selecting successful candidates became more critical. In response to the needs of the Navy to better screen LCAC crews, the Naval Aerospace Medical Research Laboratory (NAMRL) developed a computer-based performance test battery for LCAC crew selection. The battery, now known as the LCSS, was designed to measure various aspects of human performance such as eye-hand-foot coordination, reaction time, cognitive processes, time-sharing abilities, and personality characteristics and interests.

In a concurrent validity study of LCAC fleet crew performance on the LCSS (Nontasak, Dolgin, & Griffin, 1989), several psychomotor tests were significantly correlated with measures of success in LCAC training. As psychomotor tests became more complex, their association with training criteria strengthened. An initial predictive validation study (Dolgin & Nontasak, 1990) reported that subjects who performed better on the psychomotor multiple tests were more likely to succeed in the training syllabus. They also showed certain tests to have limited or no predictive validity. Furthermore, Nontasak and Dolgin (1990) found that success in primary training was positively correlated with LCSS tests involving time-sharing ability. Additional studies on LCSS validation (Dolgin, Nontasak, Blower, & Delaney, 1991; Dolgin, Street, Nontasak, & Travis, 1992; and Nontasak, Dolgin, & Blower, 1991) have demonstrated that the LCSS is predictive of both training and later fleet performance.

The LCSS (see Fig. 1) consists of four components:

1. Psychomotor (PMT) and Dichotic Listening (DLT) Tests
2. Compensatory Tracking (CT) and Digit Cancellation (DC) Tests
3. LCAC Self-Report (LSR)
4. Adult Personality Inventory (API).

The LCSS may be administered in its entirety during one automated session or started at a specified test in the menu and run to completion. The computer programs were written in GW BASIC and run on Zenith model Z-248 microcomputers using MS-DOS. The API (the fourth test) is administered separately, either on a computer or in paper-and-pencil form.

For a detailed description of the hardware configuration, hardware connections, calibration techniques, hardware maintenance, and file descriptions, see Appendixes A through D.

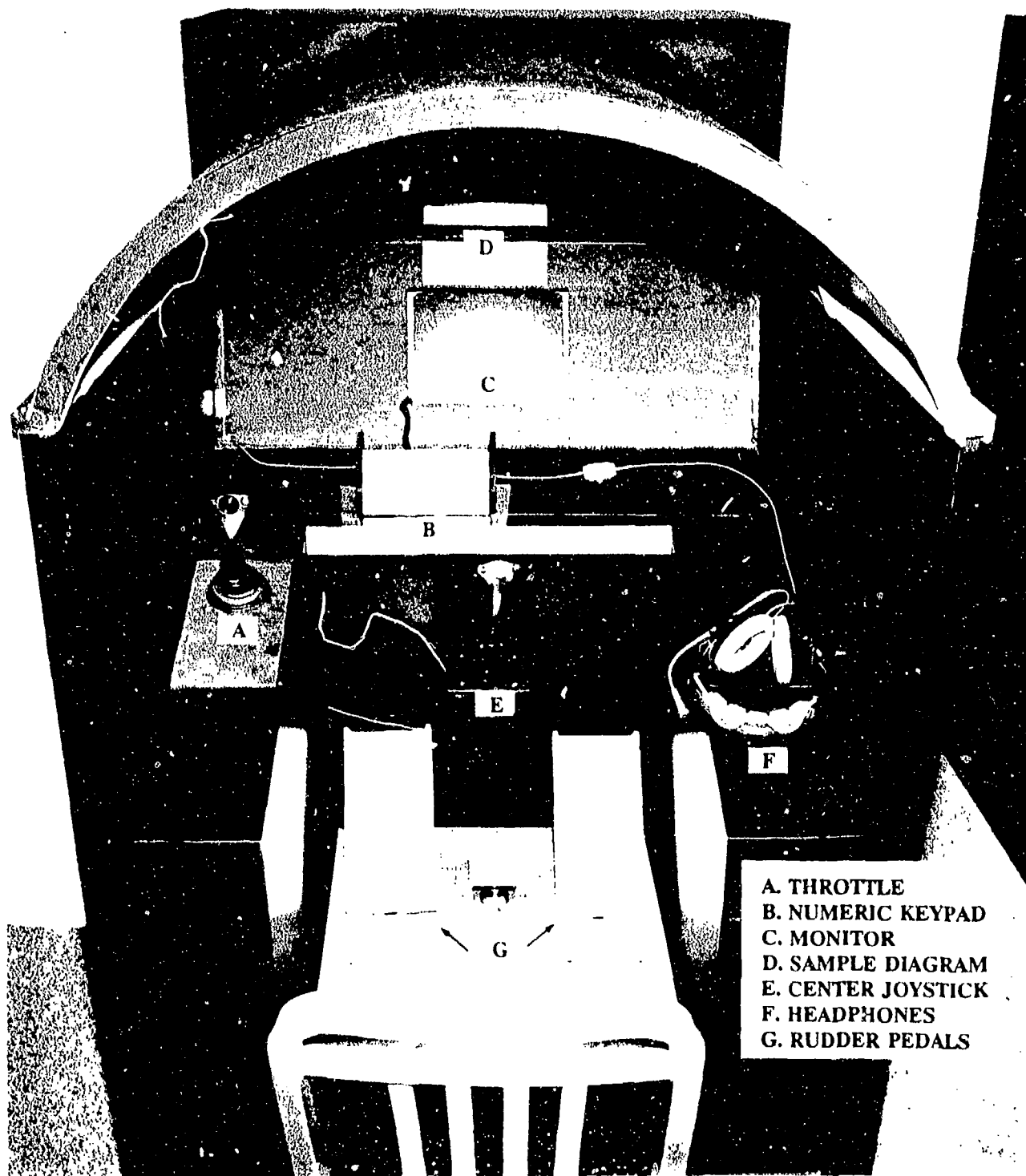


Figure 1. The LCAC Crew Selection System.

DESCRIPTION OF TESTS

Each test has detailed instructions prior to its beginning. The following are summaries of the four tests and their respective subtests.

PMT and DLT TESTS

1. **PMT: STICK.** The subjects use the joystick directly in front of them to control the middle cursor (shaped like a cross "+") on the screen. The object of the task is to maintain the cursor at the center of the screen where the vertical and horizontal rows of dots intersect (see Fig. 2). The cursor moves in the direction opposite of the stick's movement. The subjects have one 3-minute practice session, followed by a brief pause before the actual test appears.

At the beginning of the test, the cursor is located at the top right hand corner of the screen. Ten seconds into the test, the computer beeps, signifying that the computer will begin scoring. At this point, the cursor automatically moves to the target position at the center of the screen. This reset ensures that the subjects begin with zero (0) errors.

2. **DLT.** In this test, the subjects are presented with different strings of letters and numbers through headphones into both ears simultaneously. The computer specifies which ear to pay attention to ("RIGHT" or "LEFT"). Using their left hand, the subjects key in ONLY the numbers heard in the designated ear while ignoring the letters. The DLT consists of 12 trials. In each trial, the subjects receive two different streams of information with a pause between them. The first stream contains five numbers mixed with letters. The second stream contains four numbers, also mixed with letters. An example of a DLT trial is illustrated in Table 1.

After reading the instructions, the subjects are given four practice sessions prior to beginning the actual test. Both the correct responses and the subjects' responses appear on the screen after each practice session. This allows the subjects and the test administrator to evaluate the subjects' performance. It is critical for the test administrator to stay with the subjects during this period. Response errors (such as a blank, a long string of numbers, or all wrong numbers) can be corrected during this period. (Possible problems include not responding at all, keying in all the numbers heard, or paying attention to the wrong ear.)

The subjects are then asked to answer three multiple-choice questions to assure they understand the test instructions. These questions are enclosed in Appendix E. The subjects must answer all three questions correctly in order to proceed with the test. If they miss one of the questions, the computer will prompt them to "CALL TEST ADMINISTRATOR." The test administrator then may assist the subjects. To return to the test, press <Home> on the numeric keypad (or on the keyboard, press <Shift> & <A> simultaneously). The three questions will reappear and again must be answered correctly for the subjects to proceed with the DLT test.

The subjects should be informed that their responses on the actual test will NOT appear on the screen. It is also very important to emphasize that the DLT responses are keyed in with the left hand and that the headphones are worn correctly (L = left ear, R = right ear).

3. **PMT/DLT DUAL (STICK & DLT).** In this test, the subjects perform the first two tasks at the same time. The PMT single tracking is performed with the right hand, and the DLT responses are keyed in with the left hand.

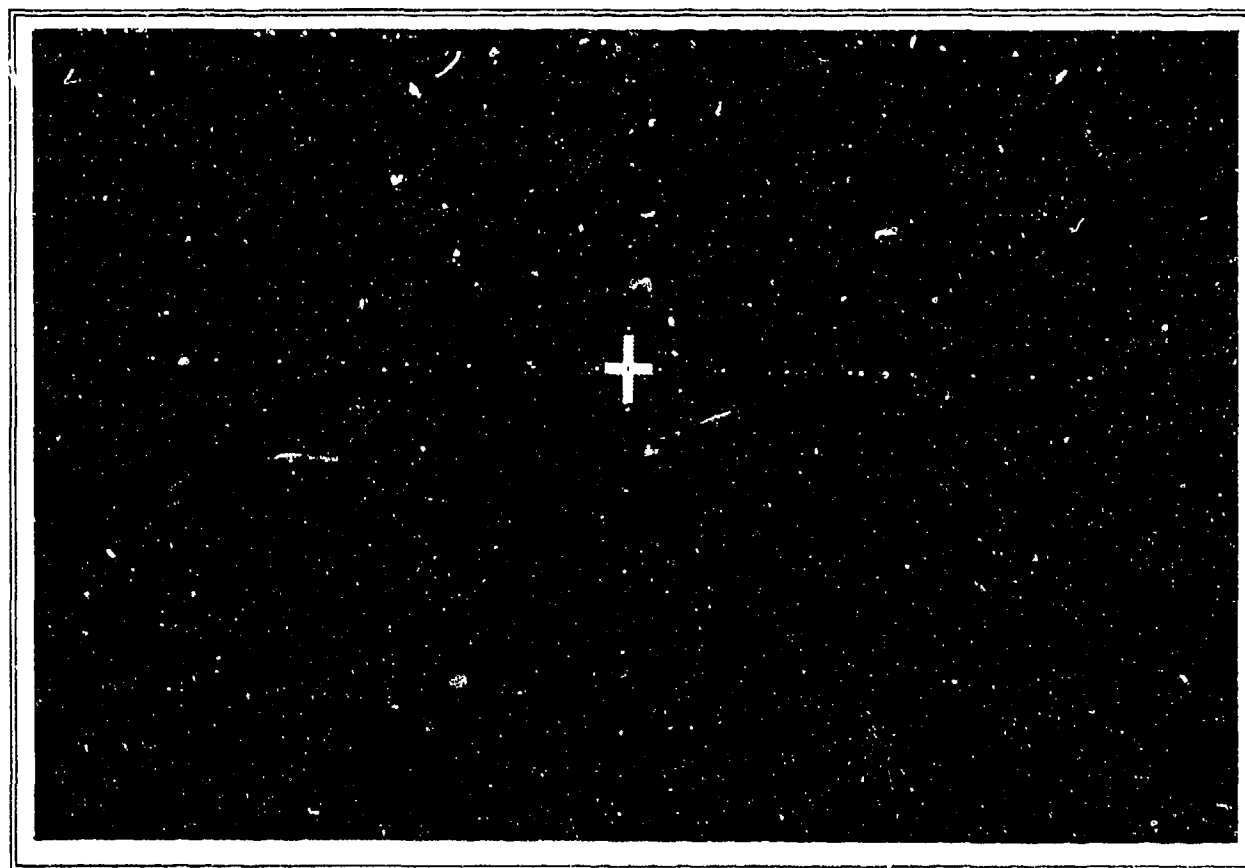


Figure 2. PMT: STICK Test. Stick cursor at zero error position.

Table 1. DLT Trial Visual Example.

(PART I)	
"Test 1"	
"RIGHT"	
Through the left ear:	R R N B M Y Z G P Z F L G K L S
Through the right ear:	Y I C S K G E T O X F O E N I I

(PART II)	
"LEFT"	
Through the left ear:	R F 4 3 2 9
Through the right ear:	G L 1 5 6 2

4. **PMT: STICK & RUDDER.** The subjects perform the stick task (as in # 1) and use both feet to control the rudder pedals to keep the bottom cursor on the vertical line. The cursor moves left or right in the same direction as the movement of the rudder pedals. Figure 3 illustrates zero error cursor positions for this dual task.

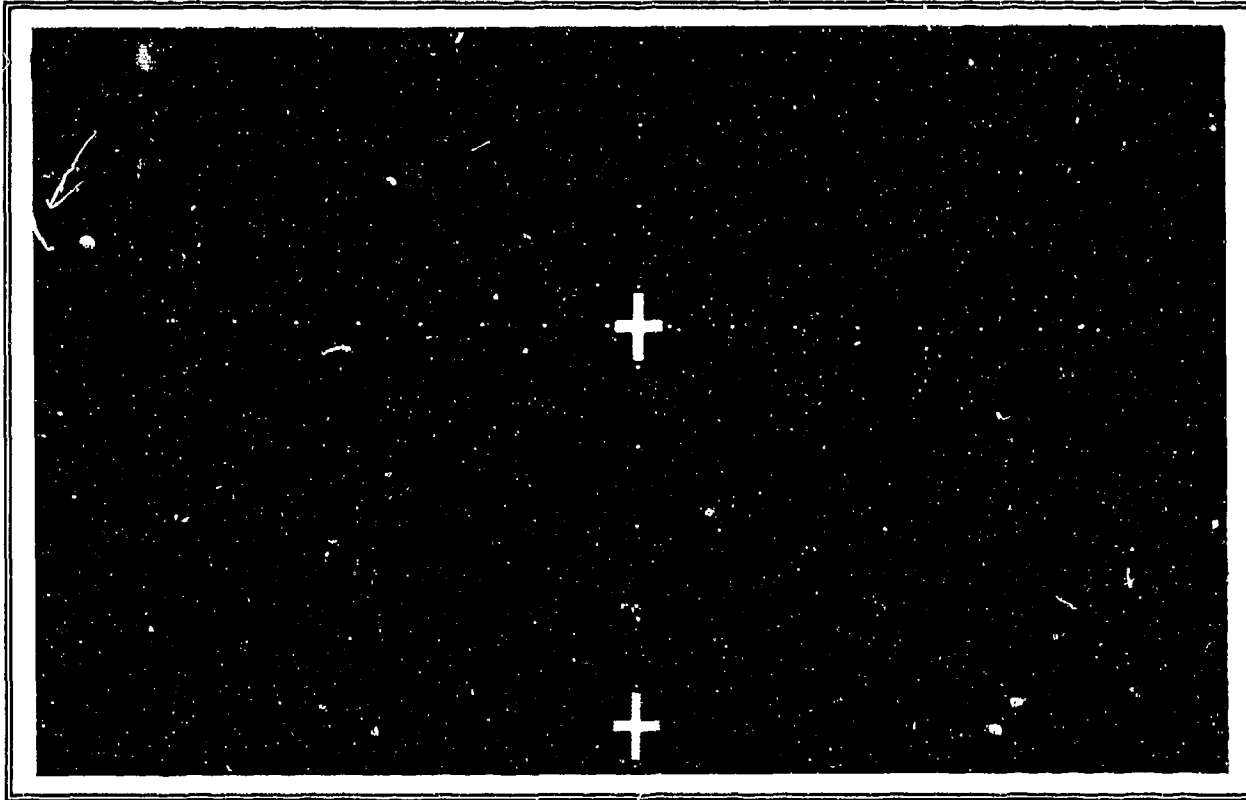


Figure 3. PMT: STICK & RUDDER Test. Stick and rudder cursor positions at zero error positions.

5. **TRIPLE (STICK, RUDDER, & DLT).** The subjects perform the previous task (# 4) as well as the DLT task (# 2) at the same time.

6. **THROTTLE (with Stick and Rudder).** The subjects perform the throttle (the joystick to the left) task and perform task # 4 simultaneously. The throttle cursor is to be kept on the horizontal line while maintaining the other two cursors on their appropriate targets. The left cursor moves up or down in the same direction as the throttle movement. Figure 4 depicts cursor at zero error positions for this task.

7. **ALL FOUR.** The subjects perform the previous task (# 6) as well as the DLT task (# 2). In this session, the subjects respond to the DLT task verbally (speaking into the microphone). These responses are to be recorded on tape by the test administrator. To back up the tape recorder, manual recording is recommended. In manual recording, all responses must be recorded. Be careful to distinguish "O" (the letter) from "0" (the number). The letter "O" is an incorrect response.

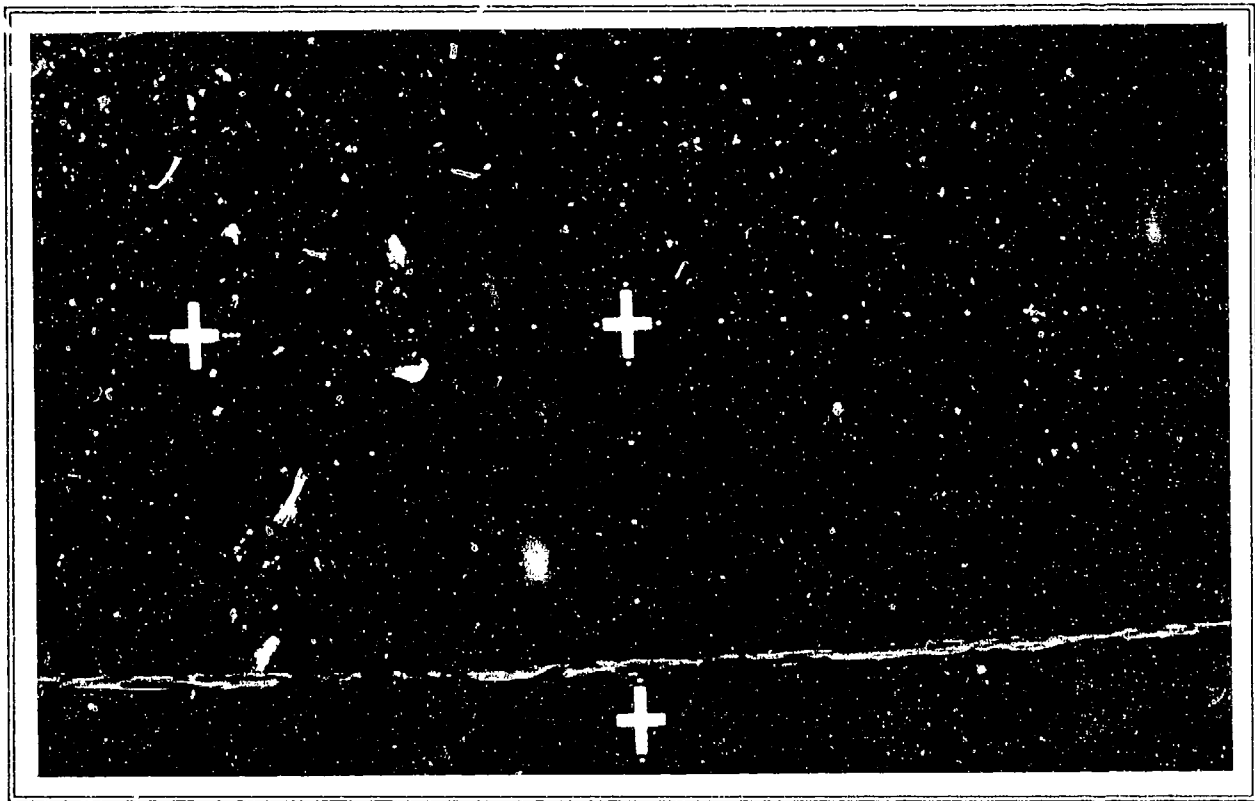


Figure 4. PMT: THROTTLE (with stick and rudder). Stick, rudder, and throttle cursors at zero error positions.

Recording these responses is facilitated by writing the answers down in the manner in which they are presented on the test. It is useful to have the answer sheet (provided to the test administrators) with the correct responses at hand so that the test administrator can determine which trial the subject is on and follow the subject's responses more easily. Sometimes a subject reports too many numbers or reports letters with numbers. Nonetheless, all responses must be written down. The DLT answer sheet must be kept under lock and key when not in use.

The length of the PMT/DLT test and its subtests is shown in Table 2.

Table 2. PMT/DLT Test Duration.

Test	Time (min)	Cumulative (min)
1. PMT: Stick		
- practice	3	3
- test	3	6
2. DLT		
- practice	3	9
- test	4	13
3. PMT/DLT Dual		
- test	4	17
4. PMT: Stick & Rudder		
- practice	3	20
- 1st test	3	23
- 2nd test	3	26
5. TRIPLE (stick, rudder, DLT)		
- test	4	30
6. THROTTLE (with stick, rudder)		
- practice	3	33
- 1st test	3	36
- 2nd test	3	39
7. ALL FOUR (stick, rudder, throttle, DLT)		
- test	4	43

Note: The times listed above only include actual test time; they do not include time taken to read the instructions. Actual time to complete testing may vary depending on the subject's ability to read and comprehend test instructions. Generally, 1 hour is needed to complete all PMT/DLT activities. If it is necessary to exit the PMT/DLT tests, press <Home> after any of the subtests to return to the LCSS main menu.

COMPENSATORY TRACKING (CT) AND DIGIT CANCELLATION (DC)

This test is divided into three parts: CT, DC, and DUAL (CT and DC combined).

1. **CT.** This portion of the test requires the subjects to keep a square cursor centered in a rectangle (see Fig. 5). The cursor is driven by a computer-programmed forcing function. Using the STICK with their right hand, the subjects make appropriate counterbalance movements of the cursor. The cursor moves in the same direction as the movement of the stick. The subjects work through seven of these sessions.

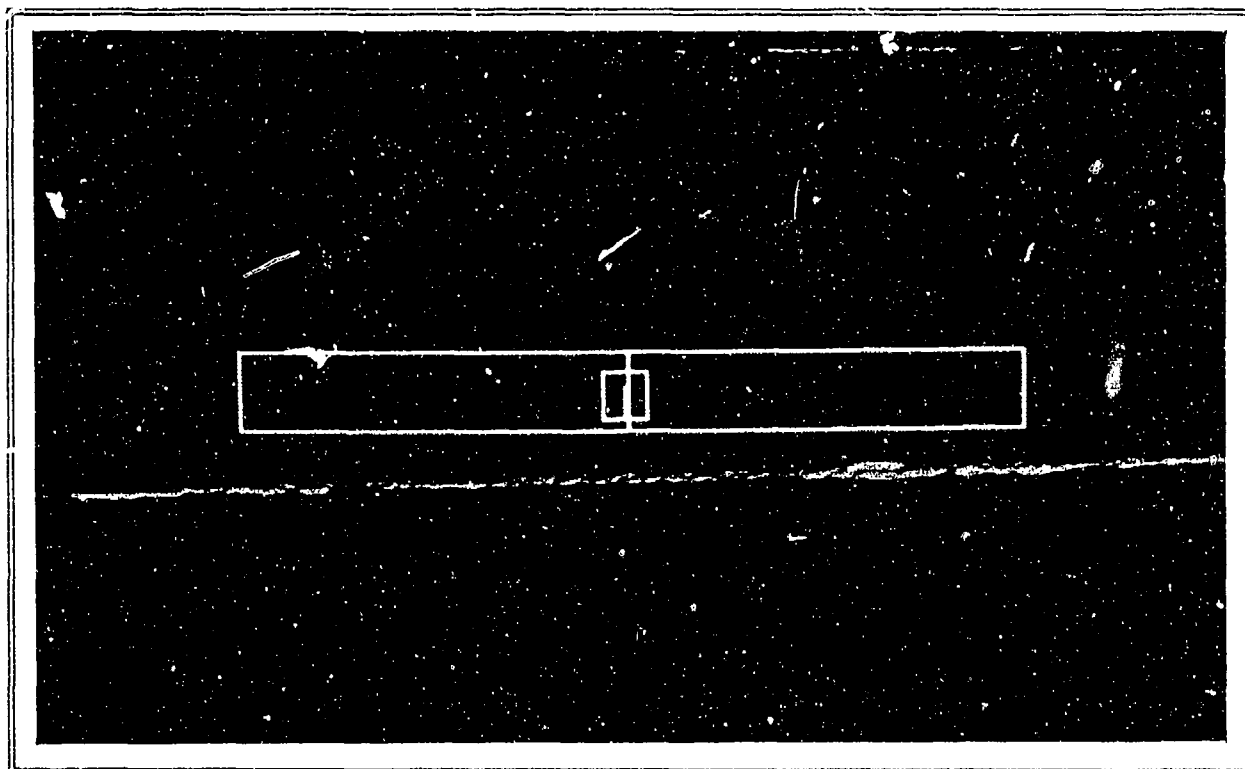


Figure 5. Compensatory Tracking. Cursor at zero error position.

2. **DC.** This task requires the subjects to use their left hand to key in numbers 1-4 on a keypad as they appear on the screen. The subjects need to be told that responses are recorded for both speed and accuracy. The subjects work through one session.

3. **DUAL CT/DC.** This final portion of the test requires the subjects to perform both tasks at the same time. The subjects must pay equal attention to each task. The numbers for the DC task are centered at the top of the CT rectangle. The subjects work through three sessions. Again, the DC is performed with the left hand and the CT with the right hand.

The length of the CT, DC, and Dual CT/DC tasks is included in Table 3.

Table 3. CT/DC Test Duration.

Test	Time (min)	Cumulative (min)
1. Compensatory Tracking	15	15
2. Digit Cancellation	2	17
3. Dual CT/DC	8	25

Note: The times listed above only include actual test time; they do not include time taken to read the instructions. Therefore, the actual time to complete testing may vary depending on the subject's ability to read and comprehend test instructions.

LCAC SELF-REPORT (LSR)

The LSR is divided into two parts. The first part is composed of various biographical and interest questions that have been found to be associated with LCAC primary training outcomes. The second part consists of statements designed to measure subjects' representations of themselves. The subjects respond to statements by selecting a number from a 5-point scale (1-5) that represents the one that best describes themselves. For example,

1	2	3	4	5
STRONGLY	SLIGHTLY	NEITHER	SLIGHTLY	STRONGLY
AGREE	AGREE	AGREE	DISAGREE	DISAGREE
		NOR		
		DISAGREE		

I like to gossip at times.

For all the statements included, there are no right or wrong responses. Subjects should be directed to answer as honestly as possible.

TEST DURATION: Approximately 20 minutes. The actual duration depends on the subject's reading and comprehension ability.

ADULT PERSONALITY INVENTORY (API)

The API is a two-part, self-report personality measure designed to assess several areas of personality characteristics, interpersonal styles, and career/life factors.

In part 1, subjects are presented with 159 statements and asked to determine if the statement is "Generally True" or "Generally False" as it relates to themselves. The subjects have the option to choose "Not Sure," but should be discouraged from using this option, because it decreases the usefulness of the test. Part 2 is composed of 30 questions having correct answers. The subjects should be told to read the instructions carefully before answering these questions. This test is not timed, but the subjects should be instructed to work as quickly as possible.

TEST DURATION: Approximately 30 minutes. The actual duration depends on the subject's reading and comprehension ability.

TEST ADMINISTRATION

INFORMATION FOR TEST ADMINISTRATOR

The test administrators should be reasonably trained in the proper administration of psychological tests. They must be aware of the ethics of testing, personal privacy, test security, and confidentiality of test results. Test administrators should be sensitive to signs of subject distress or confusion and be familiar with techniques for handling problems in the testing room.

The best way to become familiar with the tests is for the test administrators to work through them. When working through the tests, for practice or for demonstration purposes, a number from 1 to 32,767 should be selected that will be used strictly for these purposes; to avoid confusion, this number should NOT be assigned to actual subjects.

ESTABLISHING RAPPORT WITH THE SUBJECT

It is important that subjects are comfortable and relaxed before they begin the tests. When the subjects arrive, attempts should be made to put them at ease. Test administrators may want to talk to them about general areas such as their trip, their duty station, why they chose the LCAC program, et cetera; anything that will make them less anxious about the testing.

Before subjects are given the LCSS, they must pass a physical examination, for which they are required to fast. Sometimes subjects proceed to the LCSS testing without having eaten. This may hamper their ability on the psychomotor tests. If they have not eaten, they should be given time to do so.

Before testing, the subjects should be told that they may take breaks as needed between the tests. Although this is their option, subjects should be aware that their performance on the tests may be adversely affected by fatigue.

PRETESTING PROCEDURES

When the subjects are ready, ask them to read and complete the consent and Privacy Act form. (We found it useful to give subjects a handout with information about the testing and what to do after test completion. See Appendix F for a sample of this handout.) The LCSS programs require that a number be entered before beginning the tests; therefore, all subjects are assigned a subject number. For practical purposes, the subject numbers should be assigned in consecutive order. The record containing the subjects' names, social security numbers, and subject numbers should be secured.

The test administrator may use the following instructions.

"The tests that you are about to take have been found to be predictive of LCAC crew performance. They are used to determine whether or not candidates are qualified for entry into Phase 1 of LCAC crew training. They are mostly composed of computerized psychomotor tests involving eye-hand-foot coordination, and are similar to video games. You will also be asked to take a biographical inventory and some personality measures. The personality measures do not diagnose mental illness and are simply used to determine your feelings about yourself and your likes and interests."

"The entire battery takes approximately 3 hours to complete. However, the time varies depending on the number of candidates being tested."

"After each test, you will be given an opportunity to take a break if you need one. Even if you do not feel tired, we encourage that you take a short break between the tests because your performance may be affected by fatigue. No one is expected to perform perfectly on all the tests, so do not become overly concerned if you make a few errors. However, try to perform as well as you can on all the tests. It is a combination of your performance on all the tests that determines whether you pass or fail."

"Your scores on these tests will be kept confidential except to those analyzing the results and to those conducting Navy research. When testing has been completed, appropriate scientists will analyze your test results and report to BUPERS whether or not you are recommended for Phase 1 training. A final decision is made entirely by BUPERS."

ADMINISTERING THE LCSS TEST BATTERY

Before beginning each test, explain what the test consists of and what the subject should expect. (An example of the test descriptions is provided in Appendix G.)

Turn on power strip. (This turns on the entire system). The screen will have six lines of system information and also the following:

To run the LCAC Testing Program, type TEST <ENTER>

When the "C:" prompt appears, press the following keys on the numeric keypad:

	<INS>	<HOME>	<#PG UP>	<INS>	<Enter>
The computer will show:	T	E	S	T	

Note: You also can begin the tests by typing "test" and pressing <Enter> from the keyboard.

The following main menu will appear:

LCAC Crew Selection System Select test to be administered: 1. Psychomotor test (PMT) and Dichotic Listening test (DLT) 2. Compensatory tracking (CT) and Digit Cancellation (DC) 3. LCAC Self-Report 4. Administrative Utilities 5. Exit
--

1. To begin the LCSS, ask the subject to press <1>. The computer will ask for the subject's assigned number. Be sure it is keyed in correctly, then ask the subject to press <Enter> to continue. The menu for the LCAC PMT/DLT test will appear:

Enter test number to run first. To run the tests in sequential order press <1> and <Enter>.

1. Psychomotor (PMT), Stick only
2. Dichotic Listening (DLT)
3. Dual (PMT DLT)
4. Psychomotor (Stick and Rudder)
5. Triple (Stick, Rudder, DLT)
6. Throttle (With Stick and Rudder)
7. All Four
8. Return to Main Menu

To start the PMT/DLT test, ask the subject to press <1>. This takes the subject through the entire sequence of this test (the seven subtests). Once the test has started, the PMT/DLT menu will not reappear. As the subject proceeds through the testing sequence, the instructions for each test will appear on the screen.

On subtest # 7 of the PMT/DLT, the computer will prompt the subject to call the test administrator. The test administrator is required to record the DLT responses. When the subject is ready, press <HOME> (on the numeric keypad) to bring up the test instructions. Explain to the subject that he or she will now be responding verbally to the DLT.

2. When the subject has completed all seven subtests, the computer will return to the main menu. This is a good time for the subject to take a break if he or she has not already taken one. When ready to continue, ask the subject to press <2>. Again, the computer will ask for the subject's assigned number; ask him or her to key it in and press <Enter>. The instructions for the CT/DC test will appear.

3. When the subject has completed the CT/DC tests, the main menu will reappear. If ready to continue, ask the subject to press <3> to begin the LCAC Self-Report. The computer will ask for the subject's assigned number; ask him or her to key it in and press <Enter>. The instructions for this test will appear.

4. On completion of the previous three tests, the subject will take the API. Exit the LCSS Main Menu by pressing <5>. If you are giving the subject the computerized version of the API (called TestPlus), the responses to the questionnaire must be typed in from the keyboard. To begin, insert the Test Plus floppy in the a: drive, type "a:" and press <Enter>. Next, type "testplus" and press <Enter>. The Test Plus Main Menu will appear:

- [1] Administer test
- [2] Data Management Menu
- [3] Quit

Press Selection Number and ENTER

To start the test, press <1> and <Enter>. The subject will be presented with several screens of instructions. Following the instructions the subject will be given a sample test of the type of questions included in the second part of the inventory. After answering all five questions correctly, the computer program requests some identifying information. The subject needs to type in his or her name and gender.

If any one of the sample questions is answered incorrectly, the computer will prompt the subject to ask the test administrator for additional instructions. The prompt will appear after all five questions have been presented. (The answers to these questions are fairly obvious, usually the incorrect response(s) was due to a careless mistake). To return to the test, press <Ctrl> and <K> simultaneously. The main menu will reappear. Go through each question with the subject to determine why a question(s) was answered incorrectly.

This test is not timed, but the subject should answer each question as quickly as possible. Remind the subject to minimize the use of the "Not Sure" option.

Instructions for the paper-and-pencil version of the test are on the first page of the test booklet. Remind the subject to give only one answer for each test item. Instructions for entering subject responses into the computer are included in Appendix H.

DEBRIEFING SUBJECTS AFTER TEST COMPLETION

Generally, subjects like to know how they did and whether or not they have passed the test battery. Let them know this information will be available in a week. Explain that their scores on the various tests are put into a statistical formula that outputs a composite pass/fail score. Their performance on any one test does not determine whether they passed or failed. Give them a date, name, and phone number of the BUPERS contact person (provided to the test administrators) to find out if they have been accepted for LCAC crew training.

During testing, it is extremely important that the subjects are given no indication of how they are performing on the test battery. Keep in mind that their performance is scored by the computer. Also, the subjects must not be given any information regarding how their performance compares to the performance of other candidates (Privacy Act).

PRINTING THE DATA

Return to the LCSS main menu. Press <4> to go into the Administrative Utilities menu. The following menu will appear:

Utilities Menu
1. Print PMT and DLT test results
2. Print Self-Report Data
3. Print CT and DC test results
4. Copy data files to floppy (drive a:)
5. Delete subject's data files from hard disk
6. Check joystick and pedal movement (visual)
7. Check joystick and pedal range (numerical)
8. Return to main menu

If there is a printer hooked up to the test station, you can print the data directly from there.

To print the PMT/DLT data, press <1>.

At "Enter subject number for PMT/DLT report:"

Enter the subject number and press <Enter>

To print the LCAC Self-Report, press <2>.
At "Enter subject number for Self-Report?"
Enter the subject number and press <Enter>

To print the CT and DC test results, press <3>.
The CT/DC data of all subjects stored in the hard drive will be printed out.

If there is not a printer hooked up to the test stations, insert a floppy in the a: drive and press <4>.
The computer screen will show the following files being copied:

PMTSCORE.DAT	(corresponds to PMT scores)
DLTDATA.DAT	(corresponds to DLT scores)
DUAL.DAT	(corresponds to CT/DC scores)
LSELF.DAT	(corresponds to LSR responses)

When finished, remove the floppy disk, and press <8> to exit the Utilities Menu. Once in the LCSS menu, press <5> to exit.

To delete all data from the hard drive of the test stations, go into the administrative utilities menu and press <5>. The computer will display the following message:

Remove all *.dat files (1=yes, 0=no)?

Select the option you want and press <Enter>. Data deletion should be done periodically in order to avoid memory constraints.

HOW TO PRINT THE DATA FROM THE FLOPPY DISK

A menu-driven program is included in the LCSS package, which allows the user to copy and print the data directly from a menu. The menu is similar to the Administrative Utilities Menu. To install this program, create a new directory (i.e., C:\admin) where the print program and data files will be stored.

To create this directory:

1. At "C:\\" type: "md" directory name and press <Enter>
2. At "C:\\" type: "cd" directory name and press <Enter>
3. Insert PTS floppy in the a: drive
4. Type: "copy a:pts.exe" and press <Enter>
5. Type: "copy a:brun20g.exe" and press <Enter>

Your print program will be ready to execute.

To bring up the print program, type: "pts" and press <Enter>. The following menu will appear:

-- Utilities Menu --

1. Print PMT and DLT test results
2. Print Self-Report Data
3. Print CT and DC test results
4. Copy data files to hard disk drive
5. Delete subject's data files from hard disk
6. Exit

To copy the data files from the floppy to the hard drive, press <4>. The computer will show the files being copied.¹

To print the PMT/DLT data, press <1>.

At "Enter subject number for PMT/DLT report:"
Enter the subject number and press <Enter>

To print the LCAC Self-Report, press <2>.

At "Enter subject number for Self-Report?"
Enter the subject number and press <Enter>

To print the CT and DC test results, press <3>.

The CT/DC data of all subjects stored in the hard drive will be printed out.

To delete all subject data files from the hard drive press <5>. The computer will display the following message:

Remove all *.dat files (1=yes, 0=no)?

Select the option you want and press <Enter>.

To exit the program, press <6>.

See Appendix I for information on how to handle missing PMT/DLT data.

The API scores can be printed by two methods (Krug, 1985):

Method 1.

1. Insert the Test Plus floppy in the a: drive.
2. Type: "a:" and press <Enter>
3. Type "testplus" this will bring up the Test Plus main menu
4. At the main menu, press <2> and <Enter>
5. Type in the password "metritech" and press <Enter>. A second menu will appear:

¹If using more than one test station, remember the data file names are the same. Print out the data from one disk before copying the data from the other disks onto the hard drive.

- [1] Print Individual Report
- [2] Review/Select Individual Data
- [3] Create Decision Model
- [4] Print Decision Model
- [5] Review/Select/Combine Decision Model
- [6] Change Operating Environment
- [7] Operator Entry
- [8] Return to Main Menu

Press Selection Number and ENTER key:

6. Press <2> and <Enter>. Another menu will appear:

- [1] Select Record
- [2] Delete Record
- [3] List Record
- [4] Return to Data Management Menu

Current Person: None
Current Model: None

Press Selection Number and ENTER key:

7. Press <1> and <Enter> for an alphabetical listing of the subjects. To select the one you want, press <Esc> and type in the record number of the subject. You will return to the menu. The subject's name will appear by "Current Person:."

8. Press <4> and <Enter> to return to the Data Management Menu.

Method 2. The second way to print the data is by creating an ASCII file. (There are two ways to create an ASCII file of the test scores. Only one of these methods is described below; please refer to the API manual for information on the second way to create this file.)

1. Access the Data Management Menu and press <6> and <Enter>. This will bring up the Operating Environment Menu.

- [1] Change Password
- [2] Turn Password Protection ON/off
- [3] Change Test Form to long from SHORT
- [4] Select Output Device (PRINTER/screen/disk)
- [5] Select MONOCHROME/color monitor
- [6] Return to the Data Management Menu

Options in capitals show CURRENT status

Press Selection Number and ENTER key:

2. Press <4> and <Enter>. This will bring up an additional menu:

- [1] Output to Printer
- [2] Output to Screen
- [3] Output to Disk
- [4] Return to Previous Menu

Press Selection Number and ENTER key:

3. Press <3> and <Enter>.

4. At the prompt: "Enter output filename:" Enter the drive, directory, and filename of where you would like the data stored (i.e., c:\data\api.dat), and press <Enter>.

5. Press <4> and <Enter> to return to the Operating Environment Menu. To return to the Data Management Menu, press <6>.

6. At the Data Management Menu, press <1> and <Enter>. Check that the printer is at the top of the page and turned on. Press <Enter> again when ready to print.

TEST SCORES

The PMT/DLT scores are printed out already scored and summarized for each subtest. A sample printout is provided in Appendix J. The only score not printed out is the vocal DLT score, which is scored manually. Instructions for correcting the vocal DLT responses are included in Appendix K.

The CT/DC scores require certain computations to be performed before they are used in the predictive equation. A sample printout and the instructions for the computations can be found in Appendix L.

The first two sets of scores printed out from the LCAC Self-Report are the raw responses to the first part of the questionnaire. Some of the Biographical Inventory scores are coded. The coded values are provided in Appendix M. The validity score is a composite score derived from the responses to the second part of the test. A sample printout of the LCAC Self-Report is provided in Appendix N.

The API (Test Plus) scores are printed out on four different sheets. The first page contains the subject's name, test date, and gender, information about the test itself, and four validity scores. The second page contains the scores for each of the 21 scales. The third page provides a narrative report of the subject based on his responses. The final page contains the raw responses to the questions. A sample of the Test Plus printout is provided in Appendix O.

The LCAC Decision Model, the analysis used to determine if subjects should be recommended for Phase 1 training, is included in Appendix P.

If assistance is needed in evaluating subject scores, send subject data disks, DLT audio tapes, and all answer sheets to:

NAVAEROMEDRSCHLAB
Attn: CODE 25
51 Hovey Road
Pensacola, FL 32508-1046

Phone: DSN 922-8056/2244/3281
CM (904) 452-8056/2244/3281
FAX 922-4479

DEMO VERSION OF PSYCHOMOTOR TESTS

A DEMO version of the PMT/DLT test and CT, DC, and DUAL CT/DC tests has been included with the LCSS. Each PMT/DLT subtest lasts 30 seconds, except subtest # 7, ALL FOUR (stick, rudder, throttle, DLT), which lasts 50 seconds. The CT and DUAL CT/DC tests last 45 seconds each, while the DC lasts 30 seconds. To begin the DEMO, at the C:> prompt, press the following keys on the numeric keypad:

		<HOME>	<END>	<#PG DN>	<Enter>
The computer will show:	D	E	M	O	

Note: You also can begin the DEMO by typing "demo" and pressing <Enter> from the keyboard.

The following menu will appear:

Selection Test Battery Demo Select test to demonstrate: 1. Psychomotor test (PMT) and Dichotic Listening test (DLT) 2. Compensatory tracking (CT) and Digit Cancellation (DC) 3. Exit

To demonstrate the PMT/DLT subtests, press <1>. The following menu will appear:

** DEMO ** Enter test number to run first. To run the tests in sequential order press the #1 key and enter. 1. Psychomotor (PMT), Stick only 2. Dichotic Listening (DLT) 3. Dual (PMT DLT) 4. Psychomotor (Stick and Rudder) 5. Triple (Stick, Rudder, DLT) 6. Throttle (With Stick and Rudder) 7. All Four 8. Return to Main Menu
--

Press the number of the subtest to be demonstrated. The instructions for each test have been included. After each subtest, the computer will return to the PMT/DLT demo menu.

To demonstrate the CT, DC, and DUAL CT/DC tests, press <2> from the DEMO Main Menu. The following menu will appear:

**** DEMO ****

CT/DC Demo Menu

- 1. Compensatory Tracking Demo**
- 2. Digit Cancellation Demo**
- 3. Dual - CT/DC Demo**
- 4. Exit to Main Menu**

Press the number of the subtest to be demonstrated. The instructions for each test have been included. After each subtest, the computer will return to the CT/DC Demo Menu.

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- Nontasak, T., Dolgin, D.L., Griffin, G.R. (1989). Performance-based tests, personality attributes, and training outcome among Landing Craft Air Cushion vehicle operators. *Proceedings of the 33rd Annual Human Factors Society meeting*, Denver, CO, pp. 901-904.

Other Related NAMRL Publications

Cited above.

Appendix A

HARDWARE CONFIGURATION

The LCSS basic hardware items consist of the following:

- * Zenith Computer Model ZWX-0248-62 with a minimum of:
 - 1 MB RAM memory
 - 1 360kB floppy disk drive
 - 1 20MB hard disk
- * Zenith Monitor Model ZVM-1380
- * SRL LABPAK Interface Board with:
 - 4 A/D channels
 - 2 voice synthesizers
- * Numerikeys Keypad System
- * 2 aircraft-type joysticks made by Measurement Systems, Inc.
- * Mechanical rudder pedals (patterned after those of a Systems Research Laboratory Psychomotor test device)
- * Telex Headphones with microphone model CS-91
- * Sony Tape Recorder model TCM-5000EV
- * Interface Cables
- * BEST Uninterruptable Power Supply
- * Booth enclosure and chair.

HARDWARE CONNECTIONS AND MAINTENANCE

During testing, the computer monitor displays three cross symbols. Initially, each cross begins at its center position and gradually moves to an off-center location. The center joystick (STICK) will be forced to the upper right-hand corner. The left joystick (THROTTLE) will be forced to the lower left-hand corner, and the foot pedals (RUDDER) will be forced to the lower right-hand corner of the screen.

The movement of the joysticks by the subject allows the corresponding cursor to move on the screen. The center joystick (STICK) is controlled in both the X and Y axes, whereas, the left joystick (THROTTLE) is controlled only in the Y axis. The references for the STICK, RUDDER, and THROTTLE are taken from the wiper-arm of a potentiometer that has +5 volts dc on one side and -5 volts on the other side (see Fig. 6). The STICK cursor moves in the opposite direction of the STICK. The THROTTLE only moves the cursor on the Y axis and moves it in the same direction as the THROTTLE movement.

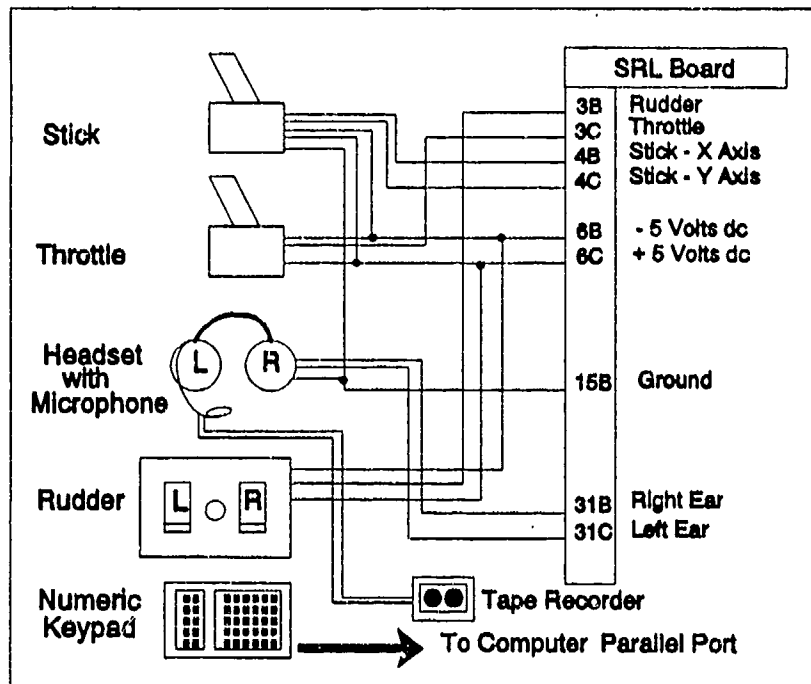


Figure 6. Basic Hardware to SRL Interface Board, Computer, and Tape Recorder Pin Connection Diagram.

The foot pedal (RUDDER) controls the movement of the cross at the bottom of the screen. When the right pedal of the RUDDER is pushed forward, the cross moves to the right. When the left pedal is pushed forward, the cross moves to the left.

The headphones are connected to two audio output channels of the SRL board (see Fig. 6). This allows two different signals to be presented at the same time.

Appendix B

COMMON PROBLEMS AND SOLUTIONS

PROBLEM: CURSOR not responding to controllers (stick, rudder pedals, or throttle).

REMEDY: Check connections for controller(s) to computer, or any other loose connections in between.

PROBLEM: STICK moves the cross in the same direction as STICK movement.

REMEDY: Reverse the leads going to pins 4B and 4C.

PROBLEM: RUDDER moves the cross in the opposite direction of RUDDER movement.

REMEDY: Reverse the two outside leads on the 5 kilo-ohm potentiometer located between the two foot pedals.

Appendix C

CALIBRATION

Two programs have been included with the system in order to ensure that the joysticks (STICK THROTTLE) and the foot pedals (RUDDERS) are working properly.

The first program is a visual check of the movement of the STICK, THROTTLE, and RUDDERS. In order to access this program, go into the LCSS Main Menu and press <4> to access the Administrative Utilities menu. Once in this menu, press <6>.

The computer monitor will display three cross symbols. The STICK cursor will be located in the upper right-hand corner, the THROTTLE cursor will be in the lower left-hand corner, and the RUDDERS' cursor will be in the lower right-hand corner of the screen. Move the STICK, THROTTLE, and RUDDERS to ensure that the STICK moves in the opposite direction as the movement of its corresponding cursor, and that the THROTTLE and RUDDERS move in the same direction as their corresponding cursors. The program shuts off automatically after approximately 1 minute.

The second program is a numerical check of the STICK, THROTTLE, and RUDDERS. In order to access this program, follow the same procedure outlined above to get into the Administrative Utilities menu and press <7>. The computer monitor will display the following information:

JOY STICK (CENTER AND THROTTLE) AND FOOT PEDAL TEST			
CENTER		FOOT	THROTTLE
X	Y	PEDAL	
127	127	131	109
PRESS 1 TO QUIT			

Note: The numbers above may vary depending on the position of the joysticks and rudder pedals at the time of the test. Approximations are acceptable.

When testing the STICK, move it from left to right and up and down. Moving the STICK all the way to the left should cause the number under the X to decrease to 0 (or near 0), and moving it all the way to the right should cause it to increase to approximately 250. Moving the STICK all the way up should cause the number under the Y to increase to approximately 250, and moving it all the way down should cause it to decrease to 0 (or near 0).

To test the RUDDERS, push the left pedal all the way; the number below FOOT PEDAL should decrease to about 114. Next, push the right pedal all the way; the number should increase to about 150.

Finally, moving the THROTTLE should cause the number under THROTTLE to increase to roughly 250, and moving it down should cause the number to decrease to 0 (or near 0).

To exit the program, press <1>.

Appendix D

DOCUMENTATION FOR FILES OF THE LCSS TEST BATTERY

Below is a description of the organization of the files that make up the LCSS. A brief description of each file is given.

Contents of \LCSS - BASIC language source files for most tests

ALL_FOUR	BAS	-Stick, Rudder, Throttle, and DLT combined.
DLT	BAS	-Dichotic Listening Test (DLT).
MAIN	BAS	-Main menu and PMT menu, also single task (Stick) test.
README	TXT	-File containing this list of files.
STIK_DLT	BAS	-Stick and Dichotic Listening Test (DLT).
ST_RD_TH	BAS	-Stick, Rudder, and Throttle tests combined.
STIK_RUD	BAS	-Stick and Rudder tests combined.
ST_RD_DL	BAS	-Stick, Rudder, and DLT combined.
SMOVE	BAS	-Test joystick movement.

Contents of \LCSS\DATA - data files used as input to the LCSS system

DLTSTIM1		-DLT stimulus for comparison during scoring.
DLTSTIM2		-DLT stimulus for comparison during scoring.
DLTSTIM3		-DLT stimulus for comparison during scoring.
EARSEQNC		-Data for order of (R or L) ear presentation.
LEFTEAR		-ASCII values of data read for left ear of speech synthesizer.
NARDAC	VOC	-Contains vocabulary mappings for speech synthesizer.
NARDAC	ROM	-Binary data for speech synthesizer that is loaded into memory by the command program, LOADDT.
QUEST	LCA	-More questions used by self-report.
RIGHTEAR		-ASCII values of data read for right ear of speech synthesizer.
SORDER		-Used by COMTRK.EXE in the DC tests.
SELF		-Contains questions used by self-report (LSELF.EXE).
TORDER		-Used by COMTRK.EXE in the DC tests.

Contents of \LCSS\BIN - executable binaries called by the LCSS system

COMTRK	EXE	-Executable program for the CT and DC tests.
LSELF	EXE	-Executable program for the self-report.
LOADDT	COM	-Command program that loads NARDAC.ROM into memory at d000.
PSELF	EXE	-Executable program that prints results of self-report.
REPORT	EXE	-Executable program that prints results of PMT and DLT tests.

Contents of \LCSS\SOURCE - other BASIC source files for compiled executables
(Also contains BASIC compiler and library for linking object files):

BRUN20G	LIB	-Library used when linking object files.
BCOM20G	EXE	-Compiler for compiling BASIC source into *.obj files.
COMTRK	BAS	-BASIC source for COMTRK.EXE.
LSELF	BAS	-BASIC source for LSELF.EXE.
PSELF	BAS	-BASIC source for PSELF.EXE.
REPORT	BAS	-BASIC source for REPORT.EXE.
PTS	BAS	-BASIC source for PTS.BAS - executable to Print Test Scores (for installation on administrator's computer).

Other files needed to operate the LCSS: LOCATED IN \bin:

GWBASIC	EXE	-Version 3.23 or higher.
BRUN20G	EXE	-BASIC runtime program for running executables.
TEST	BAT	-Batch file to change into LCSS directory and executables. the GWBASIC interpreter and MAIN.BAS.
MESG	TXT	-Opening message when computer starts up, instructing the user to type "TEST" to start the LCSS system.
MESG	BAT	-Batch file that types opening message.

Files created by LCSS: (data files used in scoring test subjects)

PMTSCORE	DAT	-Test data for PMT tests.
DLTDATA	DAT	-Test data for DLT tests.
LSELF	DAT	-Test data for self-report.
DUAL	DAT	-Test data for CT and DC test.

Appendix E

DICHOTIC LISTENING TEST MULTIPLE-CHOICE QUESTIONS

The screen displays one question at a time. After the question is answered correctly, the screen displays the next question. When the last question is answered correctly, the test begins.

QUESTION # 1

You are taking the dichotic listening test.

You hear "TEST 9" and then "RIGHT," you should:

1. Report the numbers and letters on the right ear.
2. Report the numbers on the right ear.
3. Report the numbers and letter 'O' on the right ear.

Press the key corresponding to the correct multiple-choice answer.

QUESTION # 2

Halfway through Test Trial #9, you hear the command "LEFT," you should:

1. Continue reporting numbers and letters on the right ear.
2. Continue reporting numbers only on the right ear.
3. Switch attention to the left-ear channel and report numbers and letters.
4. Switch attention to the left-ear channel and report numbers only.

Press the key corresponding to the correct multiple-choice answer.

QUESTION # 3

About the letter "O" AND the number "ZERO." You should...

1. Report "O's," but not "ZERO."
2. Report "ZERO's," but not "O's," since "O's" are letters.
3. Report both "O's" and "ZERO's."

Press the key corresponding to the correct multiple-choice answer.

Appendix F

SAMPLE OF LCSS INFORMATION HANDOUT

INFORMATION FOR LCAC CREW CANDIDATES

LCAC CREW SELECTION SYSTEM (LCSS)

During your assignment to the Naval Aerospace Medical Research Laboratory (NAMRL), you will be taking the LCSS. This system is simply a battery of tests used to determine whether or not training candidates are qualified for Phase 1 LCAC crew training.

These tests are based on several years of research comparing performance on the battery of tests with actual performance during LCAC crew training. More than one hundred LCAC fleet crew members have taken these tests and in turn provided standards for NAMRL to make a recommendation about a new candidate. The tests chosen for the selection process are those that were found to be predictive of LCAC crew performance.

TESTS

The tests you will be taking are mostly composed of computerized psychomotor tests, involving eye-hand-foot coordination, similar to popular video games. You will also be asked to take a couple of personality measures. These tests are NOT designed to diagnose mental illness, but instead, are simply used to assess your feelings about yourself, and your likes and interests. In addition, you will also take a test that taps into common memory processes.

The entire process of test administration takes approximately one and one-half days. This may vary depending on the number of candidates being tested and number of test stations available.

BREAKS

We are aware that you may feel anxious about the testing and may want to get it over with as quickly as possible. This is understandable, however, we encourage you to take breaks between the tests so that fatigue does not play a role in your performance.

PERFORMANCE

Performing perfectly on the tests is virtually impossible; therefore, if you make a few errors do not become overly concerned. Try to perform as well as you can on all the tests. Please be aware that not one test determines whether or not you will be recommended for LCAC training. It is a combination of your performance on all the tests that determines the recommendation.

TEST ADMINISTRATORS

Test administrators are only here to facilitate the administration of the tests. Because most of the tests are performed on computers, your scores are calculated by the computer. It is not possible for test administrators to tell you how you are performing on the tests. Additionally, the Privacy Act prevents NAMRL from telling you how your test performance compares to others who take the same tests.

After you have completed the battery of tests, NAMRL will analyze the results and report its recommendation to BUPERS. This process takes approximately 1 week. Remember, a final decision is made by BUPERS.

In order to find out whether you are recommended for Phase 1 LCAC crew training, you will need to contact BUPERS:

MASTER CHIEF EDGAR or
LT. BISHOP

DSN: 225-7252
COMMERCIAL: (202) 695-7252

Appendix G

EXAMPLE OF VERBAL TEST DESCRIPTIONS

(These instructions are to be given to the subjects when they are ready to begin the LCSS.)

You will be taking a total of four tests. The first three are on this computer, the last one is a written personality test.

PMT/DLT

The first test you will take is a psychomotor test. Press <1> to bring up another menu. Enter your subject number and press <Enter>.

(When menu appears): This is the menu for the subtests that make up the first test. I will explain each test to you, but you don't need to memorize what I tell you because you'll get a great deal of instructions and practice before you begin each test.

On the first test, if you'll look at the diagram above the screen, you will be using the joystick in front of you to control the center cursor. The idea is to try to keep it on or as close as possible to the intersection of both lines. The cursor moves in the opposite direction of your stick movement, so if you move the joystick to your left, the cursor will go right and so on.

On the second test, you will be using the headsets. The microphone wire goes over the left ear. On this test, you will get numbers and letters coming into both ears at the same time. The computer will specify which ear to pay attention to. Your task is to key in only the numbers heard in the specified ear. You will get a sample and practice session before you begin. Also, when you begin the practice session, I will be here to be sure you understand the instructions. Be sure to key in your responses with your left hand because you will need to get used to that.

On the third test, you will be doing the first two in combination. You will be controlling the center cursor and responding to the listening test.

On the fourth test, you will be using the foot pedals to control the bottom cursor. The idea is to try to keep the cursor on or as close as possible to the vertical line. On this test, the cursor moves in the same direction as the pedal movement. You will also be controlling the center cursor, so you will be doing two tracking tasks at the same time.

On the fifth test, you will perform the two tracking tests, the center and bottom cursors, and also the listening test.

On the sixth test, you will be using the joystick to your left to control the cursor on the left-hand side, called the throttle. The idea is to try to keep it on or as close as possible to the horizontal line. In addition, you will be doing the other two tracking tasks, the center and bottom cursors.

On the last test, you will be performing all three tracking tasks and the listening test. Because you cannot respond to the listening test with your hand, you will be calling out the numbers verbally and they will be recorded.

To begin press <1>. This will take you through the entire sequence of tests. If you need to take breaks you can do so between subtests. You will be in control of when the next test starts, for example, it will ask you to press <1> to continue. If you're ready just press <1>.

CT/DC

(Give the subjects these instructions when they have completed the PMT/DLT and are ready to begin the CT/DC task.)

Press <2> key to bring up the next test. This next test is also a tracking test. It is a little different than the one you just took. On this test, you will be using the center joystick to control the square inside the rectangle (show them on the screen). The idea is to try to keep the line in the square on the line in the rectangle. The joystick is very sensitive, so once you get the square in or close to the center make very subtle movements to try to keep it in place. Also, this rectangle has a seesaw-like effect, you cannot hold the square in place; it will begin moving after a few seconds. You will have seven trials, each lasting 2 minutes. The first one is for practice purposes.

After you finish the seven trials, you will have what is called a digit cancellation task. You will have numbers ranging from 1 to 4 appearing on the screen one at a time. Your task is to key in the number you see. On this test, we are looking at reaction time and accuracy; so you want to work as fast as you can without sacrificing accuracy. You will have a one 2-minute session.

The last task is a combination of the two. You will be performing the tracking task and the digit cancellation task at the same time. You will be given three trials of this dual task. Again, if you need to take a break, do so between tests and not during the tests.

LCAC SELF-REPORT

(When the subjects are ready to begin the LCAC Self-Report, use the following instructions.)

Press <3> to begin the LCAC Self-Report. On this test, you will be asked for some biographical information, such as your age, rate, and so forth. Then you will be asked some questions about yourself. There are no right or wrong answers, just answer as honestly as possible.

TEST PLUS

(Use the following instructions when the subjects have completed the computerized tests and are ready to take the Test Plus.)

This is a personality test. It is not used to diagnose mental illness, but is strictly used to determine your feelings about yourself, your interests, that type of thing. On this test, you either agree or disagree with a statement. You also have the option to choose "don't know." We try to discourage you from using that option too much because the more you use it the less we know about you. Only use it if you absolutely don't know.

Appendix H

ENTERING API RESPONSES INTO THE COMPUTER

To enter the subject's responses into the computer, you must first access the Test Plus main menu and then the Data Management Menu. To do this, follow the same procedure outlined on pages 15 and 16. The instructions for this procedure are also outlined in the API manual (Krug, 1985).

Once in the Data Management Menu, press <7> (for operator entry) and <Enter>. Instructions will appear on the screen stating that before proceeding, some identifying information is necessary. Press <Enter> and type in the subject's name and gender as indicated on the screen. After entering the subject's gender and pressing enter, the computer will display the following:

1	2	3	4	5	6	7
a b c	a b c	a b c	a b c	a b c	a b c	a b c
□□□	□□□	□□□	□□□	□□□	□□□	□□□
						Item 1

Use the "1" key for "T" or "a" responses, the "2" key for "?" or "b" responses, and the "3" key for "F" or "c" responses. If any other key is pressed, a tone will be heard, meaning an error has been made.

To enter the responses, simply type in the subject's responses in order. The screen will display each row as it is printed on the answer sheet. As each response is entered, the corresponding box will be highlighted to show which answer you entered. At the end of each row, the computer will ask you to verify the responses and press <Enter> to move to the next row. If you make a mistake, you can press any key other than the <Enter> key and reenter all the responses for that row.

After entering the first 159 responses, the computer displays a message to turn the answer sheet over and press <Enter>. Then it continues in the same way for the rest of the test.

After entering all the responses, the program automatically adds the test record to the data base.

Appendix I

PRINTING PMT/DLT DATA FILE WITH MISSING DATA

When printing the PMT/DLT data, the computer may display a message that the data for the subject is out of order. When this happens, hit any key to return to the Administrative Utilities Menu and press <8> to exit the menu. Next press <5> to exit the LCSS Main Menu. Go into WordPerfect® or a text editor and call up the file DLTDATA.DAT. The file will look like this:

```
-99
82765 52741
91735 57290
48751 56152
      52897
63097 52147
28605 54126
76324 51836
51937 58349
17854 57982
58032 56390
79036 58935
52678 51472
  1      1      0      0
-99
34901 69630
80264 66381
29063 69438
98105 66413
24518 60936
71394 65398
18509 60927
40628 62516
09362 63146
413   47421
81452 66214
4309  50369
  3 3 0 0
-99
82765 62741
91735 6729
04875 76152
43672 62897
63097 62147
28605 64126
76324 61836
51937 68349
17854 67982
58062 66390
79036 68935
52678 61472
  6 1 1 1
```

Note: Data missing in line # 5 of the sample file.

If any column contains missing data (such as shown in line # 5), the print program will not print the data. To solve this, enter any number (such as a "1") into that space. The DLT will have been scored already, so the number you enter will not affect the subject's score. Be sure to save the file. If editing the file in WordPerfect®, be sure to save it as an ASCII file. To save as an ASCII file when editing in WordPerfect®, press <Ctrl> and <F5> simultaneously. Press <1> for DOS Text and <1> to save. At replace, press <y>. Press <F7> to exit and <n> (to not save the file as a WordPerfect® file) and then <y> (to exit Word Perfect®).

Once you have edited and saved the file, you can print the data. Return to the Administrative Utilities Menu and follow the steps outlined on page 15.

Appendix J

PMT/DLT SAMPLE SCORES SHEET

Below is a sample of a subject's PMT/DLT test scores printout.

DLT SCORES				
SUBJECT #	99			
1A	1B	2A	2B	DLT SINGLE # CORRECT =
8	4	0	0	104
SUBJECT #	99			
1A	1B	2A	2B	FIRST DLT DUAL (XY) # CORRECT =
18	14	0	0	94
SUBJECT #	99			
1A	1B	2A	2B	SECOND DLT DUAL (XYZ) # CORRECT =
7	2	1	1	105
PMT SCORES				
SINGLE				
SUBJECT #	99			SINGLE PMT STICK (X,Y) 3 MIN =
				17520
DUAL				
SUBJECT #	99			DUAL PMT STICK (X,Y) 4 MIN =
				47148
SINGLE				
SUBJECT #	99			SINGLE PMT STICK & RUDDER 6 MIN =
				66047
DUAL				
SUBJECT #	99			DUAL PMT STICK & RUDDER 4 MIN =
				82042
SINGLE				
SUBJECT #	99			STICK & RUDDER 3 MIN =
				35393
				STICK & THROTTLE 3 MIN =
				24730
				STICK, THROTTLE, & RUDDER 3 MIN =
				43184
SINGLE				
SUBJECT #	99			STICK & RUDDER 3 MIN =
				43041
				STICK & THROTTLE 3 MIN =
				31360
				STICK, THROTTLE, & RUDDER 3 MIN =
				54278
DUAL				
SUBJECT #	99			STICK & RUDDER 3 MIN =
				32482
				STICK & THROTTLE 3 MIN =
				33880
				STICK, THROTTLE, & RUDDER 3 MIN =
				46647

EXPLANATION OF PMT/DLT PRINTOUT

Note: Refer to the PMT/DLT menu displayed on page 12.

<u>Printout Title</u>	<u>Corresponding Test</u>
DLT SINGLE # CORRECT	Subtest # 2, DLT score
FIRST DLT DUAL (XY) # CORRECT	Subtest # 3, DLT score
SECOND DLT DUAL (XYZ) # CORRECT	Subtest # 5, DLT score
SINGLE PMT STICK (X,Y) 3 MIN	Subtest # 1, Stick tracking score
DUAL PMT STICK (X,Y) 4 MIN	Subtest # 3, Stick tracking score
SINGLE PMT STICK & RUDDER 6 MIN	Subtest # 4, Stick & rudder tracking score
DUAL PMT STICK & RUDDER 4 MIN	Subtest # 5, Stick & rudder tracking score
SINGLE STICK & RUDDER 3 MIN	Subtest # 6, Trial # 1, Stick & rudder tracking score
STICK & THROTTLE 3 MIN	Subtest # 6, Trial # 1, Stick & throttle tracking score
STICK, THROTTLE, & RUDDER 3 MIN	Subtest # 6, Trial # 1, Stick, rudder, & throttle tracking score
SINGLE STICK & RUDDER 3 MIN	Subtest # 6, Trial # 2, Stick & rudder tracking score
STICK & THROTTLE 3 MIN	Subtest # 6, Trial # 2, Stick & throttle tracking score
STICK, THROTTLE, & RUDDER 3 MIN	Subtest # 6, Trial # 2, Stick, rudder, & throttle tracking score
DUAL STICK & RUDDER 3 MIN	Subtest # 7, Stick & rudder tracking score
STICK & THROTTLE 3 MIN	Subtest # 7, Stick & throttle tracking score
STICK, THROTTLE, & RUDDER 3 MIN	Subtest # 7, Stick, rudder, & throttle tracking score

Appendix K

INSTRUCTIONS FOR CORRECTING VOCAL DLT RESPONSES

Each DLT test session consists of 12 trials. Within each trial, the subjects receive two separate streams of information with a pause between them. The first stream contains five numbers mixed with letters. The second stream contains four numbers, also mixed with letters. The correct responses are the highlighted numbers on the DLT answer sheet (provided to the test administrators). A total of 108 correct responses are possible for all 12 trials.

Various DLT task scoring methods are available. A modified sequence-independent simple number correct scoring method is suggested (Griffin and Mosko, 1985). To correct the subjects' responses for each trial, consider only the first five responses (numbers and letters) for the first stream and only the first four responses (numbers and letters) for the second stream. Subtract the total number of mistakes from 108. The number of correct responses is their score. Subject responses are correct regardless of sequence position, as long as it is within the first five responses for the first stream or within the first four responses for the second stream. For example, if the following is presented²:

"Test 1"	
"RIGHT"	
Through the left ear:	R 8 N S M Y 2 G B 7 F L 6 R L 5
Through the right ear:	Y L <u>3</u> S R <u>4</u> F Z <u>9</u> X F <u>0</u> F N <u>1</u> L

"LEFT"	
Through the left ear:	B F <u>4</u> <u>3</u> <u>7</u> <u>9</u>
Through the right ear:	G L 1 5 6 2

and the subject responds:

3 8 9 4 F 0 1

4 3 7 2

The subject's score would be 3 out of a possible 5 for the first stream, and 3 out of a possible 4 for the second stream (or 6 out of 9 for the trial). The "3," "9," and "4" in the first stream and the "4," "3," and "7" in the second stream are correct.

Although the subject called out the "0" and the "1" in the first stream, the subject had already called out five responses (3, 8, 9, 4, and F) and only those are used. The "8" is incorrect because it was not heard through the designated ear, and the "F" is incorrect because it is a letter. Notice that although the "9" and "4" are out of sequence, they are still correct.

In the second stream, the subject called out four responses, but the last number should have been a "9." The number "2" was not heard through the designated ear.

Repeat this procedure for all 12 trials, and then subtract the total number wrong from 108 to obtain the subject's score.

²Correct responses are underlined.

Appendix L

COMPENSATORY TRACKING/DIGIT CANCELLATION SCORING

Below is a sample of a subject's printout and an explanation of the printout for the Compensatory Tracking (CT)/Digit Cancellation (DC) test. Following is an explanation of the computations performed on these scores and then an example of these computations using the scores from the sample printout.

Sample Printout

-99	CT:	Subject id
232351.2		tracking score Trial # 1
-99		Subject id
260007.4		tracking score Trial # 2
-99		Subject id
217626.1		tracking score Trial # 3
-99		Subject id
215735.3		tracking score Trial # 4
-99		Subject id
208696.9		tracking score Trial # 5
-99		Subject id
242608.3		tracking score Trial # 6
-99		Subject id
305812.3		tracking score Trial # 7
128	DC:	# of correctly canceled digits
.87		Mean RT for correctly canceled digits
.281		SD for correctly canceled digits
8		# of incorrectly canceled digits
.817		Mean RT for incorrectly canceled digits
.127		SD for incorrectly canceled digits
440867.7	CT/DC:	tracking score Trial # 1
102		# of correctly canceled digits
1.108		Mean RT for correctly canceled digits
.607		SD for correctly canceled digits
5		# of incorrectly canceled digits
1.022		Mean RT for incorrectly canceled digits
.712		SD for incorrectly canceled digits
300689.1		tracking score Trial # 2
121		# of correctly canceled digits
.943		Mean RT for correctly canceled digits
.404		SD for correctly canceled digits
5		# of incorrectly canceled digits
.681		Mean RT for incorrectly canceled digits
.399		SD for incorrectly canceled digits
441817.1		tracking score Trial # 3
113		# of correctly canceled digits
.983		Mean RT for correctly canceled digits
.464		SD for correctly canceled digits
8		# of incorrectly canceled digits
.754		Mean RT for incorrectly canceled digits
.268		SD for incorrectly canceled digits

The first 14 rows of the printout contain the subject id number and tracking error scores for the 7 trials of the single CT task.

The next six rows are the scores for the single DC task. The first line contains the number of correctly canceled digits, the next row contains the mean reaction time, and the next one the standard deviation for the correctly canceled digits. The following three lines contain the number of errors, the mean reaction time, and the standard deviation for those errors, respectively.

The following 21 lines contain the scores for the 3 trials of the Dual CT/DC task. Each set of seven lines represents a trial. The first number in that set of seven is the dual tracking error score for that trial. Below the dual tracking error score are the DC scores for that trial. These are presented in the same format as the single DC task scores.

CT/DC COMPUTATIONS

The CT/DC scores used in the selection prediction formula are based on computations performed on the printout scores. Following is a description of these computations and an example based on the sample printout.

The single CT score is the average of the last three trials of the CT task.
To compute:

Add the last three CT error scores and divide by three.
Result: **CT score**

The single DC score is a computed reaction time (RT) derived from a five-step process.

1. Multiply the number of correctly canceled digits by the mean RT for correctly canceled digits.
 2. Multiply the number of errors with the mean RT for errors.
 3. Add the results of step 1 with the results of step 2.
 4. Add the number of correctly canceled digits with the number of errors.
 5. Divide the result of step 3 by the result of step 4.
- Result: **DC score**

The Dual CT/DC scores are based on a series of computations computed separately for tracking and DC.

The Dual CT scores are based on two computed averages.

To compute the first average:

Add the three dual tracking error scores and divide by three.
Result: **First Dual CT score**

To compute the second average:

Add the last two dual tracking error scores and divide by two.
Result: **Second Dual CT score**

The Dual DC scores are based on a series of computations, resulting in two scores.

For each of the three trials, follow the single DC score five-step procedure above to determine the computed reaction time for each trial.

To compute the first Dual DC score:

Add the three computed dual task reaction times and divide by three.

Result: First Dual DC score

To compute the second Dual DC score:

Add the last two computed dual task reaction times and divide by two.

Result: Second Dual DC score

EXAMPLE BASED ON THE SAMPLE PRINTOUT

CT Score

$$\begin{array}{r} \text{Step 1: } 208696.9 \\ 242608.3 \\ + 305812.3 \\ = 757117.5 \end{array}$$

$$\text{Step 2: } 757117.5/3 = \underline{252372.5} \triangleright \text{CT Tracking score}$$

DC Score

$$\begin{array}{rcl} \text{Step 1:} & 128 * 0.87 & = 111.36 \\ \text{Step 2:} & 8 * 0.817 & = 6.536 \\ \text{Step 3:} & 111.36 + 6.536 & = 117.896 \\ \text{Step 4:} & 128 + 8 & = 136 \\ \text{Step 5:} & 117.896/136 & = \underline{0.867} \triangleright \text{DC RT score} \end{array}$$

DUAL CT/DC Scores

DUAL CT tracking scores

Score #1.

$$\begin{array}{r} \text{Step 1: } 40867.7 \\ 300689.1 \\ + 441817.1 \\ = 1183373.9 \end{array}$$

$$\text{Step 2: } 1183373.9/3 = \underline{394457.97} \triangleright \text{Dual CT tracking score \#1}$$

Score #2.

$$\begin{array}{r} \text{Step 1: } 300689.1 \\ + 441817.1 \\ = 742506.2 \end{array}$$

$$\text{Step 2: } 742506.2/2 = \underline{371253.1} \triangleright \text{DUAL CT tracking score \#2}$$

DUAL DC scores

Trial #1.

Step 1: $102 * 1.108 = 113.016$
Step 2: $5 * 1.022 = 5.11$
Step 3: $113.016 + 5.11 = 118.126$
Step 4: $102 + 5 = 107$
Step 5: $118.126/107 = 1.104$ ▶ Trial #1 computed RT

Trial #2.

Step 1: $121 * 0.943 = 114.103$
Step 2: $5 * 0.681 = 3.405$
Step 3: $114.103 + 3.405 = 117.508$
Step 4: $121 + 5 = 126$
Step 5: $117.508/126 = 0.933$ ▶ Trial #2 computed RT

Trial #3.

Step 1: $113 * 0.983 = 111.079$
Step 2: $8 * .754 = 6.032$
Step 3: $111.079 + 6.032 = 117.111$
Step 4: $113 + 8 = 121$
Step 5: $117.111/121 = 0.968$ ▶ Trial #3 computed RT

DUAL DC RT scores

DUAL DC RT score #1.

Step 1: 1.104
 0.933
 $+ 0.968$
 $= 3.005$

Step 2: $3.005/3 = \underline{1.002}$ ▶ DUAL DC RT score #1

DUAL DC RT score #2.

Step 1: 0.933
 $+ 0.968$
 $= 1.901$

Step 2: $1.901/2 = \underline{0.951}$ ▶ DUAL DC RT score #2

Appendix M

CODED LCAC SELF-REPORT VALUES

Present Rate

- | | |
|--------|-----------|
| 1 = BM | 5 = QM |
| 2 = GS | 6 = GSE |
| 3 = AD | 7 = GSM |
| 4 = SM | 8 = other |

Small Boat N.E.C. 1 = yes, 2 = no

State Recruited From

Based on U.S. Navy recruiting district. The number 0 corresponds to "other" (i.e., outside the United States).

- 1) CT, ME, MA, NH, NJ, NY, RI, and VT
- 3) AL, FL, GA, MS, NC, SC, and TN
- 4) DE, IN, KY, MD, OH, PA, VA, WV, and DC
- 5) IL, IA, KS, MI, MN, MO, NE, ND, SD, WS, and WY
- 7) AR, CO, LA, NM, OK, and TX
- 8) AK, AZ, CA, HI, ID, MT, NV, OR, UT, and WA

Race or Ethnic Background

- 1 = Black
- 2 = Hispanic
- 3 = White
- 4 = Other

Marital Status

- 1 = Never married
- 2 = Married
- 3 = Divorced
- 4 = Separated
- 5 = Widowed

Birth Order

- 1 = Only child
- 2 = Youngest
- 3 = Oldest
- 4 = Neither the youngest or oldest

Size of Home Community

- 1 = Farm or open country
- 2 = Town or village (<10,000 in population)
- 3 = Small city (10,000-49,999 in population)
- 4 = Medium sized city (50,000-499,999 in population)
- 5 = Large city (500,000 or more in population)
- 6 = Not applicable (e.g., due to frequent moves)

Appendix N

SAMPLE OF LCAC SELF-REPORT PRINTOUT

LCAC SELF-REPORT, SUBJECT#: 99

A) BIOGRAPHICAL INFORMATION

Present Rate	8
Length of Present Rate	65 months
Length of Military Service	65 months
Twin Screw Time	72 months
Small Boat N.E.C.	1
State Recruited From	3
Logged LCAC Hours	5
Age	27
Race or Ethnic Background	3
Marital Status	1
Number of Children	0
Birth Order	1
Size of Home Community	2

B) SELF-RATED ABILITIES

Stick Shift	4
Operate Tractor	4
Write With Non-preferred hand	4
Backup Trailer	7
Keep Files in Order	3
Paint a House	7
Operate a Jet Ski	6
Sail in a Stiff Breeze	5
Fly an Aircraft	3
Play Cards	2
Take Care of a Garden	1
Play Sports	8
Drive in Heavy Traffic	2
Public Speaking	6
Parallel Park	2
Play Video Games	7
Operate a Tugboat	4
Sing in a Choir	8
Drive a Motorcycle	1
Fly a Hang Glider	5
Handle a Poisonous Snake	4
Parachute	2
Water Ski	3
Operate a Snow Mobile	6

VALIDITY SCORE: 108

Appendix O

SAMPLE OF API PRINTOUT

ADULT PERSONALITY INVENTORY

Individual Profile Report

Name:

Sex:

Test Date:

Report Date:

This report contains personal information that should be treated confidentially. It must be considered in the context of all available information about this individual, including sources other than self-report.

Validity Scales

Four validity scales are automatically calculated to see if test-taking attitudes may have influenced the results. If any fall in the "high" range (8 or above), then any interpretation of results should be made very cautiously.

1...2...3...4...5...6...7...8...9...10									
				*					
		*							
*						*			
low			average				high		
Good Impression.....5.0									
Bad Impression.....3.0									
Infrequency.....7.0									
Uncertainty.....1.0									

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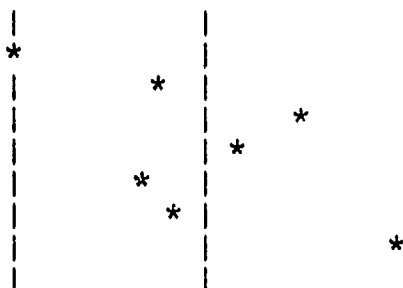
All rights reserved.

Number: 102786075

Name:

Page 2

1...2...3...4...5...6...7...8...9...10

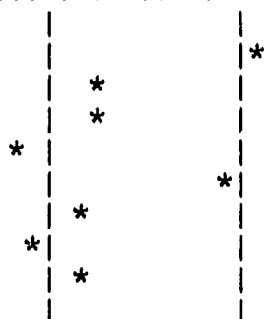


low average high

PERSONAL CHARACTERISTICS

Extroverted.....4.0
Adjusted.....6.3
Tough-Minded.....8.5
Independent.....7.5
Disciplined.....6.0
Creative.....6.6
Enterprising.....10.0

1...2...3...4...5...6...7...8...9...10

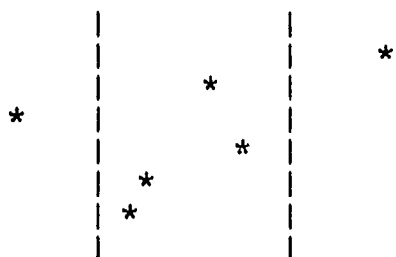


low average high

INTERPERSONAL STYLE

Caring.....7.3
Adapting.....4.8
Withdrawn.....4.7
Submissive.....3.4
Hostile.....6.7
Rebellious.....4.6
Sociable.....3.7
Assertive.....4.6

1...2...3...4...5...6...7...8...9...10



low average high

CAREER FACTORS

Practical.....8.4
Scientific.....5.7
Aesthetic.....2.8
Social.....6.2
Competitive.....4.7
Structured.....4.6

Narrative Report

He takes a logical, realistic approach to most things. He is likely to be direct--sometimes too direct-- in his relationships with other people.

Autonomy and independence are strongly evident. He values his own sense of self-expression and may find it difficult to take directions from others.

He usually relates to other people in an open, easy way. He is approachable and most people find him to be good company. They sense that he is genuinely concerned about them and is not putting on a front.

He is likely to be most productive in work settings that provide opportunities for physical activity and involve him primarily with things rather than with ideas or people.

Name:

Page 4

This page provides a record of individual item responses. Items answered "True" are represented by a "T" and those answered "False" by "F." Uncertain responses are shown as a question mark. Answers to the intelligence items are represented by "a," "b," or "c." The column heading shows the last digit of the item number. The row heading shows the first digit(s). Item 123; for example, will be found in row 12, column 3.

	0	1	2	3	4	5	6	7	8	9
0		F	T	T	T	F	F	T	T	F
1	T	T	F	F	F	F	F	T	?	T
2	?	T	F	F	T	F	F	T	F	T
3	T	F	T	F	T	F	F	T	F	?
4	F	F	F	F	F	T	T	T	F	T
5	F	T	F	T	F	F	F	F	F	F
6	T	T	T	?	F	?	T	F	F	F
7	T	F	T	T	F	F	T	?	F	T
8	F	F	F	?	F	T	F	T	F	T
9	T	T	T	F	?	F	F	F	T	F
10	T	F	F	T	?	F	T	T	F	T
11	F	F	F	F	T	F	T	T	F	F
12	T	?	F	F	F	F	F	F	F	T
13	F	T	F	F	T	?	T	F	F	T
14	?	F	?	T	T	T	T	T	T	T
15	T	F	T	F	F	F	?	F	F	T
16	c	c	c	a	a	a	a	c	c	b
17	b	b	b	a	a	b	c	a	c	a
18	a	c	b	a	b	c	a	c	b	c

Appendix P

LCAC DECISION MODEL

by

Dr. David J. Blower

An LCAC candidate is classified as a predicted PASS or FAIL by computing the posterior probability of belonging to the PASS or FAIL group, and then assigning the candidate to the group with the largest posterior probability. The criterion used to update the prior probabilities is a discriminant function score from the psychomotor test battery. Bayes's Theorem is used to calculate the posterior probability

$$P(G_i|D) = \frac{P(D|G_i) * P(G_i)}{\sum_{i=1}^s P(D|G_i) * P(G_i)}$$

where $P(G_i|D)$ is the posterior probability for Group i , $P(D|G_i)$ is the likelihood of the data given Group i , and $P(G_i)$ is the prior probability of Group i .

In particular, for the two group case which is the focus of our attention in the LCAC study, the formula reduces explicitly to

$$P(PASS|D) = \frac{P(D|PASS) * P(PASS)}{P(D|PASS) * P(PASS) + P(D|FAIL) * P(FAIL)}$$

$$P(FAIL|D) = 1 - P(PASS|D)$$

The likelihood terms,

$P(D|PASS)$ and $P(D|FAIL)$

are Gaussian,

$$P(D|PASS) = \frac{1}{\sigma_{PASS}\sqrt{2\pi}} e^{-1/2\left(\frac{x - \mu_{PASS}}{\sigma_{PASS}}\right)^2}$$

$$P(D|FAIL) = \frac{1}{\sigma_{FAIL}\sqrt{2\pi}} e^{-1/2\left(\frac{x - \mu_{FAIL}}{\sigma_{FAIL}}\right)^2}$$

where x is the candidate's individual discriminant score, μ_{PASS} is the group mean of the discriminant for the

PASS group, μ_{FAIL} is the group mean of the discriminant scores for the FAIL group, and σ_{PASS} and σ_{FAIL} are the standard deviations of the computed discriminant function scores.

The Discriminant Analysis (DA) program from the statistical software package SPSSPC+ was used to analyze the data for the LCAC candidates. The DA program calculated $\mu_{PASS} = -.11194$ and $\mu_{FAIL} = .44777$. σ_{PASS} and σ_{FAIL} are both equal to 1.

When we substitute in these values we arrive at the expression,

$$P(PASS|D) = \frac{\exp\left(-\frac{(x-\bar{x}_1)^2}{2}\right) * P(PASS)}{\exp\left(-\frac{(x-\bar{x}_1)^2}{2}\right) * P(PASS) + \exp\left(-\frac{(x-\bar{x}_2)^2}{2}\right) * P(FAIL)}$$

A numerical example using this formula for the calculation of the posterior probability of belonging to the PASS or FAIL group follows:

The discriminant score for the LCAC candidate	$x = .89$
Group mean of discriminant scores for PASS	$\bar{x}_1 = -.11194$
Group mean of discriminant scores for FAIL	$\bar{x}_2 = .44777$
Prior probability of PASS	$P(PASS) = .67$
Prior probability of FAIL	$P(FAIL) = .33$

$$\begin{aligned}
 P(PASS|x_i=.89) &= \frac{\exp\left(-\frac{(.89-(-.11194))^2}{2}\right) * .67}{\exp\left(-\frac{(.89-(-.11194))^2}{2}\right) * .67 + \exp\left(-\frac{(.89-.44777)^2}{2}\right) * .33} \\
 &= \frac{.6054 * .67}{(.6054 * .67) + (.9068 * .33)} \\
 &= .5754
 \end{aligned}$$

Therefore, the posterior probability of a PASS in LCAC training given that a candidate achieved a discriminant function score of .89 = .5754. It follows that the posterior probability of a FAIL = .4246. The probability of belonging to the PASS group given a discriminant score of .89 is about 58% and, therefore, this candidate will be classified by the system as a PASS because the PASS group has the maximum posterior probability.

Another example is an LCAC candidate with a discriminant function score of 2.6

$$\begin{aligned}
 P(PASS | x = 2.6) &= \frac{\exp\left(-\frac{(2.6 - (-.11194))^2}{2}\right) * .67}{\exp\left(-\frac{(2.69 - (-.11194))^2}{2}\right) * .67 + \exp\left(-\frac{(2.6 - .44777)^2}{2}\right) * .33} \\
 &= \frac{.0253 * .67}{(.0253 * .67) + (.0987 * .33)} \\
 &= .3423
 \end{aligned}$$

Therefore, the posterior probability of a PASS in LCAC training given that a candidate achieved a discriminant function score of 2.6 = .3423. Again, it follows that the posterior probability of a FAIL = .6577. The probability of belonging to the FAIL group given a discriminant score of 2.6 is about 66% and, therefore, this candidate will be classified by the system as a FAIL because the FAIL group has the maximum posterior probability.

The prior probabilities for the PASS and FAIL groups were assigned by looking at the historical frequencies for these groups at Naval Coastal Systems Center, Panama City, before we began our research effort. Since these prior probabilities worked well, we kept them in the decision model. They could be changed to reflect either a change in attrition rates or a desire to restrict or promote the flow of students into the training pipeline.

We can determine the threshold discriminant function score, $x_{\text{threshold}}$ above which a student will be classified as a PASS as

$$P(PASS | x_{\text{threshold}} = ?) = .50$$

$$P(PASS | x_{\text{threshold}} = 1.4333) = .50$$

Any LCAC candidate who gets a discriminant function score above 1.433 will be predicted to fail LCAC training, and likewise, any discriminant function score below 1.433 will be predicted to pass.

Based on our research to date, we chose five variables from the psychomotor test battery to serve as discriminant variables. Further research may indicate other variables in a decision model, but at the present time, these variables seem to perform well. The variables and the associated weights as computed by the DA program are given in the table below.

Table 4. Unstandardized discriminant function coefficients and values for five transformed variables plus a constant needed to compute a discriminant function score for an LCAC candidate.

Variable	Coefficient	Value	Multiplication (x_i)
Stick alone	-1.97	4.25	-8.37
Stick with DLT	4.25	4.50	19.12
Stick, Rudder, Throttle with DLT	-1.03	4.81	-4.95
Composite RT and Tracking	.58	1.22	.71
Horizontal Tracking	2.27	5.25	11.92
Constant	-18.31	1.00	-18.31

Discriminant Function Score

$$\sum_{i=1}^6 x_i = .12$$

The Dichotic Listening Test (DLT), and the value of all variables underwent some form of transformation from the raw scores, generally a logarithmic transform of tracking errors to promote normality.

As we have already discussed, an LCAC candidate with a discriminant function score of .12 falls below the threshold score of 1.433 and would, therefore, be classified as a predicted PASS by the system.

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