Lafayette Polygraph System

User Manual

LXSoftware
Version 9.0

Notice: The following information applies to the LX-4000 Data Acquisition Subsystem (DAS) Interface.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note	This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the user's own expense.

DN-006-600

The Lafayette Polygraph System

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Contents

Preface

List of Figures

List of Tables

Preface

Chapter Overview

This chapter describes the conventions used in this manual. It includes the following information:

- Information on how to use the manual

- Prerequisites for using the software

- A list of documentation conventions

- A list of related documentation

- A description of common Lafayette Polygraph System terms

How to Use This Manual

This manual is intended to help polygraphers learn how to use LXSoftware to administer, chart, document, and evaluate polygraph tests. The following table lists the information found in each chapter of this manual:

Table 1. Document Overview

Refer to…	For information about…
Preface	Documentation conventions, common LXSoftware terms, and related documentation
Chapter 1	Product features, required hardware and software
Chapter 2	Starting LXSoftware, understanding the interface, getting help, switching to another application, locking the screen, setting system options, and exiting
Chapter 3	Preparing the subject for a test, using PFs, and editing screen information
Chapter 4	Entering subject biographical data, selecting questions, entering exam data, beginning an exam, and recording charts
Chapter 5	Reviewing chart data, scoring a chart, moving a PF to another drive, reporting test results, and printing screens and charts
Appendix A	Learning about Windows basics
Appendix B	LXSoftware commands and functions
Appendix C	Installation and Maintenance
Appendix D	Troubleshooting tips
Appendix E	The Development of the POLYSCORE® System

Note   This manual does not provide detailed instructions for system administrator functions (i.e., connecting to a network or implementing security procedures). See the online help for instructions on user lists and the audit trail.

Prerequisites

To use LXSoftware efficiently, you should know how to administer a polygraph test and how each of the sensors function. Additionally, you should be familiar with basic Windows operations. To review basic Windows functionality, see Appendix A, "Learning Windows Basics."

Documentation Conventions

This manual uses the following documentation conventions:

- Items you select from a menu or dialog box are in **bold** type.

- Text you enter from the keyboard is in italic, such as *password*.

- Keys you press on the keyboard are in brackets, such as <**delete**> and <**enter**>.

- Keystrokes you use to perform commands are in parentheses, such as (**Ctrl + H**).

Understanding LXSoftware Terms

While reading this manual, you will see a variety of terms associated with LXSoftware. You should be familiar with most of them, but if you need clarification, refer to the following table:

Table 2. LXSoftware Terms

LXSoftware Term	Definition
Artifact	A physiological response caused by an artificial stimulus which might affect the sensor traces on a chart, such as a cough, a sniff, yawn, loud noise, or body movement. When an artifact is detected, press the keystroke that corresponds to the artifact and annotate the chart accordingly.
Automatic GSC	The AC-coupled GSC displayed data; changes or reactions are more noticeable. Automatic GSC is the default display mode. If you want to view raw GSC traces (Manual display mode), deselect the **Enable automatic GSC mode** (GSC sensor option) in the Trace Preferences dialog box (Figure 18) prior to beginning a chart recording.
Channel	Sensor component providing input for the scoring algorithm.
Chart	A collection of questions, sensor responses, etc. displayed on the screen between time and amplitude grid marks. All charts for the current Polygraph File (PF) are listed in the Chart menu.
DAS	Data Acquisition Subsystem–a hardware device that converts physiological signals to digital form. The DAS is connected to the PC to record the examination chart data. The DAS receives input from the pneumatic respiratory sensors, the cardio sensor, the GSC sensor, and the auxiliary sensors. Input is sent to the workstation for recording and display.

Drug Reference   The Drug Reference can be used to determine the effect of a drug on the physiologic markers most relevant for polygraph testing assessments.

Exam   A specific period of time when the examiner tests a subject, charts one or more test responses, and records the results.

Examiner   The person who conducts a polygraph test, charts the responses, records the results, and reports the final evaluation.

Exam Info   Exam information focuses on the variables which might affect test results, such as lack of sleep, no breakfast or lunch, recent alcohol consumption, or emotional distress. You can conduct multiple exams for each subject's PF (Polygraph File). Each exam can have multiple associated charts.

Final Call   The evaluation derived from the polygraph test results. This evaluation is recorded in the Exam Info dialog box (Figure 16) after the test has been reviewed.

Logoff   Closes LXSoftware.

LXSoftware   The LXSoftware is a computerized version of the traditional pen and paper polygraph instrument. The LXSoftware collects physiological data from standard polygraph sensors connected to the DAS.

Manual GSC   The display mode for viewing the raw GSC data, as opposed to the AC-coupled GSC sensor data. To use Manual GSC, you must deselect **Enable automatic GSC mode** from the Trace Preferences dialog box (Figure 18).

Move File   Transfers a Polygraph File (PF) from one storage medium to another.

Notepad   A text editor which displays a document window you can use to record comments about any aspect of an examination.

Password   A system administrator-defined word used in conjunction with the User ID to gain access to the LXSoftware application. For highest security, use a mixture of alphabetic characters and numeric values or symbols. If you incorrectly enter a User ID or password three times, the system locks you out and you must contact the system administrator for assistance.

Personal History   Biographical information about the subject. In the Personal History dialog box, supply information such as Name, ID Number, and Date of Birth.

PF   Polygraph File (PF)—a folder (directory) containing all information about the test subject. Each PF contains biographical information on the subject as well as all examination data categorized by exam.

Question ID   An identification number for a specific question. The Question ID may be up to four characters.

Question Set   A list of questions the examiner asks the subject to answer while recording a polygraph chart. Several question templates come with LXSoftware; however, you can also create a new set of questions. The questions in the set can be asked in any order.

Question Template   A list of standard questions for a specific type of case. You can modify a question template to meet the requirements for each subject.

Report   A word processing document that contains the biographical and exam information merged into the report template. You can edit this document to include test results and comments that pertain to the examination.

Self-test   A series of diagnostic tests that verify the system is functioning normally. The self-test is performed automatically when you start LXSoftware. If any of the diagnostic tests fail, a message box posts a corrective action. When the self-test is completed successfully, you can log on to LXSoftware.

Sensors   The respiratory, cardio, GSC, and auxiliary detection devices attached to the subject and connected to the DAS for input to the polygraph workstation.

Spot   A unique, relevant question possibly asked multiple times during chart recording.

Statistical Outlier   Data that is anomalous when compared to surrounding data.

Subject   The person on whom the polygraph test is being administered.

System Administrator   The person responsible for installing and maintaining LXSoftware and for assigning User ID/Password pairs to all users (see online help for instructions). The system administrator can gain access to workstations that become locked due to unsuccessful logon attempts.

Note   If you are totally responsible for setting up and maintaining your own computer, you are the system administrator.

Tagging   The process by which questions are identified as a particular type, such as relevant or control.

User ID   The logon name assigned to you by the system administrator which grants you access to the system.

User List   The list of users who can access LXSoftware. This list displays the User IDs assigned by the system administrator. Only the system administrator can change the user list.

Introduction 1

Chapter Overview

This chapter describes the Lafayette Polygraph System hardware and software. It includes the following information:

- A description of the product

- A list of features and benefits

- A list of hardware and software requirements

Product Overview

The Lafayette Polygraph Workstation is a state-of-the-art polygraph system with all the benefits of a personal computer. This system closely emulates the familiar chart and pen instruments. In addition, it introduces the modern capabilities of a high-speed microcomputer in a user-friendly manner, specifically designed with new computer users in mind. With LXSoftware, physiological data is collected from standard polygraph sensors connected to the Data Acquisition System (DAS).

Features and Benefits

LXSoftware utilizes the intuitive, graphical Windows interface and features pull-down menus, mouse capability to initiate commands and functions, easy-to-use dialog boxes, and context-sensitive help. Inexperienced users can learn to use LXSoftware quickly, and experienced users can take advantage of its advanced capabilities.

The PC provides capabilities unavailable with analog polygraph systems:

- Physiological waveforms are converted to digital format, allowing them to be recorded and stored on high-density magnetic media (computer disks) rather than on long strips of chart paper.

- All of the examination information, including biographical data, charts, and reports are stored on high-density magnetic media, thereby reducing the need for paper files.

- All previously recorded chart sensor data can be displayed and reviewed.

- Sensor controls provide the ability to adjust the gain for a specific sensor trace.

- On-screen buttons, function keys, and user-selectable keystrokes provide alternate methods for providing input and invoking commands.

The benefits of LXSoftware include:

- High-resolution, real-time graphic display of physiological waveforms

- High-capacity storage capabilities for subject data and chart waveforms

- High-speed networking operation

- Customizable sensor trace and system preferences

- Advanced printing capabilities

- Computerized chart scoring

- Chart audio/video recording capabilities

Hardware and Software Requirements

The LXSoftware software operates in the standard Windows operating environment. LXSoftware consists of the following major components:

- the PC and software
- a DAS to collect physiological data
- an optional printer to print charts, reports, biographical information, and exam information
- an optional web cam or camcorder to record chart audio and video

To use LXSoftware effectively and efficiently, you need at least the following hardware and software components:

Table 3. Minimum Hardware and Software

WORKSTATION	
A personal computer with a Pentium 166 MHz or higher microprocessor and 64 MB RAM	Standard VGA color monitor
USB Port	Microsoft mouse or compatible pointing device
80 MB hard drive	CD-ROM drive (for software installation)
DAS AND SENSORS	
LX-4000	USB cable
Pneumo Chest Assembly - Bronze 76513-2B	Pneumo Chest Assembly - Gold 76513-1G
Pump Bulb and Gauge 76506LX	Standard Blood Pressure Cuff 76530
Lafayette Instrument Finger Electrode Set 76640DP	
OPTIONAL PRINTER	
Pentax PocketJet II LX-1575 Alternatively, any HP DeskJet printers that support the PCL3 printer language.	Pentax paper stand LX-1575STD
SOFTWARE	
Windows 98/98SE, 2000, ME, or XP	LXSoftware
Microsoft Word, Microsoft WordPad, or WordPerfect (optional for Final Report generation)	

Note	If any of the required hardware or software is not installed correctly, contact your system administrator.
Note	If you are planning on recording chart audio and video, the minimum system requirements listed above will depend on the camera with which you choose to record. See the camera manufacturer's recommendation for minimum system requirements.

The PC

The polygraph workstation consists of a PC running Windows and its peripheral devices. The computer has an internal hard disk (local primary drive), monitor, keyboard, and mouse.

The high-resolution monitor provides optimum chart display. The keyboard offers a set of arrow keys, a numeric keypad, and a row of function keys. The mouse can be used to scroll through screens, access pull-down menus, and perform editing functions.

The Data Acquisition Subsystem (DAS)

The DAS is used in conjunction with the PC to record examination chart data by converting physiological signals to digital form. The DAS receives input from the pneumatic respiratory sensors (P1 and P2), the cardio sensor, the GSC sensor, and the auxiliary (e.g., movement) sensors. The DAS then sends the input to the workstation to be recorded and displayed. Before you can record charts, the DAS must be connected to the PC. If it is not connected, you can review and edit existing examination data as well as create new files, but you cannot record new charts.

Back Panel

GSC   AUX1   AUX2   AUX3   P1   P2   BULB   CUFF

Side A Panel

Pneumo Vent

Side B Panel

Computer
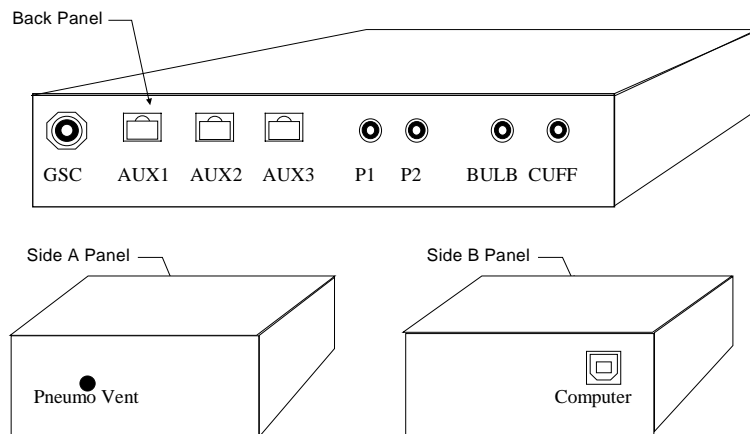
The Printer

You can use a printer to print text, such as biographical data, exam data or reports. You can also print graphics such as physiological chart data. The Lafayette Polygraph System supports a wide selection of Windows printers.
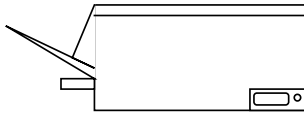
Note   You do not need a printer to perform polygrapher tasks.

Running LXSoftware

2

Chapter Overview

This chapter provides instructions for running LXSoftware. You learn to:

- Prepare to run the software

- Start LXSoftware

- Use the Help facility

- Switch to another application

- Lock the screen

- Select system preferences

- Exit LXSoftware

Preparing

Before starting, be sure the PC and DAS are set up correctly. Refer to **Appendix C** to learn how to connect the hardware, cables, and sensors. The LXSoftware must also be installed and configured to meet your needs.

Starting LXSoftware

To start LXSoftware:

1. Ensure all components are plugged in.

2. Turn on the computer. The Windows desktop appears.

3. Double-click the LXSoftware icon. LXSoftware starts and performs a self-test.

Note   The LXSoftware **Security option** requires a valid list of users and logon and logoff routines. It also lets you lock the screen. If the Security option is **not** enabled via the Administrator Preferences, the information in "Logging On," "Entering a User ID and Password," "Locking the Screen," and "Logging Off ," later in this chapter, are not applicable.

Understanding the Self-Test

When you start LXSoftware, the system performs a self-test which lasts several seconds; the system counts down the steps as they are performed. If any problems occur during the self-test, a message appears on the screen describing the problem and a corrective course of action. When the self-test is finished, the Logon dialog box appears and you're ready to log on (provided the Security option is enabled).

Figure 1. Logon Dialog Box

Note   If the self-test fails due to a DAS failure, exit the application and disconnect the USB cable from the DAS unit. Wait a few seconds, and then reconnect the cable. For troubleshooting tips, refer to **Appendix D**.

Logging On

The system administrator determines who has access privileges to the system and provides a user ID and password to each user. To gain access to the system, you need to enter a valid user ID and password in the Logon dialog box.

To log on to LXSoftware:

1. In the User ID box, type your assigned user ID. Press the **Tab** key to move to the next field.

Note   The **first person** to log on to LXSoftware should use the default user ID *admin* and the default password *security*. To safeguard the system's security, change the default user ID and password immediately after logging on. See online help for instructions.

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2. In the Password box, type your password (alphabetic characters only). For security purposes, the characters appear on the screen as bullets (••••).

3. To access the system, select the **Logon** button (or press <**enter**>). The LXSoftware menu bar appears at the top of the screen and the Chart Display window opens. The chart traces being received from the DAS appear in the window:

Figure 2. LXSoftware Menu Bar and Sensor Display
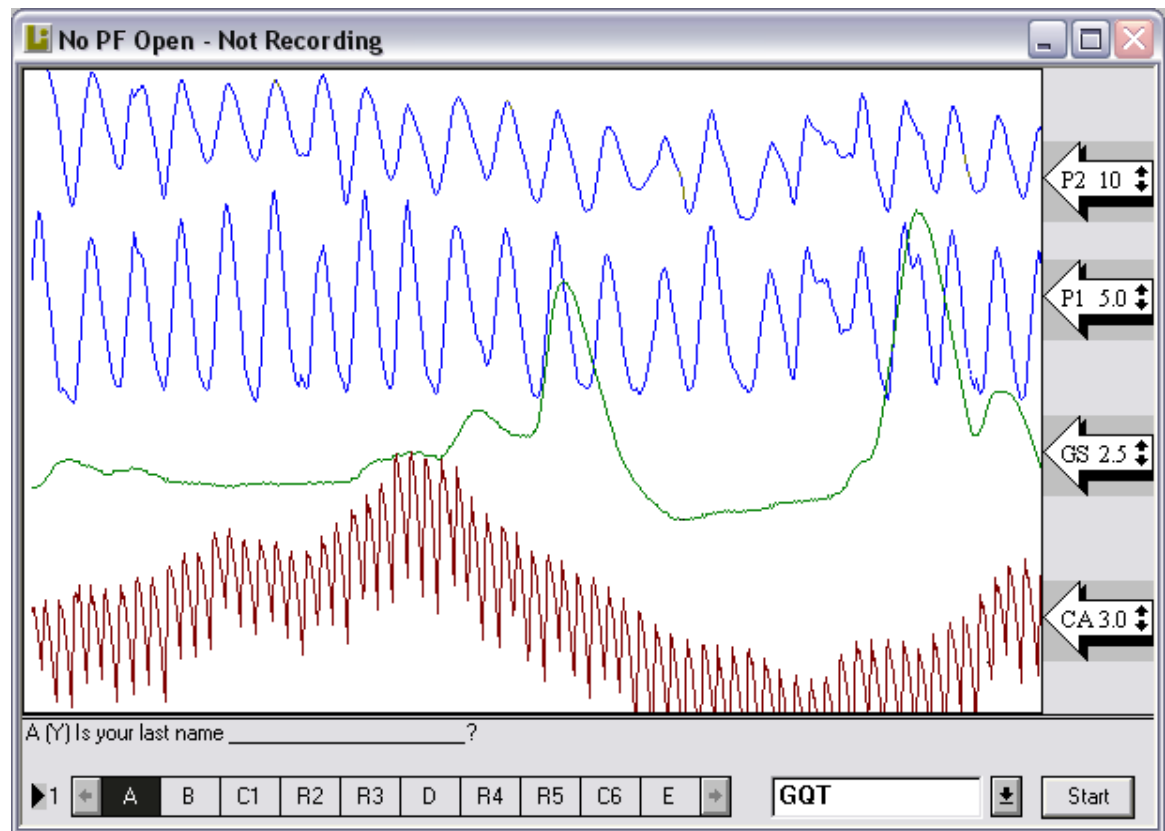
Note   If you did not enter your user ID and password correctly, or if the system administrator has not registered you as a valid user, the following dialog box appears:

Figure 3. Logon Attempt Failed Dialog Box
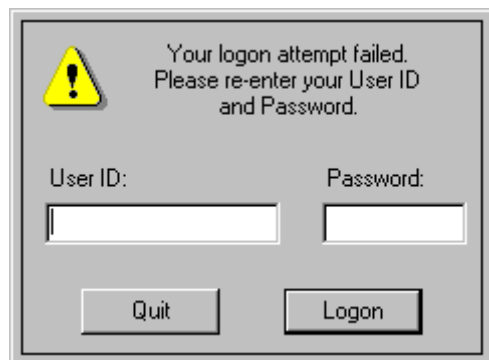
In this dialog box, either re-enter your user ID and password as described previously, or select **Quit** to exit the application**.** You can re-enter your user ID and password only three times. After three failed attempts, the system locks you out and only the system administrator can gain access to the system. If you get locked out, the following dialog box appears:

Figure 4. System Lock Out Dialog Box

Displaying the Product Version Number

To determine what version of the LXSoftware you are using, select **About LXSoftware…** from the **Help** menu. A dialog box appears with the software version information.

Using the Help Facility

After logging on to the system, you can get helpful information about the many LXSoftware functions and features using the Windows Help facility. You can access help topics the following ways:

- Pressing a help key (**Alt** + **H** or **F1**) from any window or dialog box.

- Selecting the **Help** menu.

To get help on a specific topic or procedure:

1. Select **Index** from the **Help** menu. A list of topics appears.

2. Click on the topic you want to read.

Viewing the ReadMe File

To view a list of recent changes to the LXSoftware, select **View ReadMe File…** from the **Help** menu.

Viewing the User Manual

To view this document from within the LXSoftware, select **View User Manual…** from the **Help** menu.

Switching to Another Application

You can switch back and forth between Windows applications using the **taskbar** located at the bottom of the screen. Every time you start a program or open a window, a **button** for that window appears on the taskbar. To use another application without logging off the LXSoftware application:

1. Click the **taskbar button** for the window you want.

   If a button for that window does not appear on the taskbar, switch to the **Windows Explorer** and double-click the application's icon.

Tip   For a shortcut to Windows Explorer, use the right mouse button to click the **My Computer** icon. Then click **Explore**.

When you generate a report for an examination, your word processor is automatically invoked to provide you a report template to use. When the word processor is started, the LXSoftware workstation application is put in the background so you can quickly switch back to it when you are finished reporting results. You don't have to Quit the word processor, just select LXSoftware from the taskbar and you will return to the same screen you were using prior to switching. Use the same procedure any time you want to switch to another application.

Tip   When you're working between two applications, you can press **Alt + Tab** to toggle between them. You do not have to access the Task List.

Locking the Screen

If you need to leave the room while a subject is present, lock the screen before you leave the room. Locking the screen is a way to protect data by preventing access to the display. To lock the screen, select **Screen Lock** (Ctrl + L) from the **File** menu. A gray background replaces the current display, and the following dialog box appears:

Figure 5. Screen Lock Dialog Box
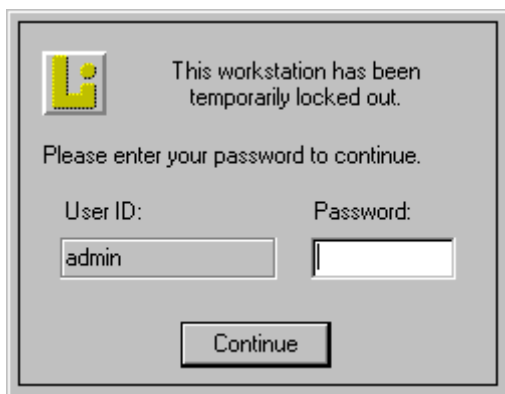
To unlock the screen, enter the **Password**, then select **Continue**.

Setting System Preferences

Trace Preferences

LXSoftware lets you customize the way the system operates. To change the default LXSoftware system preferences, select **Preferences** from the **Tools** menu. The Trace tab is the first tab that appears:

Figure 6. Preferences Dialog Box, Trace Tab
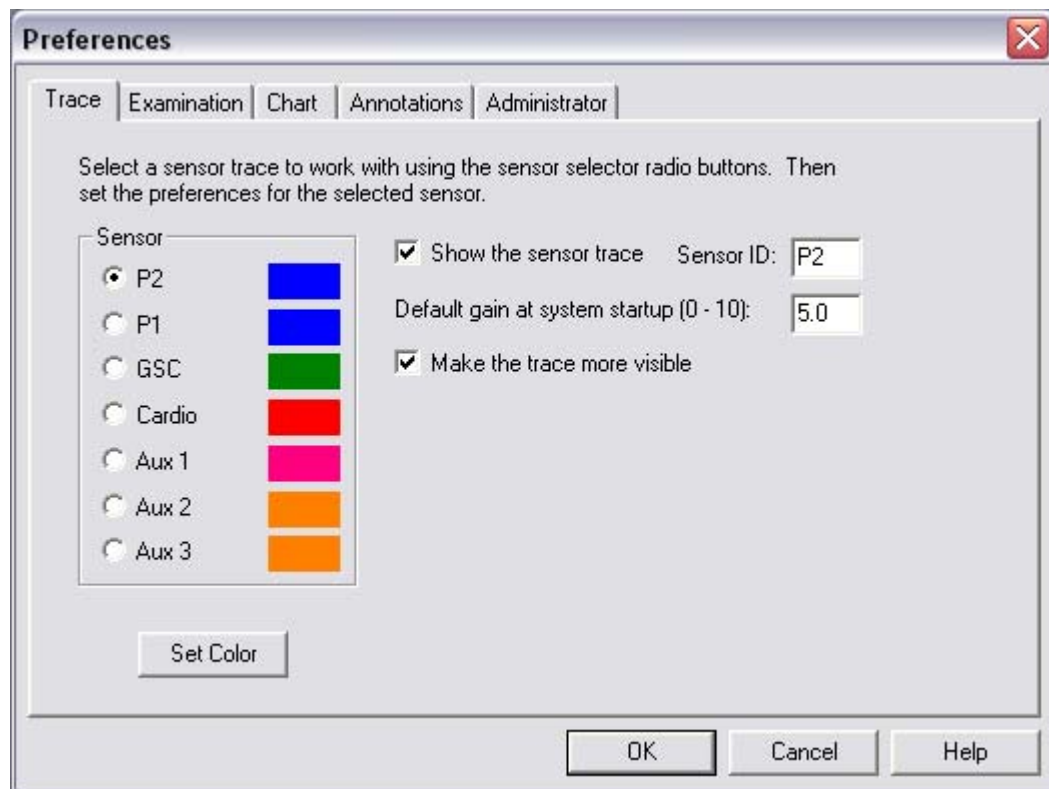
To modify

1. From the Sensor group box, select the **option** button next to the sensor you want to change.

2. From the options displayed at the right, select the check box for each option to use or enter a value in the corresponding text box.

3. To specify a color for the selected sensor trace, select the **Set Color** button. The Color dialog box (Figure 7) appears. Select a color as explained in "Selecting a Trace Color," next.

This tab controls the appearance of the sensor traces. The following table explains your choices:

Table 4. Trace Preferences

Preference	Description
Show the sensor trace	Displays the selected sensor's trace and sensor control on the screen.
Sensor ID	Specifies the characters to use to identify the on-screen sensor control for the selected sensor
Default gain at system startup	Specifies the gain value to use at startup for the selected sensor

Make the trace more visible Displays the sensor's trace more boldly

Enable automatic GSC mode Displays the AC-coupled GSC data while recording the chart response; changes and reactions are more noticeable

Selecting a Trace Color

To choose a new color for a chart trace:

1. Select the **Set Color** button in the **Trace Preferences** dialog box as explained in "Setting Trace Preferences." The Color dialog box appears:

Figure 7. Color Dialog Box

You can choose from any color in the **Basic Colors palette**.

2. Click a color box in the Basic Colors palette.

3. Select **OK**. The Trace Preferences dialog box appears. The new color appears next to the sensor.

4. Select **OK**. The Chart Display window appears and the chart trace for the selected sensor begins drawing in the new color.

Defining a custom color

If you do not like the basic colors, create your own:

1. Select the **Define Custom Colors** button in the **Color** dialog box. The Color Refiner box appears to the right of the Basic Colors palette.

Figure 8. Custom Color Dialog Box

The **color refiner box** lets you create new colors...

...and add them to the **Custom Colors palette**.
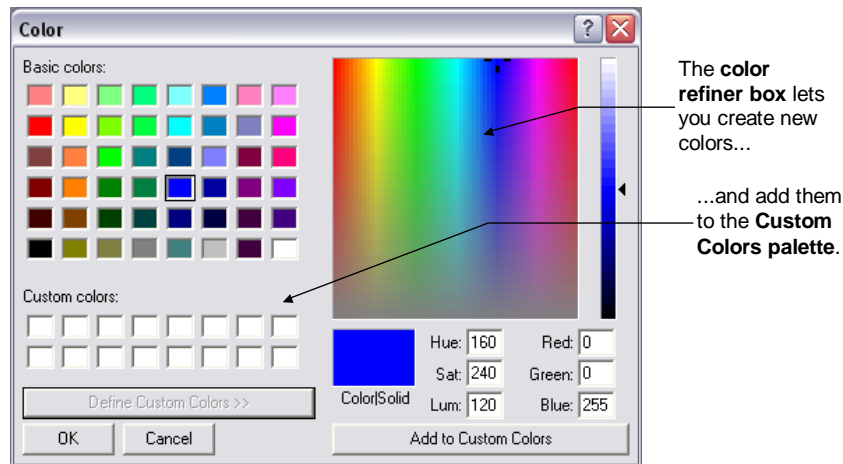
2. Drag the color refiner pointer through the **refiner box** until you reach the color you want. Then drag the arrow in the **vertical luminosity bar** up or down to adjust the luminosity.

Figure 9. Custom Color Dialog Box, Luminosity Box

After you pick a color here...

...slide the arrow up or down to adjust the luminosity.

The color you're creating appears on the **left side**. Ignore the color on the right side.
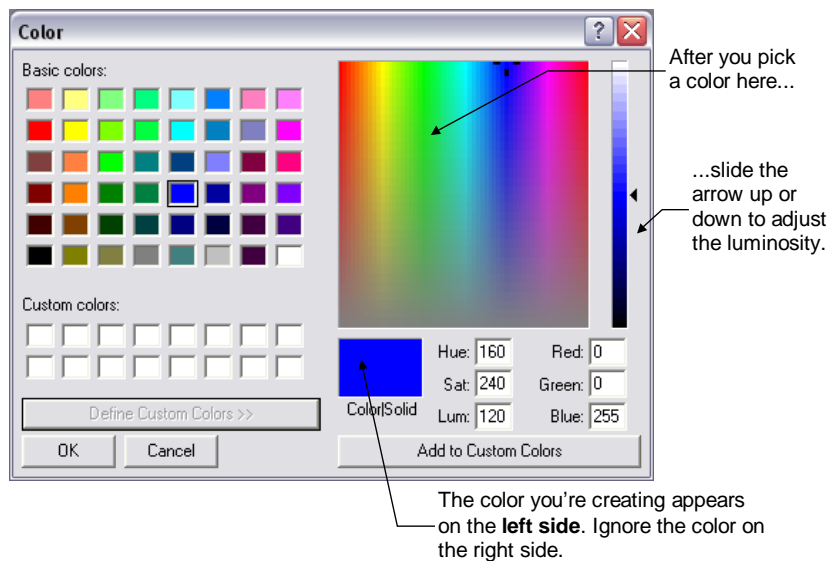
The color you're creating appears on the **left side** of the **Color/Solid box**. Ignore the color on the right side, which simply shows the basic colors supported by your video card depending on your configuration.

Note   If you know the correct values, you can skip the refiner box and type them in the Red, Green, and Blue or the Hue, Sat and Lum boxes.

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3. Select an empty box in the **Custom Colors palette** for the new color (or select one that contains a color you want to change).

4. Click the **Add to Custom Colors** button to add the new color to the Custom Colors palette.

5. Define any other custom colors you want to add to the palette.

6. Select the **OK** button to close the Color dialog box. You can now choose a color from the Custom Colors palette the same way you would choose a color from the Basic Colors palette.

Examination Preferences

To change the preferences for the Exam options select the Examination tab:

Figure 10. Preferences Dialog Box, Examination Tab
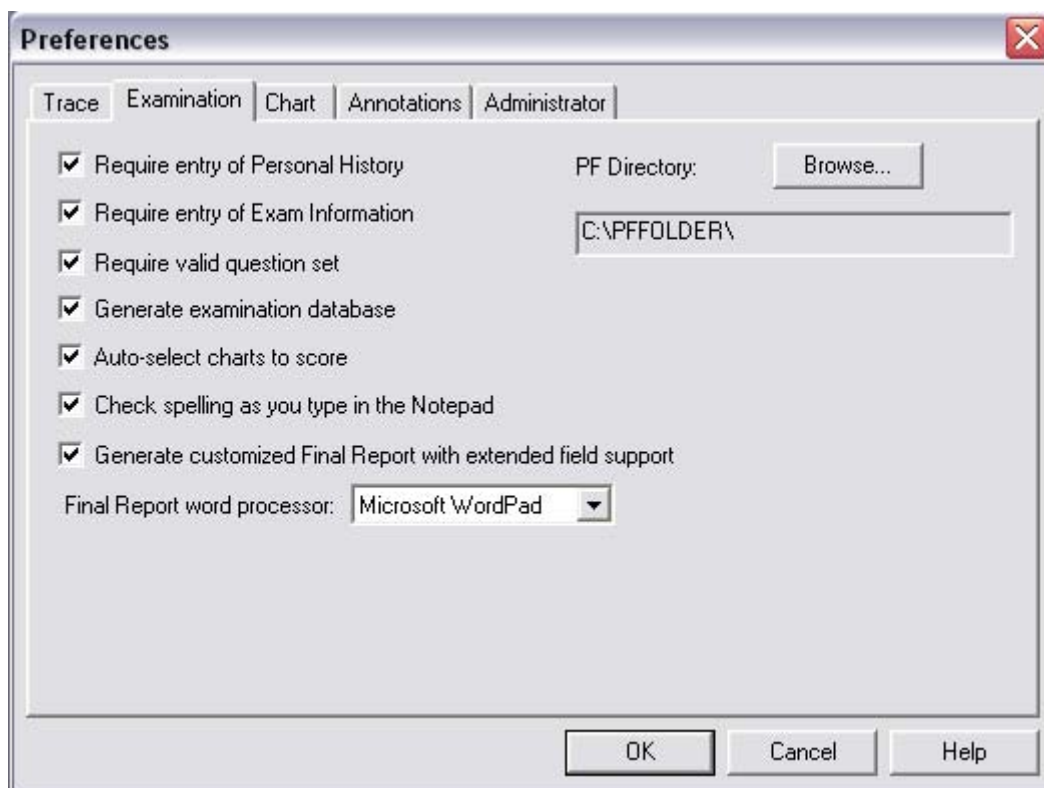
The following table explains your choices:

Table 5. Examination Preferences   LXSoftware:system preferences 2- :

Preference	Description
Require entry of Personal History	Select to require a subject name and date of birth to be entered in the Personal History dialog before a PF can be created.
Require entry of Exam Information	Select to require an Exam to exist before a chart can be recorded for an open PF.
Require valid question set	Select to require a valid question set before chart recording can commence. A valid question set contains at least one question, no duplicate question IDs, and all components (e.g., ID, expected response, and text) of a question entered.
Generate examination database	Select to enable generation of auxiliary Microsoft Access database files consisting of all Personal History and Exam Information for a PF. The PF database files can then be merged for analysis by Microsoft Access. Note that the database files will be generated each time Personal History or Exam Information is modified or created.
Auto-select charts to score	Select to automatically select all recorded charts for automatic scoring when the scoring selection dialog is displayed.
Check spelling as you type in the notepad	Select to check text as it is entered into the Notepad. Unrecognized words will appear with a red highlight. Right-clicking on a highlighted word will display a list of suggested alternate spellings. If you do not select this option, you may still perform a manual spell check at any time by selecting **Check Spelling** from the **Tools** menu.
Generate customized Final Report with extended field support	When this check box is selected, support is provided for a custom Final Report with extended field support. With extended field support, any field that appears in the examination database may be exported to the Final Report, as well as chart and PF Question Set information.
Word Processor	Select the word processor to use for automatic generation of the Final Report.
PF Directory	Use the "Browse" button to display a dialog box to use to specify the working PF directory. The PF directory is the location on disk where newly created PFs are stored. The PF Directory edit field may be used to directly enter a PF directory name, bypassing the Browse dialog. The PF directory will be created if necessary.

Chart Preferences

To change the preferences for the Chart options select the Chart tab.

Figure 11. Preferences Dialog Box, Chart Tab
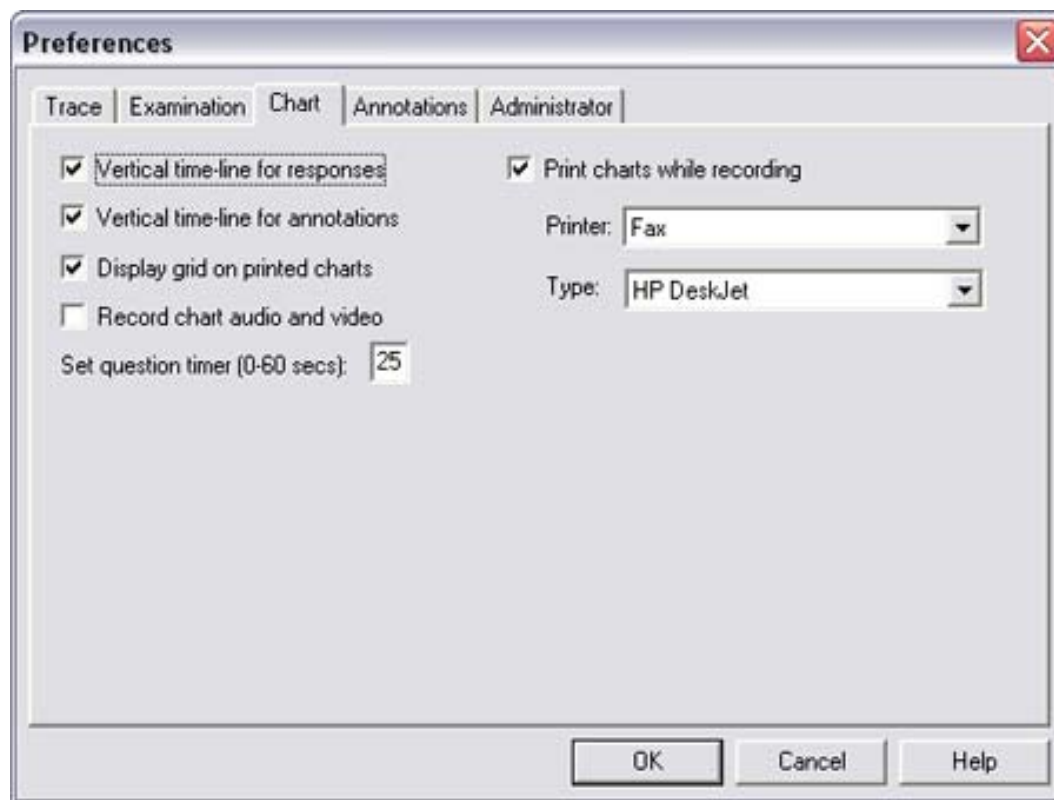
The following table explains your choices:

Table 6. Chart Preferences

Preference	Description
Vertical time-line for responses	Select to display a vertical line on displayed and printed charts for each subject response.
Vertical time-line for annotations	Select to display a vertical line on displayed and printed charts for each annotation, or chart marking, made by the examiner.
Display grid on printed charts	Select to include a grid on printed charts.
Set question timer	Enter a value from 0 to 60 to indicate the minimum amount of time between question onsets.
Print charts while recording	Select if you want to print a chart as it is being recorded.
Printer	Select the printer to use if the "Print charts while recording" option is selected.

| Type | Select the type of printer to use. |

Note   Automatic scoring requires **25 seconds** between question onsets. Scoring charts with less than the minimum time between onsets may invalidate scoring results.

Annotation Preference

To change the preferences for the Annotation options select the Annotations tab.

Figure 12. Preferences Dialog Box, Annotations Tab

While recording a chart, you can use specific keystrokes to annotate the chart indicating certain responses. The following table lists the default keystrokes and chart annotation marks for the recognized conditions or responses.

Table 7. Chart Annotation Keystrokes

To Record…	Press…	Annotation ID
Start Announcement	X	X
Stop Announcement	X	XX
Question Reading	<Onset button> or <numeric 0> or <spacebar> **Note:** Press and hold down the buttons or keys until you are finished reading the question.	Gray Bar
Yes	<+ button> or <numeric +>	+
The Expected Response	<spacebar> or <numeric 0>	+ or -
No	<- button> or <numeric ->	-
Not the Expected Response	<esc> or <*>	+ or -
Movement	M	MV
Talking	V	T
Deep Breath	D	DB
Cough	C	C
Clear Throat	T	CT
Swallow	W	SW
Sniff	F	SNF
Yawn	Y	Y
Sneeze	S	SZ
Laugh	L	LGH
Sleep	Z	SLP
Belch	B	B
Other	<F1>	OTH
Outside Noise	<F2>	OSN
Inside Noise	<F3>	ISN
Examiner Error	<F4>	EE

To Record…	Press…	Annotation ID
Poorly Worded Question	<F5>	PW
Will Repeat Question	<F6>	WRQ
Movement Instruction	<F7>	MI
Talking Instruction	<F8>	TI
Answering Instruction	<F9>	AI
Breathing Instruction	<F10>	BI
Wake Up	<F11>	WU
Take Deep Breath	<F12>	TDB

The values presented in Table 7 are the default settings; however, the programmable keys let you assign an equivalent key and annotation ID as appropriate. To program function keys and keyboard keys for annotating charts, use the following procedure:

For each *function key* you want to reprogram, highlight the value in the corresponding annotation **ID** field, and enter the new ID to be displayed on the chart.

For each *keyboard key* you want to reprogram, follow these steps:
1. Highlight the value in the **Key** column, and enter the new keystroke.

2. If desired, select the corresponding annotation ID field, and enter the new annotation ID to be displayed on the chart.

Adminstrator Preferences

To change the preferences for the Administrator options select the Administrator tab.

Figure 13. Preferences Dialog Box, Administrator Tab
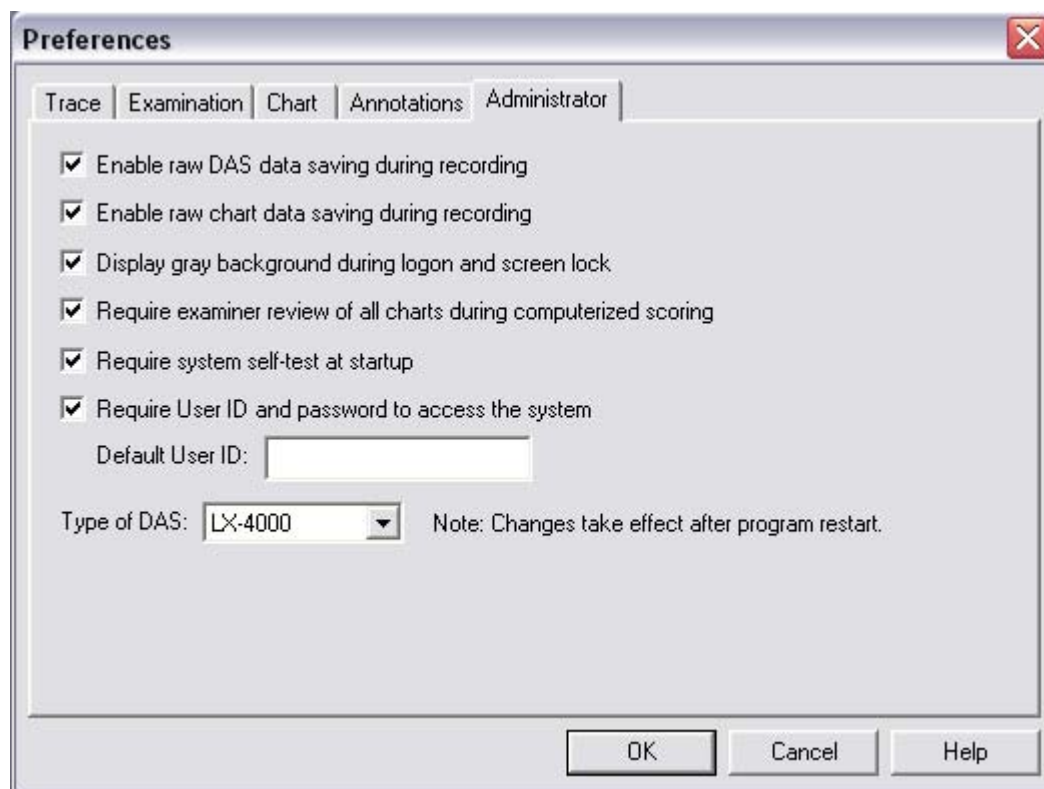
The following table explains your choices:

Table 8. Administrator Preferences

Preference	Description
Enable raw DAS data saving during recording	Select to set all data received from the DAS to be saved in individual sensor files. These files can then be reviewed using a third-party program such as *Microsoft Excel.* The files are stored in individual directories within the exam folder. These directories are named **ChartN.raw**, where 'N' is replaced with the chart number. The sample rate for the saved data is 120 samples per second.
Enable raw chart data saving during recording	Select to set all chart data to be saved in individual sensor files. These files can then be reviewed using a third-party program such as *Microsoft Excel.* The files are stored in individual directories within the exam folder. These directories are named **ChartN.dat**, where 'N' is replaced with the chart number. The sample rate for the saved data is always 30 samples per second.
Display gray background during logon and screen lock	Select to prompt the user must for a valid User ID and password to access the system. A default User ID may be specified in the Administrator Preferences that will auto-fill the User ID during a logon sequence, requiring entry of the password only.

Require examiner review of all charts during computerized scoring	Select to require review of all charts during computerized scoring.
Require system self-test at startup	Select to force the system to perform a self-test of the major components of the system during the initial startup sequence.
Require User ID and password to access the system	Select to lock LXSoftware from users who are not authorized. When enabled only registered users may access the system.
Default User ID	A default User ID may be specified in this field that will auto-fill the User ID during a logon sequence, requiring entry of the password only.

Note   To save the preferences, select **OK**. To close this dialog box and ignore any changes, select **Cancel.**

Exiting LXSoftware

Upon exiting, the application automatically closes any open windows and saves the PF information (polygraph file) to disk.

To log off the system, follow these steps:

1. Select **Logoff** from the File menu. A confirmation dialog box appears, prompting you to verify you want to log off.

Figure 14. Logoff Dialog Box
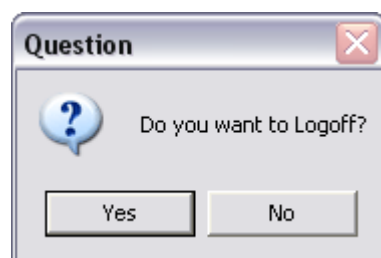
2. Select the **Logoff** button. When you log off, the **Logon** dialog box illustrated in Figure 1 appears. You can either choose **Quit** to exit the system or let another user log on.

Tip   If you know you want to exit the system, choose **Exit** from the File menu instead of **Logoff**. When you choose Exit, you bypass the Logon dialog box and exit the system directly.

Preparing a Test

3

Chapter Overview

This chapter describes how to prepare for a test. It includes the following information:

- An overview of the general procedure you will need to follow to conduct a test

- A description of a Polygraph File

- Instructions for creating a Polygraph File

- Instructions for opening a Polygraph File

- Instructions for switching between Polygraph Files

- Instructions for closing a Polygraph File

Procedure Overview

Below is the general sequence in which you will most often conduct a polygraph test. This is a general procedural overview. Each step in this sequence represents a separate task, each requiring a series of steps to complete.

Table 9. Procedure Overview.

Step	Description	Instruction Heading
1	Open or create a Polygraph File (PF).	"Creating a Polygraph File" in Chapter 3
2	Enter the personal history information.	"Entering Biographical Data" in Chapter 4
3	Select a question set and edit it appropriately.	"Selecting a Question Set" in Chapter 4
4	Prepare the subject for the test.	"Reviewing the Test Questions" in Chapter 4
5	Enter the exam information.	"Entering Exam Data" in Chapter 4
6	Run the test, ask questions, record a chart.	"Beginning an Exam" in Chapter 4
7	Review a chart.	"Reviewing a Chart" in Chapter 5
8	Score a chart.	"Scoring a Chart" in Chapter 5
9	Document the results.	"Reporting Test Results" in Chapter 5
10	Print the results.	"Printing" in Chapter 5

What is a Polygraph File?

A Polygraph File (PF) is a folder containing a variety of essential information about a test subject and polygraph test results. The PF contains biographical (history) information, exam information, charts, videos, question sets, and reports, as well as any comments recorded by the examiner. The PF is the primary element for conducting a test—without it, you can't use any of the other LXSoftware functions.

Figure 15. PF Folder
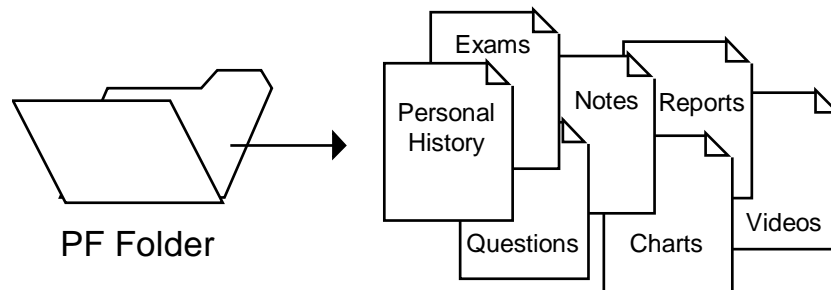
Creating a Polygraph File

Before beginning a polygraph test, either *create* or *open* a PF for the subject. Everything recorded about the subject's test is saved to the corresponding PF folder. If a PF is open, the PF name appears in the title bar. If a PF is not open, some of the menus are dimmed and unavailable.

If a PF does not already exist, follow these steps to create a new one:

1. Select **New PF...** (Ctrl + N) from the File menu. The following dialog box appears.

    Figure 16. New PF Dialog Box
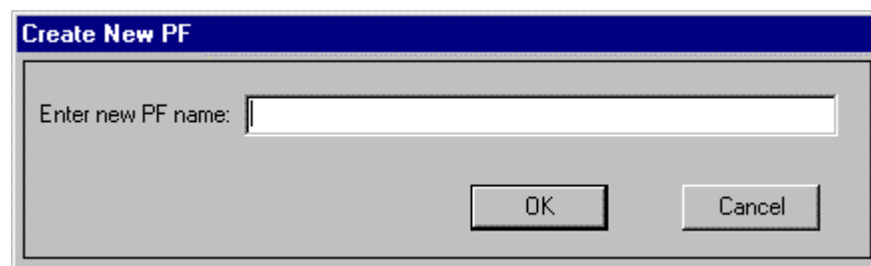
2. In the **PF** text box, enter a unique name. The name can be any legal Windows filename that is not a device name (e.g., COM, LPT). The name can contain embedded spaces but cannot contain any of the following characters: \ / : * ? " < > |. Note that the period character (.) can be part of the PF name but may not be the last character in the name.

3. Select **OK** to create a new PF, or select **Cancel** to close the dialog box and ignore the New PF… command.

    If the PF name you enter already exists in the current PF directory, a duplicate name

message will be displayed. At this point, repeat steps 1–3 and enter a unique name in step 2.

Note   After you create a new PF, the **Personal History dialog box** appears (if the personal history check box is selected in the System Preferences dialog box; see "Setting System Preferences" in Chapter 2). In the Personal History dialog box, you enter biographical information about the subject. Type information in at least the fields that are **underlined** and any others as appropriate. See "Entering Biographical Data," in Chapter 4, to learn how to complete the dialog box and **continue** the procedure.

Opening a Polygraph File

If a PF exists on the hard drive, you can open it using one of the following methods:

- Select **Open PF** from the File menu, then select the Polygraph File name from the Open PF submenu. The file name appears in the title bar.

- Select **Open PF** (Ctrl + O) from the File menu, then select **Open PF...** from the Open PF submenu. The Open PF dialog box appears:

Figure 17. Open PF Dialog Box

PF Name	Date	Time	Subject
5-31-98 Robbery Suspect #3AB5-2	05/31/98	08:05 AM	Joe Smith
LHS Arson 4-3-98	04/13/98	08:09 AM	Mark Jones
Over the Rhine Murder 3-21-98 Su...	05/31/98	08:07 AM	David Smith
Wilmington Shootout with Ohio Stat...	05/25/98	10:42 AM	Dennis Clark
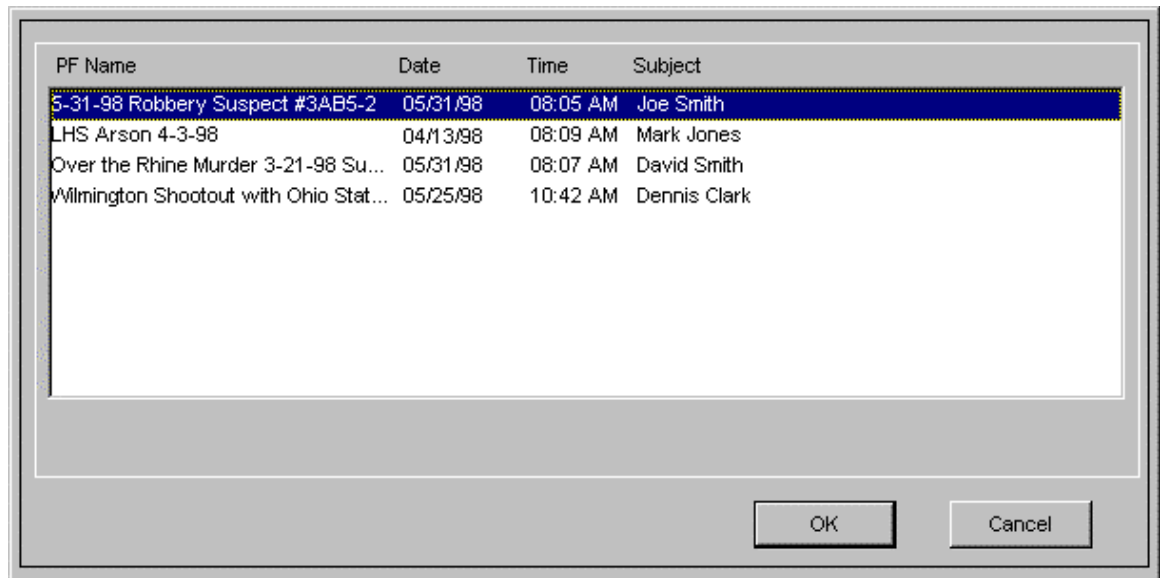
Highlight the PF you want to open and select **OK**. To close the dialog box and disregard any changes, select **Cancel**.

Tip   For a shortcut, double-click the PF to open it.

After selecting a PF, you can perform a variety of functions by selecting commands from the menus. For example, you can display biographical data, start a new exam, create a new set of questions, record exam information, etc.

Switching Between Polygraph Files

Note   Only one PF can be open at any given time; therefore, to "switch" between files you simply close the open file and select another.

If you want to use a different PF, select **Close PF** (Ctrl + U) from the File menu to close the current PF. Then, select **Open PF…** (Ctrl + O) to display the list of PFs that are available. Open a PF according to the previous instructions "Opening a Polygraph File."

Closing a Polygraph File

When you are finished recording test data for a subject, close the PF by selecting **Close PF** (Ctrl + U) from the File menu. When a PF is not open, many menu items and LXSoftware commands become disabled.

Administering a Test

4

Chapter Overview

This chapter provides instructions for administering a test. It includes the following information:

- Instructions for entering biographical data

- Instructions for selecting and using question sets

- Instructions for entering exam data

- Instructions for beginning an exam

- Instructions for generating a report

- Instructions for recording comments in the notepad

Entering Biographical Data

The first time you administer a polygraph test to a subject, you must create a PF (polygraph file) as previously explained in "Creating a Polygraph File" in Chapter 3. If the personal history check box is selected in the **Examination Preferences**, the **Personal History** dialog box appears when you create the PF.

Note   You can display the **Personal History** dialog box at any time by selecting **Personal History** from the **Exam** menu.

Figure 18. Personal History Dialog Box

Use this dialog box to enter biographical information about the subject. The subject's age is automatically entered.

1. Enter information in *at least* the fields that are underlined and any other additional information as appropriate. See the table on the following page for a description of each field.

2. Review the information and correct any typographical errors.

3. Record any comments pertaining to the personal history as explained in "Recording Comments in Notepad" later in this chapter.

4. When you are finished entering the biographical data, double-click the **Control-menu box** in the top-left corner (Ctrl + F4) to close the window.

If you entered all the required biographical examination information, the PF is created and you can create a new exam. You should proceed to the next step and **select a question set**.

The following table describes each field in the Personal History dialog box:

Table 10. Personal History Parameters

Field	Description	Options
<u>Name</u>	The subject's name.	NA
Aliases	Other name(s) by which the subject is referred.	NA
ID Number	The subject's social security or other identification number.	NA
Case Number	The subject's case number.	NA
Driver's License #	The subject's driver's license number.	NA
Driver's License State/Province	The state or province in which the driver's license was issued.	NA
Driver's License Country	The country in which the driver's license was issued.	NA
Driver's License Expiration	The expiration date of the subject's driver's license.	NA
Description	The subject's physical description, such as hair color, eye color, height, etc.	NA
Street	The street on which the subject lives.	NA
Apt	The subject's apartment number.	NA
City	The city in which the subject lives.	NA
State/Province	The state or province in which the subject lives.	NA
Country	The country in which the subject lives.	NA
Postal Code	The zip or postal code for the subject's mailing address.	NA
Home Phone	The subject's home phone number, including the area code.	NA

Field	Description	Options
Business Phone	The subject's business phone number, including the area code.	NA
<u>DOB</u>	The subject's date of birth. If a 2-digit year is entered, it is assumed to be relative to 1900.	NA
Age	The subject's age when the PF was created.	NA; Automatically calculated
Sex	The subject's gender.	Male Female
Birthplace City	The city in which the subject was born.	NA
Birthplace State/Province	The state or province in which the subject was born.	NA
Birthplace Country	The country in which the subject was born.	NA
Marital Status	The subject's marital status.	Single Married Divorced Separated Widowed
Education	The subject's highest level of education.	Some High School High School Graduate GED Some College College Graduate Graduate Work
Race	The subject's ethnic origin.	White Black Hispanic American Native Asian/Pacific Islander Other Illegal to Designate Pending Designation
From	The date the subject entered the military.	NA
To	The date the subject was released from the military.	NA

Field	Description	Options
Service Branch	The military branch in which the subject served.	Army Navy Air Force Marines Coast Guard
Highest Rank	The highest rank the subject achieved while in the military.	NA
Discharge	Type of military discharge.	NA
Other	Additional information related to the subject's military history.	NA
From/To	The date the subject became employed by the specified employer.	NA
Employer	The name of the subject's employer.	NA
Position	The subject's job title while employed by the specified employer.	NA
Other	Additional information related to the subject's employment with the specified employer.	NA
Relationship	The relationship of the relative to the subject.	NA
Name	The relative's name.	NA
Age	The relative's age.	NA
Occupation	The relative's occupation.	NA
Location	The current city or state in which the relative resides.	NA
Comments	Additional comments clarifying the biographical profile.	NA

Note   When the **Require entry of Personal History** option is selected in the System Preferences dialog box (Figure 10, Chapter 2), you need to supply the information in the underlined fields. If you do not enter the required information, the following message box appears, identifying the incomplete field.

Figure 19. Mandatory Examination Information Message Box
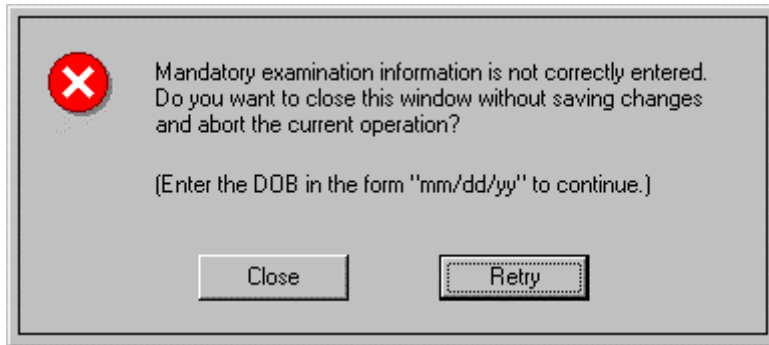
To close the dialog box, do either of the following:

- Select **Retry** to return to the Personal History dialog box to enter the required information.

- Select **Close** to close the message box and disregard any modifications made to the exam information. If the Personal History was displayed as a result of the **New PF** command, the PF will not be created.

Selecting a Question Set

After creating or opening a PF and entering or verifying the subject's biographical data, choose a set of questions to use during the test.

To select a question set:

1. Click on the drop-down list at the bottom of the screen. A list of **question set names** appears.

Figure 20. Question Set Names
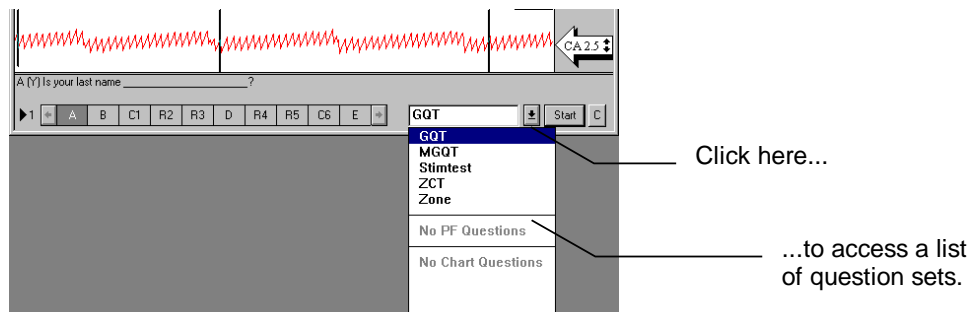
2. Select the question set you want to use from the **drop-down list box**. If you **do not see** a
    suitable question set, select a question set to modify or create a new question set. See
    "Using the Question Editor," next, for more information.

Note	If the **Require valid question set** check box is selected in the **Examination Preferences**, (Figure 10, Chapter 2) a question ID, expected response, and question text is expected for each entered question. Duplicate question IDs are not permitted in valid question sets. Only valid question set names appear in the question set drop-down list.

Using the Question Editor

You use the Question Editor dialog box to:

- **edit** an existing question set

- **create** a new question set

Question sets may contain up to 25 questions. The Question Editor window can only display
information for 15 questions at a time; use the scroll bars to see the question information that
exceeds the display area.

Each question in the question editor has a field for question ID, expected response, and question
text. You can tab between fields, or use the mouse to move directly to a field. To enter question
information, simply move to the desired field and begin typing.

Figure 21. Question Editor Dialog Box
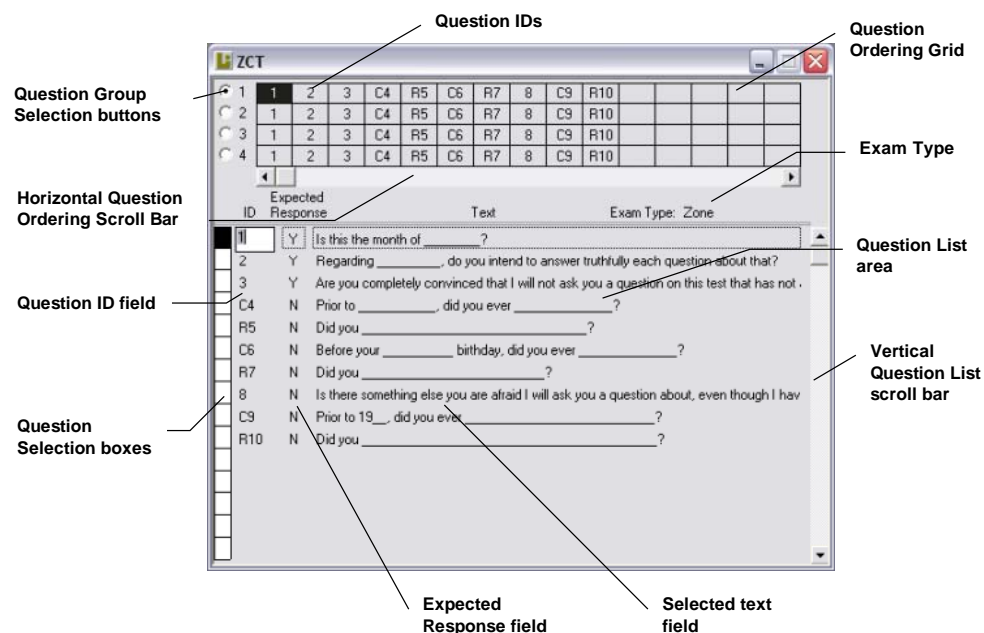
Question sets fall into the following three categories:

TEMPLATES	LXSoftware comes with several templates. A template is a question set that may be used as the basis for creating other question sets, or as a question set containing commonly asked questions. To open a template: highlight **Templates** on the **Question** menu, and select a template name from the submenu.
PF QUESTION SETS	PF Question Sets are only available when a PF Folder is open. PF Question Sets are question sets that have been customized for a particular subject and are stored with that subject's PF Folder. To open a PF question set: highlight **PF Question Sets** on the **Question** menu, and select a name from the submenu.
CHART QUESTION SETS	Chart Question Sets are only available when a PF Folder is open. Chart Question Sets are question sets that have been used during chart recording for a specific subject, and they also are stored with that subject's PF Folder. To open a chart question set: highlight **Chart Question Sets** on the **Question** menu, and select a name from the submenu.

Editing an Existing Question Set

You can edit a question set by:

- rephrasing a question in the set

- adding a question to the set

- copying a question from one set to another

- deleting a question from the set

- rearranging the questions in the set

Note   When you're finished editing a question set, double-click the **Control-menu box** in the top-left corner (Ctrl + F4 or Ctrl + W) to close the Question Editor dialog box. The **Save Question Set** dialog box appears. See "Filling in the Save Question Set Dialog Box," later in this chapter, for more information.

Rephrasing a question

In the current question set, you can rephrase any of the questions, change the ID, change the expected response, add questions, delete questions, etc. To edit a question:

1.   Choose the question you want to edit using one of the following methods:

     • In the Question Ordering grid, highlight the ID for the question you want to change.

     • In the question list area of the dialog box, position the I-beam cursor on the question you want to change.

Note   When you choose a question, a **selection box** surrounds the information.

---

2.   Highlight the portion of text to change or remove.

3.   Select **Cut** (Ctrl + X) from the Edit menu. Only the selected portion is affected; the rest of the question remains intact.

Note   This step is optional; you can highlight the text and type the new information without using the Cut command. Using the Cut command places the text on the clipboard which you can paste somewhere else.

---

4.   Type the new information.

Adding a question

To add a new question to the current question list:

1.   Position the cursor in an empty text field.

2.   Enter up to a four-character identification number in the **ID** field, then press <Tab>.

3.   Enter the expected response in the **ER** field (Y or N), then press <Tab>.

4.   Type the question in the **Text** field. When the question has been added, the identification number appears in the last column of the Question Ordering grid.

Copying a question

You can copy questions from one question set and insert them in another. You can use the standard Copy, Cut and Paste functions to duplicate questions, or you can use the *drag and drop* feature. To drag and drop questions:

1.   Open the question set that contains the question(s) you want to copy. This dialog box is called the **source**.

2. Open or create the question set you want to insert the copied question(s) into. This dialog box is called the **target**.

3. Position the source and target dialog boxes so you can see a portion of each.

4. In the **source** dialog box, position the cursor on the **Question Selection box** for the question you want to copy.

5. Press and hold down the mouse button as you drag the question to the **target** dialog box. The question is added to the bottom of the question list.

To select multiple questions:

1. Click the mouse on the **Question Selection box** for the first question in the range of questions you want to copy. You can only select a range of questions, not non-sequential questions from the list.

2. Hold down the <shift> key and click the mouse on the **Question Selection box** for the last question in the range to copy. All questions in the range are highlighted.

3. Slide the mouse pointer across the screen until the arrow is within the border of the target template dialog box.

4. Release the mouse button. The questions are added to the bottom of the question list.

Deleting a question

If a question is no longer applicable and you don't plan to use it in any future polygraph tests, you can delete it. To delete a question from the current question set:

1. Select the **Question Selection box** for the question you want to delete. **Do not** highlight the ID, expected response, or text; only highlight the Question Selection box (see Figure 22).

2. Select **Cut** (Ctrl + X) from the Edit menu. The question is deleted from the list.

Note To select multiple questions, press and hold down the <shift> key as you click the mouse on the Question Selection box for each question (you can only select a range of questions, not non-sequential questions from the list).

Rearranging the question order

The Question Ordering grid boxes allow you to create four groups of questions. Each group contains the same questions (which appear in the question list area), but you can arrange them in different orders (ordering 1, ordering 2, ordering 3, and ordering 4).

Figure 22. Question Editor Dialog Box, Rearranging Questions.
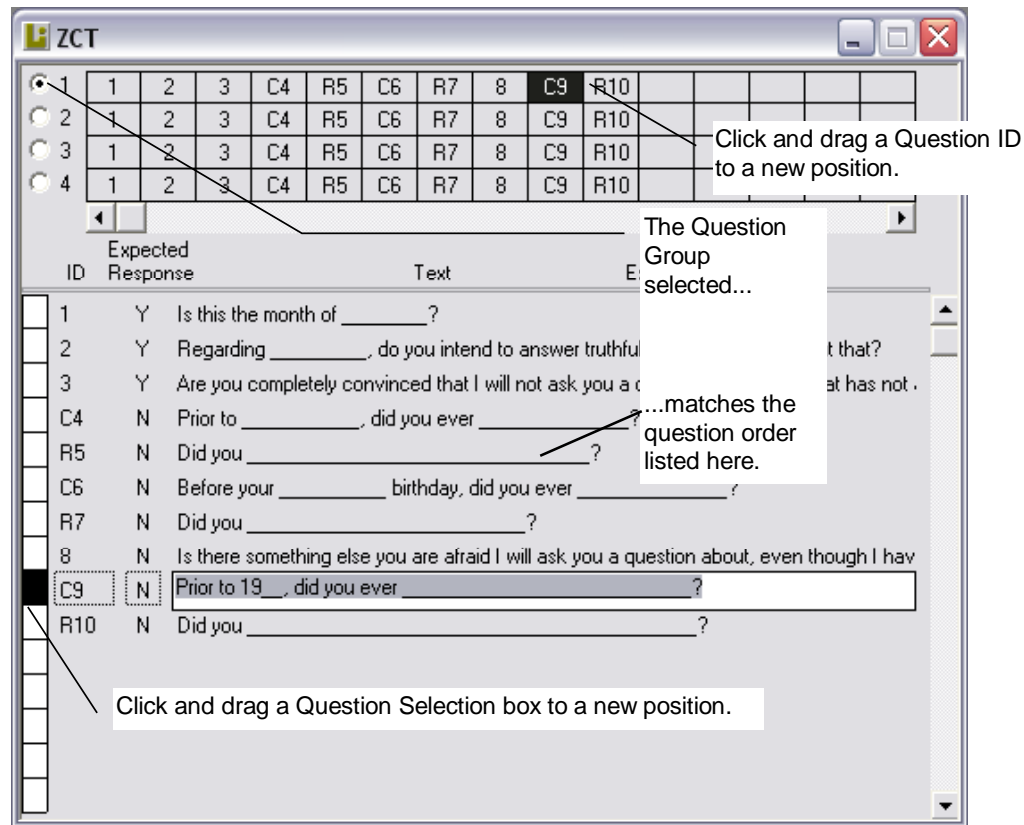
To arrange the questions in a different order:

1. Position the pointer on the **Question Ordering Grid box** for the ID you want to move.

Note You can also use the **Question Selection boxes** in the question list area to move questions around in the selected group.

2. Drag the highlighted grid box to a new position in the group or list, and release the mouse button.

3. Repeat steps 1 and 2 for each group you want to re-order.

Creating a New Question Set

If the existing question sets do not suit your needs, create a **new set of questions**:

1. Select **New Questions** from the Question menu. The **Question Editor** dialog box appears in an untitled window (see Figure 21 in "Using the Question Editor").

2. Enter the questions you want to use for this template using one or a combination of the following methods:

    -   Position the I-beam cursor in an empty **Text** field, and type in each question as explained previously in "Adding a Question."

    -   Copy and paste questions from an existing question set. Select **Templates** (available to any PF) or **PF Question Sets** (available only to the current PF) from the Question menu. Then select the name of the Question set to open. To copy questions, use the procedure explained previously in "Copying Questions from One Template to Another."

3. When you're finished, double-click the **Control-menu box** in the top-left corner (Ctrl + F4) to close the window. The **Save Question Set** dialog box appears. See "Filling in the Save Question Set Dialog Box," next, to continue.

Filling in the Save Question Set Dialog Box

The Save Question Set dialog box appears whenever you edit a question set or create a new set of questions.

Figure 23. Save Question Set Dialog Box
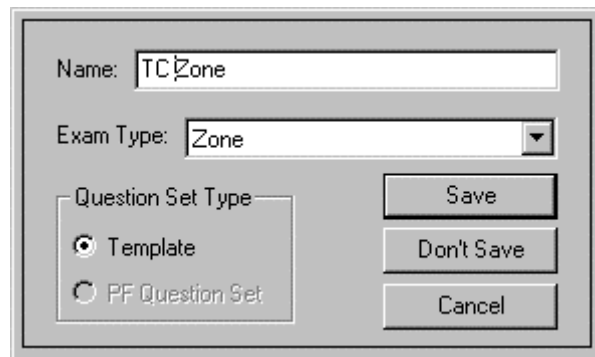
To complete the dialog box:

1. In the **Save Question Set As** field, enter a unique name for the new question set. You can use up to **255 characters** in this field. The name can contain embedded spaces but cannot contain any of the following characters: \ / : * ? \ " < > |.

Note   Also avoid **DOS device names** such as COM1, COM2, LPT1, LPT2, NUL, AUX, etc.

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2.   Select the exam type.

3.   Select the type of question set (e.g., Template or PF Question Set).

Note   **Template** is available for any PF at any time. **PF Question Set** is available only when a PF is open.

4.   Exit the dialog box by selecting one of the following options:

   • Select **Save Changes** to save the questions**.**

   • Select **Don't Save Changes** to disregard the new question information and close both the Name Question Set dialog box and Question Editor Window.

   • Select **Cancel** to close the Name Question dialog box and return to the Question Editor window.

Reviewing the Test Questions

Before you begin recording an exam, review the selected questions with the subject and note the responses. During the test, you must indicate whether the subject provided the expected response; therefore, you need to know what to expect.

Entering Exam Data

After you create a PF for a subject, enter biographical information, select a question set, and review it, you can create a **new exam**. You should use an exam to store charts recorded over a **short period of time** (usually one or two days).

Note   When a subject is given an examination **periodically**, you should create a **new exam** at the beginning of each polygraph session. Exam information focuses on variables which might affect test results.

To record new exam information:

1.   Select **New Exam** from the Exam menu. The Exam Info dialog box appears.

Figure 24. New Exam Dialog

Box

> Use this dialog box to enter *exam* information about the subject. The Examiner, Start Date, and Start Time fields are automatically filled in. (Stop Date and Stop Time are automatically filled in when you create a final report.)

2. Enter information in all applicable fields. Refer to Table 11 "Exam Info Parameters" for a description of each field. In some instances, selecting a field will cause additional associated fields to appear on the screen. Complete the requested information thoroughly.

3. Review the information and correct any typographical errors.

4. Record any additional comments pertaining to the exam information as explained in "Recording Comments in Notepad" later in this Chapter.

5. When you are finished entering exam data, double-click the **Control-menu box** in the top-left corner (Ctrl + F4) to close the window.

Table 11. Exam Info Parameters

Field	Description	Associated Information
Requester	The person, department, or agency requesting the test.	NA
Location	The place where the polygraph test is being conducted.	NA

Field	Description	Associated Information
Room Recorded	Room audio is being recorded.	NA
Room Monitored	The room is being monitored.	NA
Sleep Soundly	The subject slept well.	NA
Normal Amount	The average number of hours the subject normally sleeps in a 24-hour period.	NA
Amount Last 24 Hours	The actual number of hours the subject slept within the last 24 hours.	NA
Breakfast	The subject ate breakfast.	NA
Lunch	The subject ate lunch.	NA
Dinner	The subject ate dinner.	NA
Pregnant	The female subject is pregnant.	NA
Prior Polygraph Exam	The subject has had a polygraph test.	When (date) By Whom Why Result
Prior Arrests	The subject has been arrested.	When (date) Location Offense Disposition
Presently Taking any Medication	The subject is currently taking medication.	When (date/time) Type Amount
Illegal Drug Use	The subject has used illegal drugs.	When (date) Type Amount
Alcoholic Beverage Last 24 Hours	The subject has consumed alcohol recently.	When (time) Type Amount
Consultation with Psychiatrist or Psychologist	The subject has spoken with a psychiatrist or psychologist.	Name When Address Why
Heart or Respiratory Problems	The subject has either heart or lung problems.	When Diagnosed Type
General Health Problems	The subject has general health problems.	Nature Extent
Hospital Patient Last 2 Years	The subject has been a hospital patient within the last two years.	When (date) Why
Medical Exam Last 2 Years	The subject has had a medical examination within the last two years.	When (date) Result

Field	Description	Associated Information
Present Health (Examinee Opinion)	The subject's personal evaluation of his or her current health condition.	Poor Fair Good Excellent
User-defined questions	Blank text fields for creating your own questions for the current exam.	NA
Other	Additional information related to the subject's condition (physical, mental, emotional) at the time of this exam.	NA
Comments	Additional comments clarifying the exam information.	NA

If an exam has already been created for the current PF, the following dialog box appears when you select **New Exam** from the Exam menu.

Figure 25. New Exam Warning Dialog Box
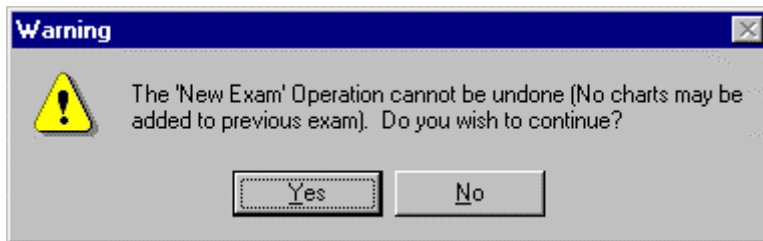
Note   If you select **Yes** to create a new exam, you will not be able to record another chart for a previous exam.

Viewing Previously Recorded Exams

To view information about a previously recorded exam, compete the following steps:

1. Select **Exam *x* Info** from the Exam menu (*x* represents the number of the exam for the current PF). The **Personal Info** dialog box (Figure 18) appears listing information about the specified exam.

2. After reviewing the exam information, double-click the **Control-menu box** in the top-left corner (Ctrl + F4) to close the dialog box.

Beginning an Exam

Before beginning a new exam, select a question set and choose the order you want to ask the questions by toggling through the Question sequencer, 1-4 (see Figure 21). Interview the subject and enter information about the exam as explained in "Entering Exam Data."

Testing the Chart Response Sensors

Before you begin an exam, you need to test the chart response sensors. To test the sensors, complete the following steps:

1. Place the Thoracic (P2) and Abdominal (P1) Respiration sensors around the subject.

2. Place the electrodermal sensors on the subject's fingers.

3. Place the Cardio cuff on the subject, but do not inflate it.

4. Verify that the Auxiliary sensors (e.g., movement) are in place (if used).

Using the On-Screen Sensor Controls

The sensor control (illustrated Figure 26) allows the examiner to perform the following functions quickly and easily:

- Identify the sensor ID and gain value

- Adjust the signal gain by clicking on the up and down arrows

- Re-position the chart traces

- Open the Trace Preferences dialog box by double-clicking on the sensor control

Figure 26. Sensor Control
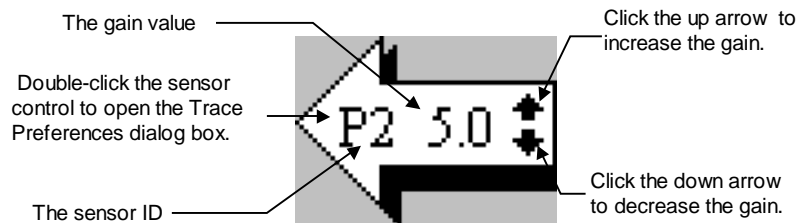
The two characters at the left identify the sensor. The gain value appears in the center. The up and down arrows at the right are used to increase and decrease the gain value. When you increase the gain, the magnitude of a sensor trace increases. Likewise, when you decrease the gain, the magnitude of a sensor trace decreases. For more information, refer to the previous section "Setting Trace Preferences."

Recording Responses

During the exam, you can indicate the subject's responses and other activities while recording a chart. As you record a chart, keep the following points in mind:

- You can center chart traces that extend above or below the designated trace area by clicking the **Center** button (C).

- You can use the sensor controls to adjust the gain for any chart trace.

- You can record artifact annotations on the chart (refer to "Programming Keys for Chart Annotation" in Chapter 2).

- The **Set question timer** value specified in the **Chart Preferences** (Figure 11, Chapter 2) controls the number of seconds that must elapse between the time you start to ask a question and the time you start to ask the next question.

- You can ask questions in a random order by selecting the question ID from the Question Ordering grid to display the text.

- You can ask the same question more than once.

As you start to record a chart, the screen display changes as indicated in the following *before* and *after* illustrations.

Figure 27. Chart Display Window—Not Recording
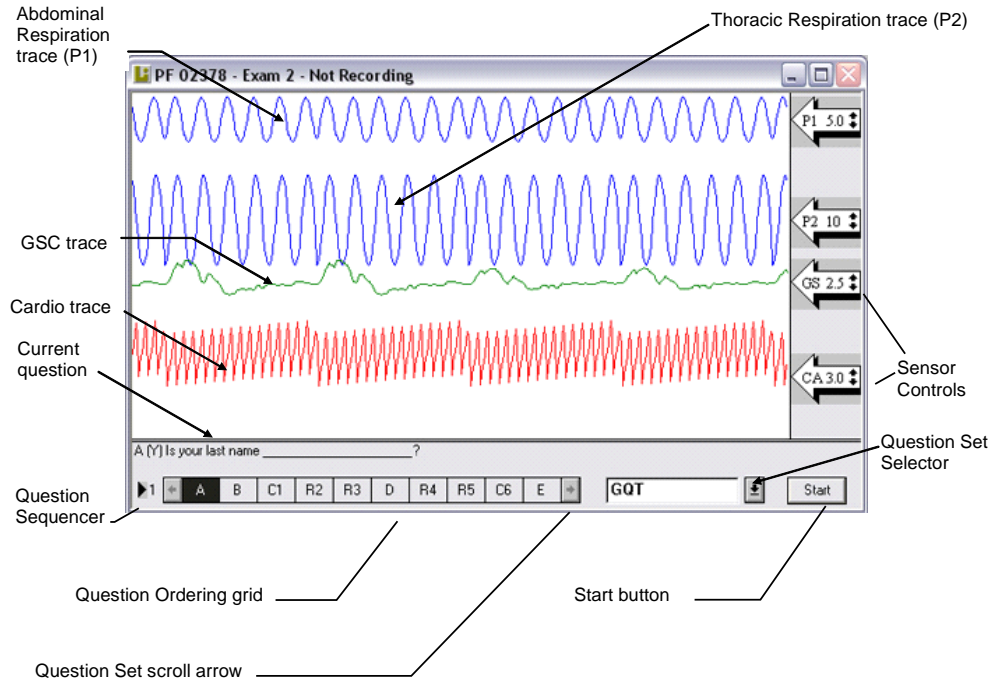
Note   The Cardio trace will not appear normal until the cuff is inflated.

Figure 28. Chart Display Window—Active Recording

Generating a Chart

Before generating a chart, check the following:

1. Make sure the question set and sequence appear at the bottom of the screen.

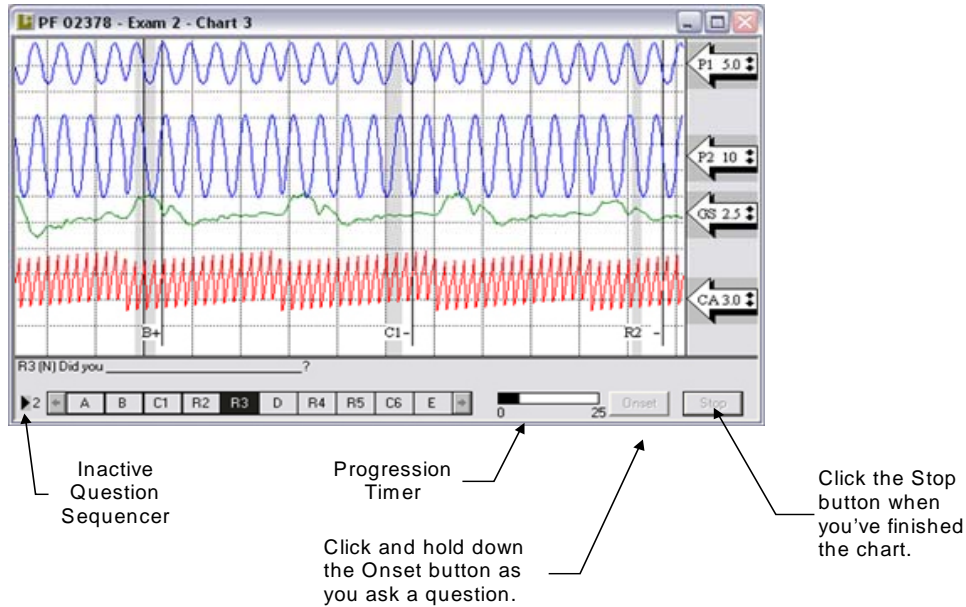   Use the Templates pop-up menu or the ⇑ and ⇓ keys to select a question set for the current PF. Use the mouse or ⇒ and ⇐ keys to display the next or previous question.

2. Ensure the physiological sensors work properly. Inflate the Cardio cuff pressure to between 50 mmHg–135 mmHg, and check the sensor trace.

The LXSoftware system supports various input methods, especially when recording and annotating charts. To document a specific action, you can use the mouse to select a button on the screen, press a standard key on the keyboard, a function key, a key on the numeric keypad, the <spacebar>, etc. Therefore, the following instructions for generating a chart provide general instructions about what to do at each step in the process. For a list of the keystrokes and buttons you can use to perform each action, refer to Table 7 in Chapter 2.

To begin recording:

1. Press the **Start** button.

2. Press <x> to record the start position and inform the subject that recording has begun. The *Start* annotation ID is marked on the chart.

3. If you do not want to ask the displayed question, select another question ID.

4. While reading the current question, press and hold down the **Onset** button (or <numeric 0> or <spacebar>). A gray "Q" bar marks the time it took to read the question.

5. Indicate the subject's response by clicking the **+** button (Yes) or the **-** button (No) located at the bottom of the window. The next question in the sequence appears.

Note You can also indicate the subject's response by pressing the **+** key or the **-** key on your keyboard; or press the **spacebar** to indicate the subject gave the expected response.

---

6. Wait until the progression timer is completely gray and the Onset button is redisplayed.

Tip To cancel a question without waiting for the progression timer to time out, select (Ctrl + Q) or the "Stop Question" button from the Toolbar.

---

7. Annotate the chart if necessary. Refer to "Programming Keys for Chart Annotation" in Chapter 2 for a keystroke and annotation mark reference.

8. Repeat steps 3–7 for each question you want to record.

9. Once you finish recording question responses and inform the subject that you are ending the exam, press <X>. The *Stop* annotation ID is marked on the chart.

10. Press the **Stop** button.

Troubleshooting Information

If you try to begin recording a chart before you open a PF and establish an exam, LXSoftware may display a message box that indicates what you need to do before continuing. For example, if a PF is not open when you press the **Start** button on the Chart window, the following dialog box appears:

Figure 29. Select a PF for Chart Recording Dialog Box
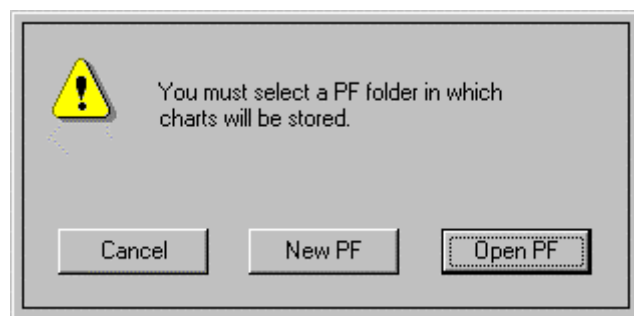
To use an existing PF, select **Open PF** (see "Opening a Polygraph File" in Chapter 3). To create a new PF, select **New PF** (see "Creating a Polygraph File" in Chapter 3). To close this dialog box without choosing a PF, select **Cancel**.

If the **Require entry of Exam Information** option in **Examination Preferences** is enabled (Figure 10), and an exam has not been established for the current PF, the following dialog box appears when you press the **Start** button on the Chart window:
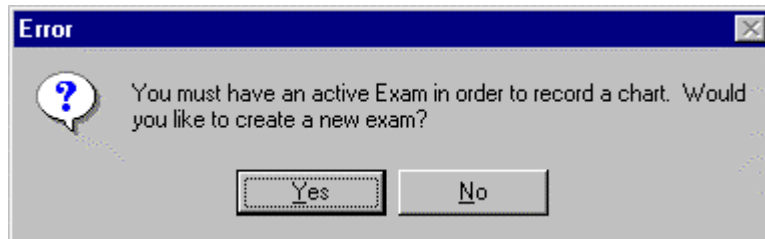
Figure 30. No Active Exam for Chart Recording Dialog Box

To create an exam, select the **Yes** button and enter the appropriate exam information (see the previous instructions "Entering Exam Data") before recording a chart.

If the **Require valid question set** check box in the **Examination Preferences** is enabled (Figure 10) and a valid question set has not been selected from the Question Set Selector (Figure 20), the following dialog box appears when you press the Start button on the Chart window:

Figure 31. No Valid Question Set for Chart Recording Dialog Box
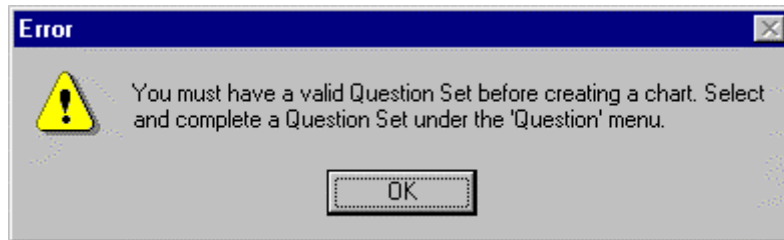
To create a valid question set, follow the directions provided in "Selecting a Question Set" in Chapter 4.

Centering Chart Traces

You must center all traces within their corresponding regions by clicking the Center button located on the chart toolbar. **LXVideo Audio/Video Recording Functionality**

Overview

The LXSoftware utilizes the multimedia capabilities present on most modern computers to digitally record audio and video (A/V) information as the polygraph examination progresses. When the A/V capabilities are activated, LXSoftware stores the digitized A/V information on the computer's hard disk drive along with the chart data itself. LXSoftware also provides the capability to replay a recorded chart along with the A/V information.

Requirements:

In order to utilize the LXSoftware A/V capabilities, the host system must be a multimedia-capable computer with a large hard disk drive (20 GB or greater is recommended), a sound card with built-in or external microphone, a USB or Firewire port, and a video camera. The video cameras supported by LXSoftware range from inexpensive "web cams" (starting at about $25 and up) to much more expensive digital video camcorders. Note that the image size, image quality, and hard disk requirements will vary depending upon the type of camera being used. Also note that capturing A/V information places significant demands on the host computer's hardware (processor, USB port, and hard disk drive). Some computer systems may be unable to take advantage of the A/V capabilities due to limited system resources. Older computers that claim to be multimedia compatible may have trouble running the video camera and DAS unit on the same computer. In addition, A/V files require a considerable amount of hard disk drive space. The exact amount of hard disk space required varies depending upon the type of camera being used. If your computer runs out of hard disk drive space, Windows may perform erratically or the computer may lock up. You should have a minimum of 10 gigabytes of free disk space before starting an examination. LIC recommends periodically backing up the examinations to a recordable CD-ROM drive (CDR or CD-RW) and removing them from your system to avoid running low on hard disk drive space.

In order to verify the multimedia performance of your computer, LIC recommends thoroughly testing the A/V capabilities in a controlled environment prior to using the functionality during a real polygraph examination.

Supported Hardware

The LXVideo application supports any Microsoft DirectShow-compatible video capture device, including USB and Firewire-based video cameras. In order to reduce the storage requirements for the captured audio and video, LIC recommends using a "web cam" device instead of a digital video camera. Web cams typically provide a default image size of approximately 352x288 pixels at a rate of approximately 15 frames (images) per second. This image size and frame rate is sufficient for most purposes and provides a good trade-off between image quality and hard disk drive free space requirements. While Firewire-based digital camcorders can be used to provide much better resolution, these cameras typically require significant amounts of hard disk drive space for image storage. Therefore, using a digital camcorder as a video capture device is not recommended.

Installation

Before using the LXSoftware A/V capabilities, please install and test your video camera according to the manufacturer's instructions. Please ensure you can successfully record audio and video according to the manufacturer's instructions before you attempt to use the LXSoftware A/V functionality.

Most video cameras are plug-and-play compatible devices—USB and Firewire devices can be installed by simply plugging the camera into the computer after the computer has booted. When the camera is plugged into the computer, a "found new hardware" dialog may appear instructing the user to insert the disk containing the driver for the camera. Insert the disk that came with the camera and follow the prompts to install the camera.

Note that some cameras may require you to install the drivers before you plug in the camera; therefore, the camera's installation guide should be consulted prior to starting the installation.

The audio can be recorded using the computer's built-in microphone (if available) or an external microphone can be connected to the computer's microphone jack. Note that some web cameras are equipped with an internal microphone. For optimum quality and compatibility, LIC recommends using the computer's sound card instead of the internal microphone.

Recording

Once the video camera has been installed, a microphone has been connected, and the multimedia performance of the computer has been verified, start LXSoftware and select the "Tools | Preferences" menu item. Select the "Chart" tab, and select the "Record Audio and Video" check box. Select "OK" to dismiss the preferences dialog box. If the video camera is installed correctly, the LXVideo window will appear in preview mode. In this mode, the video feed from the camera is displayed on the screen, allowing the camera to be aimed and focused if necessary. If an external microphone is attached to the computer, place the microphone where it can record the voices of both the examiner and examinee. Note that the microphone is not activated in preview mode.

Once the camera and microphone have adjusted, the A/V recording will automatically begin when the "record" button is pressed to start a polygraph examination and will terminate when the examination is concluded.

Playback

Previously recorded charts can be replayed using the VCR-style controls at the bottom right of the chart review window. Pressing the "Play" button starts the playback operation. During playback, the chart will scroll from the right edge of the window similar to when the chart was originally recorded. If an A/V file was recorded along with the chart, the LXVideo window will appear and the video will begin playing automatically when the "Play" button is pressed. The chart will stop scrolling at the end of the playback and, if a video file is present, the video will pause at the last frame of the video. Press the "Stop" button to return the chart to the normal view and return the LXVideo application to preview mode.

While the playback is progressing, the "Fast Forward" button can be used to accelerate the rate of playback. When the "Fast Forward" button is pressed, the video (if applicable) is paused and the chart rate increases to 2x normal speed. If the "Fast Forward" button is pressed again, the chart playback rate increases to 4x. Subsequent presses of the "Fast Forward" button cycle the video playback rate between 1x, 2x, and 4x. To resume video playback, press the "Play" button.

The "Home" button can be pressed during playback to restart the chart (and video, if applicable) at the beginning. Pressing the "Pause" button toggles the video between pause and play mode.

Recording Additional Charts

You can record a new chart at any time, provided one is not already in process. To record a new chart, complete the following steps:
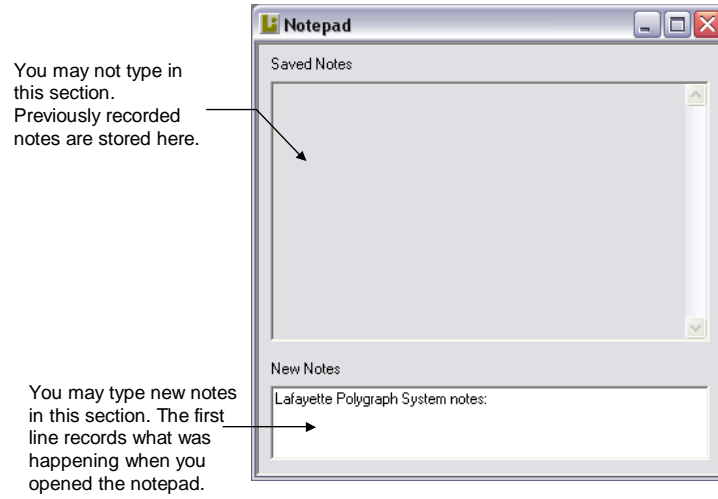
1. Open a PF.

2. Select a question set and sequence.

3. Repeat the procedure described in "Generating a Chart."

Recording Comments in Notepad

While using LXSoftware to administer, record, and review charts, you can record comments about any aspect of the test or subject provided a PF is open. To record comments, select **Notepad** from the Exam menu. The Notepad Window appears as illustrated below:

Figure 32. Notepad Window

You may not type in this section. Previously recorded notes are stored here.

You may type new notes in this section. The first line records what was happening when you opened the notepad.

The top section of the Notepad window displays previously recorded examiner's notes. Use the bottom portion of the window to record new comments. Information is automatically entered to identify which window or dialog box you were using when Notepad was selected.

When you are finished recording comments about the current window, double-click the **Control-menu box** in the top-left corner (Ctrl + F4) to close the notepad.

Evaluating a Test

5

Chapter Overview

This chapter provides instructions for evaluating a test. It includes the following information:

- Instructions for reviewing a chart

- Instructions for scoring a chart

- Instructions for reviewing and editing PF Information

- Instructions for copying a Polygraph File to another drive

- Instructions for reporting test results

- Instructions for printing

Reviewing a Chart

To help you evaluate a subject's chart, you can review previously recorded charts at any time.

To choose a chart for review:

1.   Select **Open PF…** (Ctrl + O) from the File menu.

2.   From the list of PFs, select the PF name for the chart you want to review.

3.   Select *Chart 1 Exam 1* from the **Chart** menu. *Chart 1 Exam 1* represents the first chart of the first exam. As you select a chart for review, the chart is displayed.

Figure 33. Chart Review Window
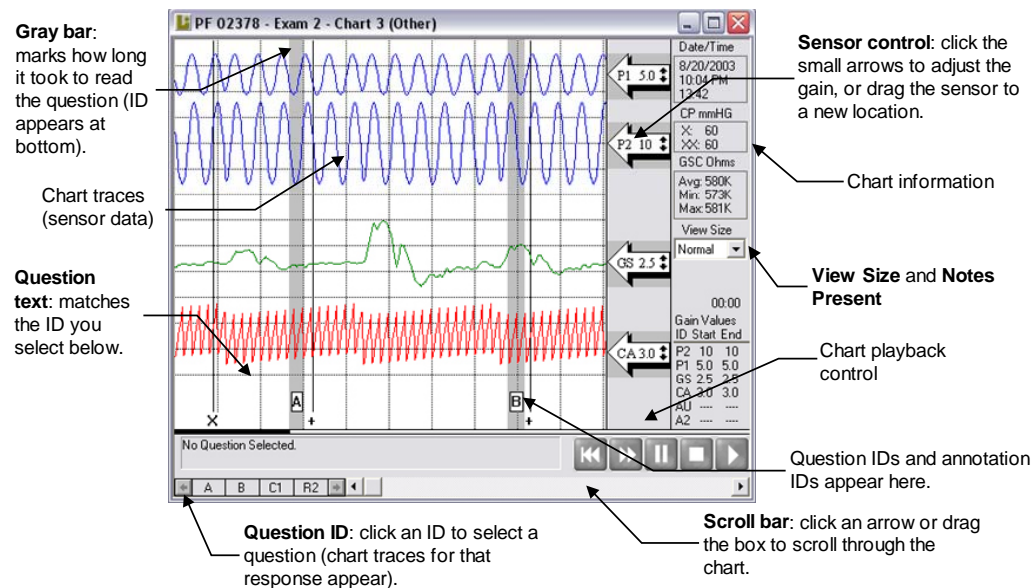
This window is similar to the Chart Display window (Figure 27), but you use it to review previously recorded charts. Using the scroll bar, you can view the portions of the chart that exceed the window area. Using the **View Size** drop-down menu, you can select how a chart will be displayed on the screen. See "Understanding the Chart Review Functions," next, for details. Using the Question Ordering grid at the bottom of the window, you can select a specific question. Use the left and right arrows to display question IDs that exceed the display area.

Tip   The Chart information boxes in the right-hand column supply you with the following information:

DATE/TIME   This box lists the date of the test, the time the test was started, and the duration of the test.

CUFF PRESSURE   This box lists the beginning and ending cuff pressure readings.

GSC   This box lists the minimum, maximum, and average reading for the GSC (Galvanic Skin Conductance).

CHART PLAYBACK TIMER   This field indicates the current offset of the data at the right edge of the screen in seconds from the start of chart during chart playback.

GAIN VALUES   This box lists the starting and ending gain values for each sensor used during the recording of this chart. If a sensor was not used during recording, a special pattern will be displayed instead of the gain.

Understanding the Chart Review Functions

The Chart Review functions let you to display charts in several ways. The following explains:

View Size   The View Size drop-down menu lets you choose how much of the chart to display in the Chart Review window. Select from the following options:

Table 12. View Size Options

Option	Description
Normal	Displays chart traces for approximately 70 seconds worth of data.
25%	Displays chart traces for approximately 1/4 of the chart.
33%	Displays chart traces for approximately 1/3 of the chart.
50%	Displays chart traces for approximately 1/2 of the chart.
100%	Displays chart traces for all questions. The entire chart is compressed to fit in a window.

Notes Present   The Notes Present function lets you open the notepad to review or record Chart Review comments.

Adjusting the Gain of a Specific Chart Trace

When a chart is displayed, you can adjust the gain of a specific chart trace. Adjusting the gain increases or decreases the height of the trace as you click on the up and down arrow of the corresponding sensor control. The gain adjustments you make are only active while the PF is open. As soon as the PF is closed, the gain values are restored to their original values. To adjust the gain, use the following procedure:

1.   Display the portion of the chart containing the chart trace you want to adjust.

2.   Click on the sensor control for the appropriate chart trace.

3.   Click the small up and down arrows in the sensor control to increase or decrease the gain.

Reviewing Corresponding Questions

The LXSoftware system provides the ability to display the list of questions that were asked during chart recording. To display the questions for a particular chart, use the following procedure:

1.   Select **Open PF…** (Ctrl + O) from the File menu.

2.   From the list of PFs, select the PF name for the chart you want to review.

3.   Select *QS CxEx* from the Question menu. *QS CxEx* represents the question set name, chart number, and exam count. The questions are displayed in the Question Editor dialog box.

Examiner Scoring

For each chart recorded using TES, MGQT, Rank, and Zone exam type questions, an examiner's *manual* score sheet can be created for the chart.

Opening an Examiner Score Sheet

To review an existing score sheet use the following method:

- Select the score sheet from the Open Score Sheet dialog box according to the following instructions:

  1. Select **Score** from the Exam menu.

  2. Select **Examiner** from the Score submenu. A dialog box similar to the following is displayed listing the available score sheets for the current PF.

Figure 34. Open Score Sheet Dialog Box
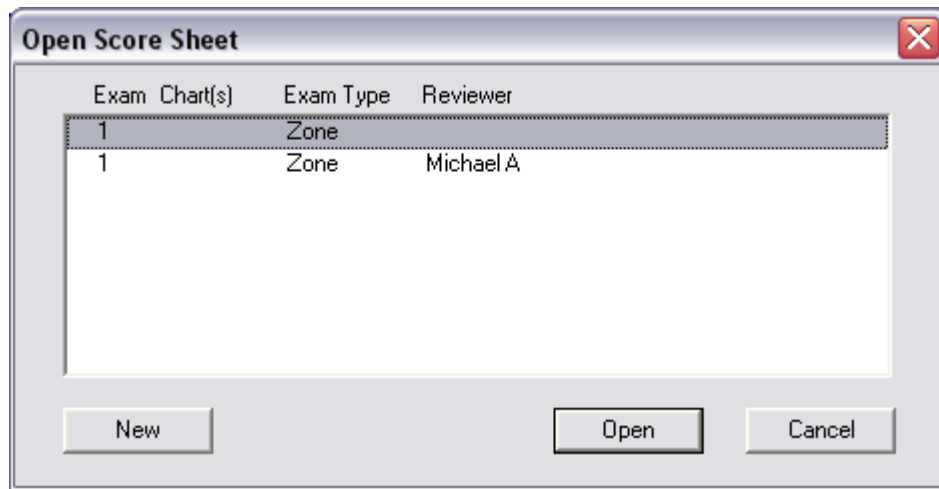
3. Select one or more score sheets from the list and press **Open**. To select multiple score sheets, either drag the mouse through the list of score sheets or hold down the "Shift" key while clicking on individual score sheets.
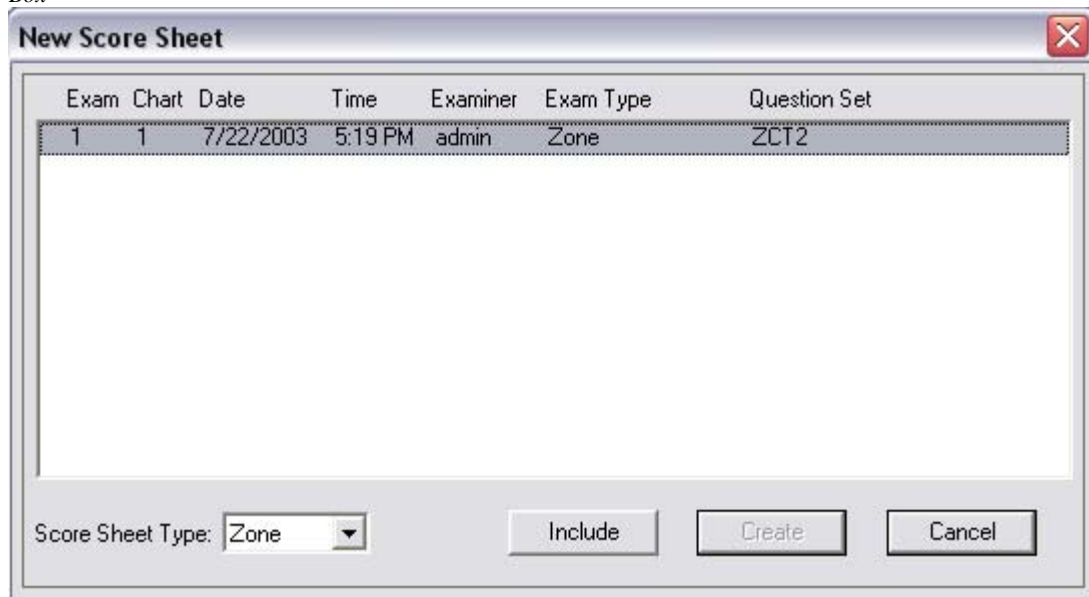
Creating an Examiner Score Sheet

Examiner score sheets can be created as needed by either the original examiner or by one or multiple reviewers.

To create a new score sheet use the following method:

1. Select **Score** from the Exam menu.

2. Select **Examiner** from the Score submenu. The Open Score Sheet dialog box is displayed (see Figure 34).

3. To create a new score sheet, press **New**. A dialog box similar to Figure 35 is displayed listing all charts available for the current PF.

4. For TES examinations, select the chart to be scored. For Zone, Rank, or MGQT examinations, select any chart for the exam to be scored. For example, in Figure 35 below, selecting chart 1, 2, or 3 will result in creation of the same score sheet for exam

5. In the Exam Type combo box, specify the type of score sheet to generate.

6. Click **Create** to generate a new score sheet for the specified exam, chart, and exam type. A blank examiner score sheet will be displayed.

Figure 35. New Score Sheet Dialog Box

Following is a sample Zone score sheet:

Figure 36. Example MGQT Score Sheet

You can hand score each relevant question for the Pneumo, GSC, and Cardio responses by entering values (-3 to +3) into the rows and columns on the score sheet. As values are entered, a total (Spot or Grand) is automatically calculated and displayed at the bottom of the score sheet. For the Zone score sheet, a total is calculated for each relevant question, for each chart, for each spot, as well as a grand total. Score sheets are saved with the chart(s) in the subject's PF folder.

The **Information** tab of the Score Sheet dialog box contains relevant information about the chart including the subject name, original examiner, and date the chart was recorded. Additionally, space is provided to enter reviewer information, including reviewer name, reviewer title, date reviewed, and whether the reviewer concurred with the original examiner's score.

On the examiner's score sheet, **R1** indicates the first relevant question, **R2** indicates the second relevant question, etc. **ID** indicates which respiration sensor, P1 (Abdominal) or P2 (Thoracic), was used for scoring.

You can toggle between the examiner score sheet and the Chart Review window.

- To bring the Chart Review window to the front, click on it with the mouse.

- To bring the score sheet to the front, press (Ctrl+A).

Automatic Scoring

During automatic scoring, a computer algorithm examines the sensor data and automatically provides a recommended decision with minimal effort on the part of the examiner. Automatic scoring algorithms are commonly referred to as computerized scoring algorithms. Examples of automatic scoring algorithms provided by the LXSoftware are PolyScore®, QuESt, and the Objective Scoring System (OSS).

Automatic Scoring Using PolyScore®

Note	The instructions included in this section pertain to the version of PolyScore® built in to the LXSoftware. A standalone version of PolyScore® is available with its own help system

After charts are recorded, they can be scored using the Johns Hopkins University/Applied Physics Laboratory PolyScore® scoring algorithm. The scoring algorithm analyzes specific sensor traces for each chart selected and calculates a percentage score to indicate the probability of deception. For the most part, the scoring algorithm automatically determines which questions and sensor components to use during scoring. However, you can override some of the algorithm's recommendations by selecting or deselecting items from the various scoring dialog boxes presented in this section.

The general procedure for scoring charts is as follows:

1.   Open the PF containing the charts to score.

2.   Select a scoring technique for the algorithm to use.

3.   Select the charts to include in the scoring process.

4.   Review the question type tags for all questions in each chart and revise if necessary.

5.   For each chart, review the list of components that the algorithm recommended to exclude from the scoring process and revise if necessary.

6.   For each chart, review the list of statistical outliers that the algorithm excluded from the score (if any).

7.   Review the scoring report.

PolyScore® imposes the following chart collection requirements:

1. The event markers (beginning-of-question and end-of-question) must be entered for each valid comparison/control and relevant question. The keystrokes must be entered accurately (within one second of the actual time).

2. You must allow at least 25 seconds between question onsets (the time between when you start asking a question and the time you start asking the next question). Refer to "Setting System Preferences" in Chapter 2 for information about setting the question timer.

3. Use the start of chart (X) and end of chart (XX) marks when recording a chart.

4. Record at least three (3) charts for Zone and MGQT format and four (4) charts for Bi-Zone.

5. For all charts, only the first nine (9) minutes following the start of chart (X) mark are used.

6. The test type (Zone/MGQT or Rank) must match the test given. The SKY question sequence sometimes used with the Zone Comparison test has not been used in algorithm development and should not be scored using PolyScore®.

7. If there is a movement or other artifact occurring during a comparison/control or relevant question response (within the first 18 seconds after the beginning of the question for respiration, within the first 8 seconds for blood volume, or within the first 14 seconds for the electrodermal or galvanic skin response), then components of the response must be dropped.

8. The blood pressure cuff should not be inflated beyond the diastolic pressure, typically less than 65 mmHg.

Proper use of the software is required for accurate results. First, PolyScore® is designed only to evaluate charts collected in accordance with standard Zone Comparison, Modified General Question Test (MGQT), or peak-of-tension procedures. Second, any reactions unrelated to the questions that occur while collecting the charts must be identified by you, the user, when scoring a test using PolyScore®. For example, if the subject coughs, the reaction would not be scored by you and should not be tagged as a response to be scored by PolyScore®. If the electrodermal on a chart is of poor quality, that chart should not be scored. It is up to you to make sure all movement or other artifacts are properly marked. PolyScore® will find and mark most of the artifacts. Finally, the PolyScore® system consists of many specialized scoring algorithms. (An algorithm is a scoring technique or recipe for scoring). The scoring procedure should be matched to the testing procedure (Zone, MGQT, etc.) and only the overall test result should be used to reach a conclusion. The spot and question scores are based on different scoring algorithms and should only be used to assist you in evaluating the charts.

!!!WARNING !!!

PolyScore® results are affected by the quality of the chart recording process. Computerized scoring cannot overcome improper pretesting, bad question formulation, or degenerate tracings (i.e., pneumo tubes that are stretched too tightly or not tightly enough, underinflated cardio cuff, or flat, wandering, noisy, or erratic GSC). Do not use PolyScore® to score poor-quality charts.

Recommended Question Formats

PolyScore® produces a probability of deception for two common test question sequences: Zone Comparison and MGQT. These are both Probable Lie comparison/control question techniques. The Zone is a single issue exam, while the MGQT allows for multiple aspects of a single issue. The Zone/MGQT algorithm is not suitable for the truly multiple issues of a screening exam (e.g., RI, TES).

The **Rank** scoring algorithm has been used successfully when *comparing responses* in multiple issue (screening) tests and it is recommended for use for Guilty/Concealed Knowledge tests. It does **not** provide a probability of deception, but it can help you identify which of the subject's reactions are the greatest over a series of charts. The most reactive spot will be assigned a value of ten (10.0) for both the deceptive and non-deceptive subject, even if all the reactions are small. The others will be assigned a ranking relative to the largest between 0 and 10.

For example, if there are five questions being ranked and each is asked on three different charts and each generates similar small (or large) reactions, then all will have rankings near ten. However, if the subject responds equally to four spots and much more to the fifth, then the more reactive spot would be assigned a ten and the others would be assigned smaller values, perhaps less than 6.0.

Each of the scoring options (Zone/MGQT, Rank) on the scoring menu consists of several specially tailored scoring algorithms. For example, the Zone/MGQT option uses one algorithm for judging whether the subject is deceptive, another for evaluating spots, and still another for evaluating questions. Spot scores are necessarily based on less information than test scores. The test evaluation made by PolyScore® is based on all comparison/control and relevant reactions. Other scores (spot and question) are provided for diagnostic information only.

The Zone algorithm performs best when scoring three or more charts collected by using questions similar to the following:

X	The test is about to begin.
1	Is today Friday?
2	Regarding the money taken from the cash drawer, do you intend to answer truthfully each question about that?
3	Are you completely convinced that I will not ask you a question on this test that has not already been reviewed?
C4	Prior to your last birthday, did you ever lie to anyone in authority?
R5	Did you take any of that money taken from the safe?
C6	Before 1994, did you ever deliberately do anything dishonest?
R7	Did you take any of that money from the safe last Wednesday?
8	Is there something else you are afraid I will ask you a question about, even though I have told you I would not?
C9	Before your last birthday, did you ever lie to someone who really trusted you?
R10	Did you have any of that money after it was taken from the safe?

or

R10	Do you know where any of that money that was taken from the safe is now?
XX	The test is over. Please remain still.

Depending on the situation, Question R10 can sometimes make the Zone a two-issue test. The performance of PolyScore® is improved when question R10 addresses the same issue as is addressed in questions R5 and R7. The "Do you know where …?" is often used. When it is possible that the subject strongly suspects someone or thinks they know where the money is, then another form of question R10, perhaps as suggested, should be used.

The (Army) MGQT algorithm performs best when scoring three or more charts collected by using questions similar to the following:

X	The test is about to begin.
1	Are you in the state of Maryland?
2	Is this the month of November?
R3	Did you plan with anyone to steal those truck tires from your mother's basement?
4	Are you called John?
R5	Did you steal any of those truck tires from the basement of your mother's home?
C6	Prior to this year, did you ever steal anything from someone who really trusted you?
7	Are the lights on in this room?
R8	Do you know where any of those missing truck tires are now?
R9	Were you present when those truck tires were stolen from your mother's home?
C10	Have you ever cheated a friend out of anything?
XX	The test is over. Please remain still.

When using the MGQT format with PolyScore® , the mixed series must be used on the third chart, and should look similar to the following:

X	The test is about to begin.
4	Are you called John?
1	Is today Thursday?
R5	Did you any of those truck tires from the basement of your mother's home?
C6	Prior to this year, did you ever steal anything from someone who really trusted you?
R3	Did you plan with anyone to steal those truck tires from your mother's basement?
C10	Have you ever cheated a friend out of anything?
R9	Were you present when those truck tires were stolen from you mother's home?
C6	Did you ever steal anything from someone who really trusted you?
R8	Do you know where any of those missing truck tires are now?
C10	Have you ever cheated a friend out of anything?
XX	The test is over. Please remain still.

As illustrated in the previous typical question lists, using a C or R in the question ID field when constructing the question list will allow PolyScore® to automatically identify the comparison/control and relevant questions, respectively, when scoring

Selecting a Scoring Technique

When preparing to score charts for a PF, first select a scoring technique to be used by the algorithm. To choose a scoring technique, use the following procedure:

1. Select **Score** from the Exam menu.

2. Select APL from the Score hierarchical menu. The Scoring dialog box displays a list of charts for the current PF. If Auto-select charts to score was selected in the System Preferences, all charts will be automatically selected for inclusion in the scoring process. Refer to "Setting System Preferences" in Chapter 2 for information about automatically selecting charts to score.

Figure 37. Scoring Dialog Box
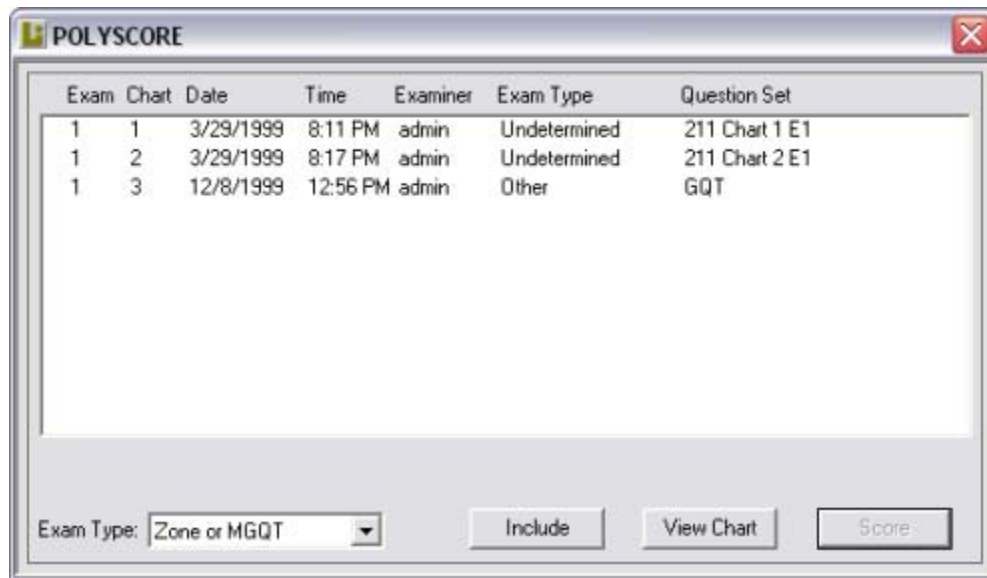
The algorithm used must correspond to the actual exam question sequence. The algorithms were developed using standard question sequences for Zone and MGQT as taught by the Department of Defense Polygraph Institute. These formats use probable lie comparison/control questions. This version of PolyScore® uses a single algorithm to evaluate both the Zone and MGQT (Army or Air Force) formats. Small deviations from these formats, such as extra irrelevants are not a problem. However, significant deviations, such as using the MGQT on multiple, independent issues, will likely cause erroneous results. SKY sequences, if collected, should not be tagged for scoring.

The **Rank** algorithm was developed from a spot model using data collected during criminal investigations. Ranking should be used in screening situations or on stims collected as part of an exam.

Selecting Charts to Score

From the Scoring dialog box, you can:

- Display charts for review.

- Specify which charts to use in the scoring process.

- Select an exam type to use for scoring.

To display a specific chart, use the following procedure:

1. Highlight the number of the chart you want to display using the mouse or the ↑ and ↓ keys.

2. Select **View Chart** (V).

To select one or more charts to include in the scoring process, use the following procedure:

1.   Highlight the number of the chart you want to include using the mouse or the ↑ and ↓ keys.

2.   Select **Include** (I). A check mark appears in front of the chart number.

Figure 38 Scoring Dialog Box Selection

A check mark beside a chart number indicates you've selected it.
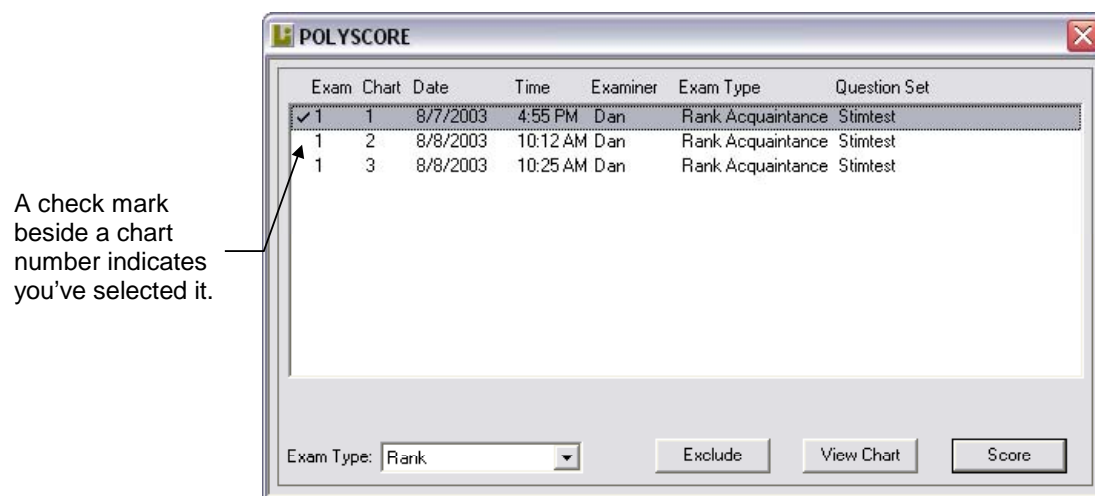
| Tip | For a shortcut, **double-click** the chart. A check mark appears in front of the chart number. |

3.   Repeat steps 1 and 2 for each chart.

To exclude a selected chart from the scoring process, use the following procedure:

1.   Highlight the number of the chart you want to exclude using the mouse or the ↑ and ↓ keys.

2.   Select **Exclude** (E). The check mark is removed from in front of the chart number, and the chart will not be scored.

| Tip | For a shortcut, **double-click** the chart. The check mark is removed. |

After selecting all of the charts to include in the scoring process, perform the following steps:

1.   Select an exam type from the **Exam Type** list box.

•   Select **Score** (S). The scoring algorithm performs initial data processing and question type identification, then displays a dialog box for tagging questions (Figure 39).

Tagging Questions

The Set Question Types dialog box displays the list of questions for the first chart included in the scoring process.

Figure 39. Set Question Types Dialog Box
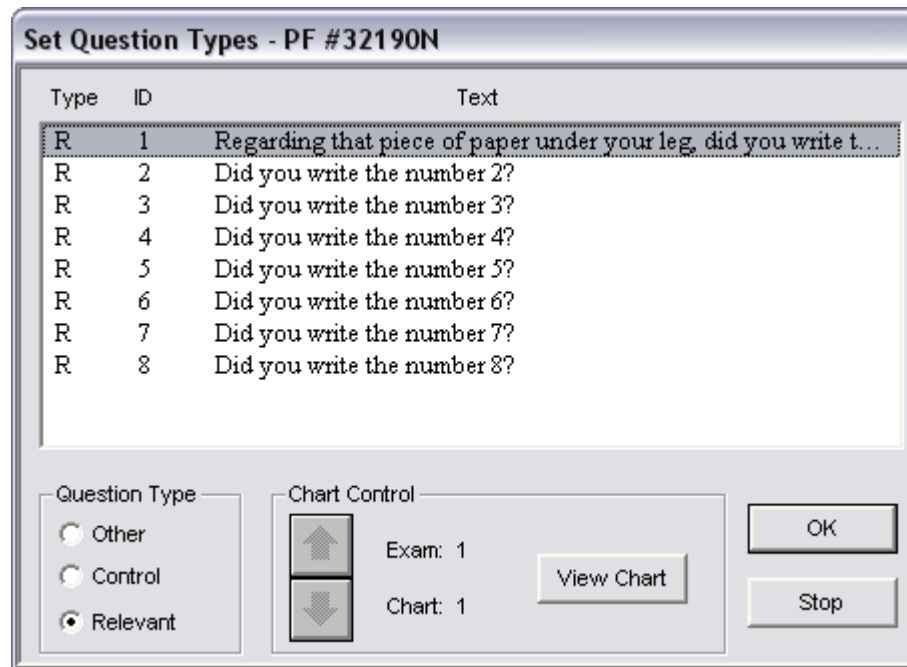
The scoring algorithm evaluates the questions and tags each one based on the selected scoring technique. The question type tags are displayed in the Type column and correspond to the first letter of the question type (e.g., C = Comparison/Control, R = Relevant).

Note   Scoring accuracy depends on the correct tagging of questions.

Warning

If comparison/control or relevant questions contain artifacts or should not be used in scoring for other reasons, you must remove those questions from use by the scoring algorithm by using a blank for a mark. Any question not marked with a **C** or an **R** will not be used in scoring the test. If only certain components of a reaction contain artifacts, then only those components need to be deleted. A procedure for deleting components is described later. Although an effort has been made to minimize the effects of abnormalities, you may obtain invalid scores if you include invalid questions or questions with artifacts or other abnormalities while scoring charts. You need only to be concerned with artifacts that occur during the period between the beginning of the question and 20 seconds after that point. The entire question should be dropped if, for example, a reaction is produced by a noise outside of the room or by a mistake in the question.

Changing a tag

To assign a different tag to a question in the current list, use the following procedure:

1. Highlight the question using the mouse or the ↑ and ↓ keys.

2. In the Question Type group box, select the appropriate option button or type the first character of the tag, such as **r** for Relevant. The new tag is displayed in the Type column.

3. Repeat steps 1 and 2 for each question tag you want to change.

For Rank scoring, any or all questions can be ranked and no question is tagged as a comparison/control. It is recommend that **the first two responses on each chart not be marked**. Experience indicates that the first two questions sometimes generate orienting responses.

Viewing other questions

To display the questions used while recording one of the other selected charts, use the following procedure:

1. Press the↑ and ↓ arrows in the Chart Control group box, or use the <page up> and <page down> keys until the desired exam and chart number is displayed.

Use these arrows to
move through the charts.

┌─ Chart Control ──────────────┐
│ ↑   Exam: 3   │
│   ┌──────────┐│
│   │View Chart││
│ ↓   Chart: 2   └──────────┘│
└──────────────────────────────┘
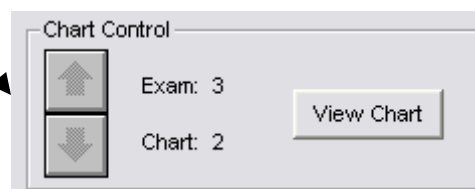
2. Revise the question type tags as appropriate.

3. Repeat this process for each chart selected for scoring.

After reviewing the questions and tags, select **OK**. A Scoring Status box displays processing status messages, then the dialog box illustrated in Figure 40 is displayed.

Excluding Components

The scoring algorithm analyzes the sensor traces for each question and identifies which components (i.e., Respiration, Electrodermal, Cardio Blood Volume, or Cardio Pulse) should not be used when scoring. If a movement artifact is detected, the sensor component of the affected question is recommended to be dropped from the scoring process. Questions with dropped components will not be scored, similar to "zeroing out" a component during hand scoring.

The Exclude Components dialog box displays the current chart's questions and recommended exclusions, indicated by the capital letters appearing in the Drop column.

Figure 40. Exclude Components Dialog Box

Recommended drops appear in this column. →

For this chart, movement artifacts were detected in the Electrodermal (E), Pulse (P), and Blood Volume (B) of question 5. You can display and evaluate the current chart and consider the recommendations by selecting **View** (V) from the Chart Control group box. To continue the scoring process, accepting the scoring algorithm's recommendations, select **OK**.

Adding and removing exclusions

You can exclude components that were not automatically selected or re-include components marked for exclusion. As a general rule, you should follow the suggestions made by PolyScore® and, in addition, drop all components that you feel contain artifacts or should not be used in scoring the chart. If the program tags a component that is a valid response, you must remove the tag.

Components should be dropped only if the artifact occurs during the reaction interval used by PolyScore®. For the Blood Volume Derivative channel, PolyScore® examines the rate of increase of the blood volume from the beginning of the question until 8 seconds after the start of the question. For the Electrodermal channel, the reaction period is from 2 seconds after the start of the question until 14 seconds after the start of the question. Artifacts outside of the response window should be ignored. Figure 39 shows the response interval for each channel.

Figure 41. APL Response Intervals
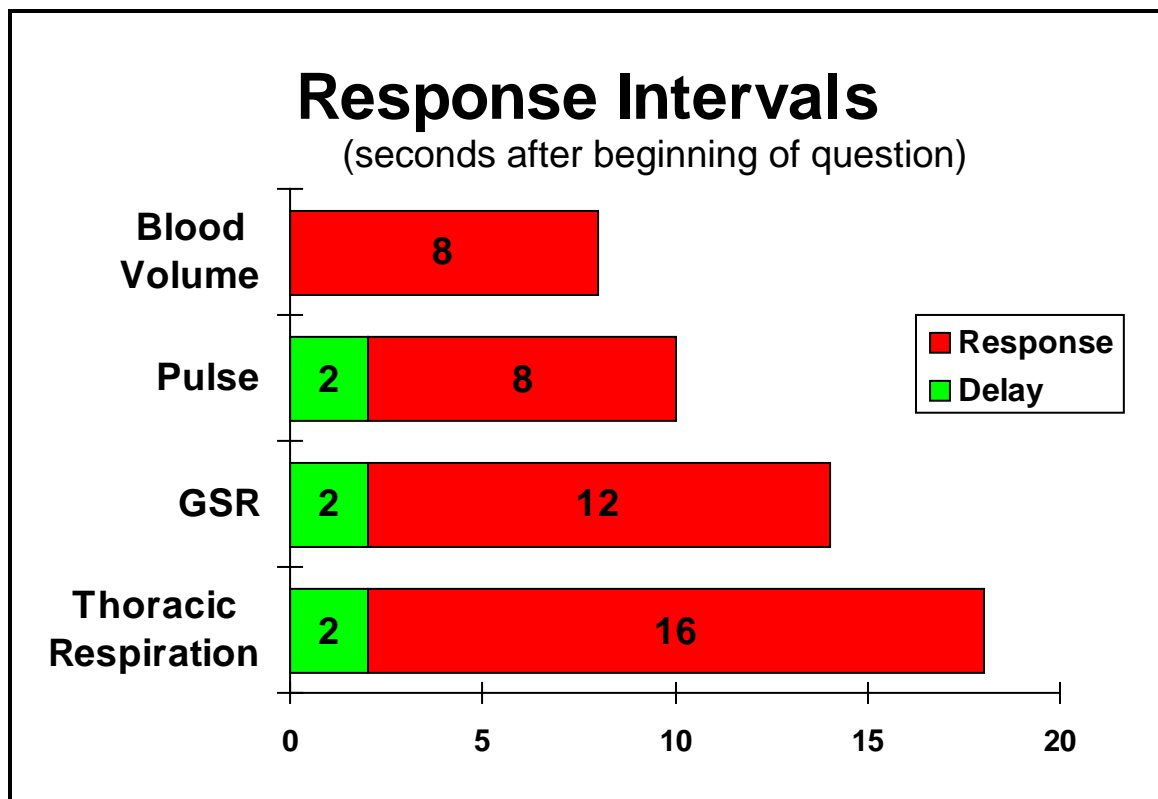
If, for example, the subject moves a finger 7 seconds into question 5, you should drop the Electrodermal component for that question.

For analysis, the cardiograph or "cardio" channel is split into a Pulse channel and a Blood Volume rate of change (derivative) channel. These new channels are both used in scoring. If one of these channels is selected as an artifact, the other is automatically selected. In many cases, either both the Blood Volume derivative and the Pulse components will be retained, or both will be dropped. For example, if Pulse is selected, Blood Volume will also be selected. To select only Pulse, first select Pulse and then deselect Blood Volume.

To exclude additional components, use the following procedure:

1.   Highlight the question using the mouse or the ↑ and ↓ keys.

> 2.   To exclude a component from the score, either select the check box in the Drop Components group, or type the first character in the component's name, such as **E** to drop the Electrodermal component for the highlighted question.

To ignore a recommended exclusion and **include** a component in the scoring process, use the following procedure:

> 1.   Highlight the question using the mouse or the ↑ and ↓ keys.

> 2.   To include the component in the score, either select the check box in the Drop Components group to unmark it, or type the first character in the component's name.

Viewing other chart exclusions

To view the questions and the automatically selected components to exclude from other charts, use the following method:

> 1.   Press the ↑ and ↓ arrows in the Chart Control group box, or use the <page up> and <page down> keys until the desired exam and chart number is displayed.

Use these arrows to
move through the charts.

Chart Control

Exam: 3

Chart: 2

View Chart
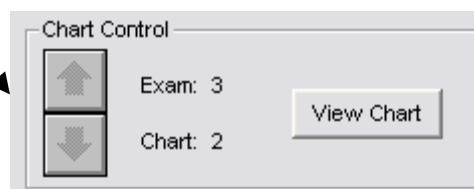
> 2.   Review and modify the component exclusions for each chart as described in "Adding and Removing Exclusions," then select **OK**.

In a few cases, one component of a reaction will affect the scoring in a way that can diminish the importance of that component for all other reactions. When this situation occurs, PolyScore® automatically detects the unusual condition. The offending component of the question is called a statistical outlier and is tagged with a lowercase **e**, **p**, **r**, or **b**. Except when ranking a single chart, these tags cannot be removed. However, often some of the other components (scoring criteria) of the reaction in the channel will still be used by PolyScore®.

For example, the Electrodermal range may be close to values for other reactions, so that portion of the reaction will be used even though another characteristic of that same Electrodermal reaction may be an outlier. For example, if for that Electrodermal reaction, the rate at which the tracing increased were twenty times that of the next largest rate of increase, then that rate component would be declared an outlier and would not be used. If this twenty-times-larger rate were to be used, it would make all the other rate of increases look relatively small (essentially zero) by comparison. Except for the one reaction, the rate of increase criteria would have almost no effect on the scoring. Studies have shown that not using the components declared as outliers improves the scoring results. If you see a reaction declared an outlier, it may look different or it may appear similar to others on the charts. However, there is a characteristic of that reaction that may not be obvious, but is radically different than any other.
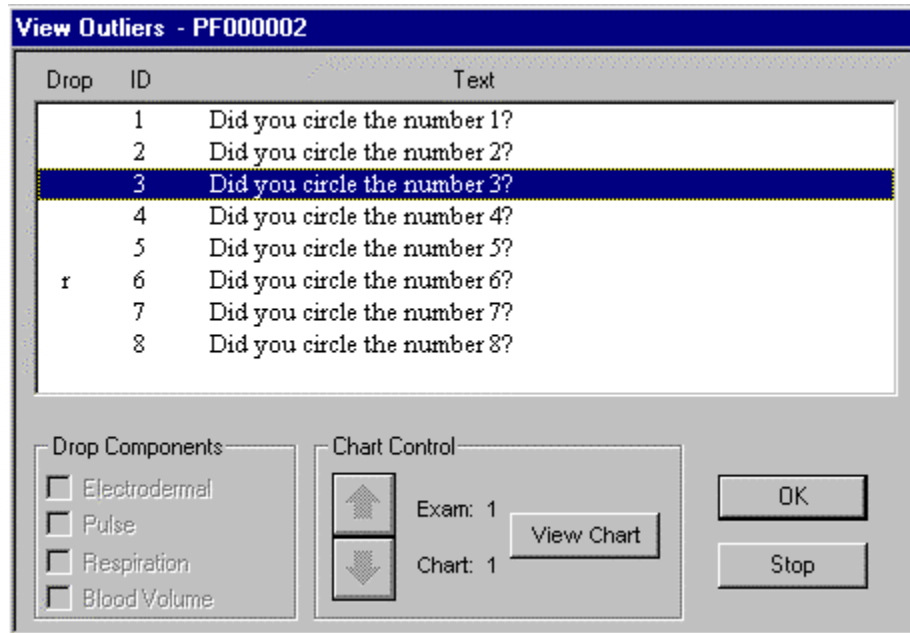
If statistical outliers are detected, and you are Rank scoring a single chart, the following message is displayed.

Figure 42. Statistical Outlier Notification Message
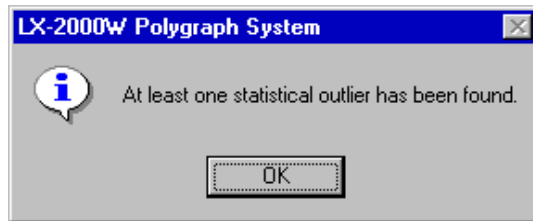
Select **OK** to display the dialog box illustrated in Figure 41.

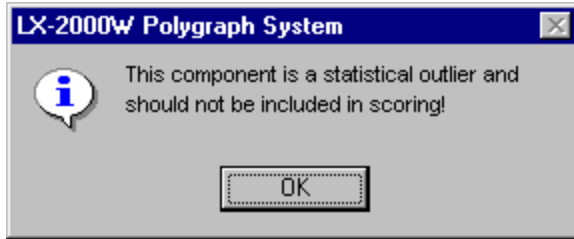*Figure 43. View Outliers Dialog Box*

Outliers are identified by lower case letters of the corresponding component, such as **p** for Pulse. In Figure 43, question 6 contains an outlier in Respiration (**r**). You cannot add outliers to the list of components to drop. If you are Rank scoring a single chart you can override the scoring algorithm's recommendations and include an outlier in the scoring process. This may be necessary when ranking a single chart, such as a stim, because of a single, very large reaction to, say, the selected number. To include an outlier in the scoring process, use the following procedure:

1.	Highlight the question containing the outlier using the mouse or the ↑ and ↓ keys.

2.	To include the component in the score, either select the check box in the Drop Components group to unmark it, or type the first character in the component's name.

If you try to include a component that has been marked as an outlier, a warning is displayed.

Figure 44. Statistical Outlier Warning Dialog Box

Select **OK** to close this dialog box. To finish scoring the selected charts, select **OK** from the View Outliers dialog box (Figure 41). As the algorithm processes the data, status messages are displayed and then a Scoring Report is generated as illustrated in Figure 45.

Reviewing the Scoring Report

The following figure illustrates a sample scoring report.

Figure 45. Scoring Report
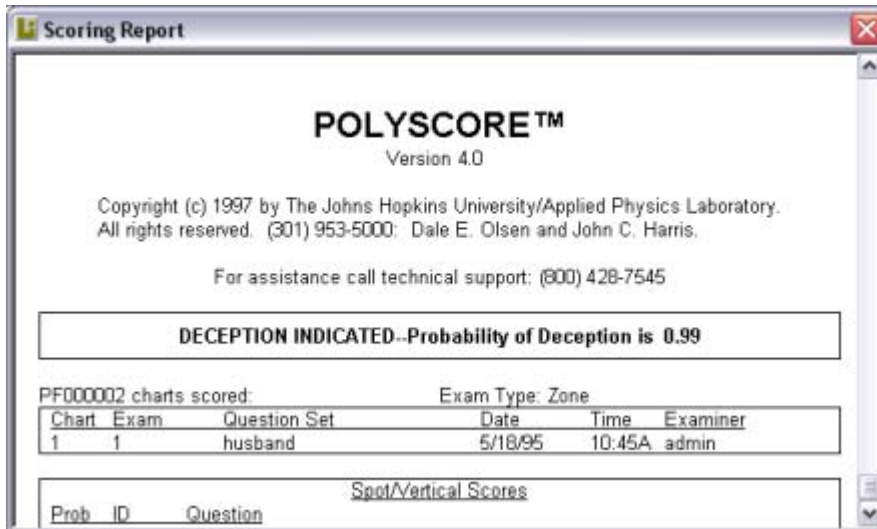
The scoring report includes the following information in the order presented:

1. Algorithm version number (for example, 4.0)
2. Overall probability of deception
3. Algorithm format used (Zone/MGQT)
4. PF name and charts scored
5. Spot scores
6. Channel weights

7.   Question scores

Spot Scores

The spot scores give you the probability of deception for each of the relevant questions. It assumes that each of the different relevant questions will have different wording, but that relevant questions are repeated on different charts. The spot scores are useful for identifying "hot" issues for interrogation or questions which may need rephrasing.

The spot score is the probability of deception based only on the particular question. Spot scores result from a completely different algorithm than the overall score. **Therefore, the spot scores do not add up to the overall score**. Particularly for MGQT exams, spot scores should NOT be used as the basis for making an overall decision—that is what the overall probability is for.

Channel Weights

The channel weights approximate the percentage contribution to the overall probability of deception stemming from a particular channel. Positive weights indicate an NDI tendency and negative weights a DI tendency. The absolute values of the weights add to one (except for round-off error where the total will be .99). Two points must be noted:

- It is not uncommon to have differing tendencies between channels.

- The actual amount of information coming from, and therefore weight given to, a channel varies from individual to individual.

Channel weights can be used to confirm an examiner's suspicion about controlled breathing, for example.

Question Scores

The question scores show how each question on the exam was tagged, which questions had artifacts, and which had outliers. The reactivity for each comparison/control and relevant question is shown.   Like the spot and channel scores, the reactivities provide the examiner with diagnostic information. No conclusions should be reached on the basis of these scores. Individual question scores may not be consistent with the overall probability of deception.

Recommendation

PolyScore® processes information from the charts in a way which is different from the traditional method and on occasion will be different from your scores. The spot probabilities must necessarily use different quantities than those used in computing the overall probabilities. Therefore, channel or spot probabilities may not be consistent with the overall probability.

The scoring report provides the single number from which to make a decision—the overall probability of deception. If, for example, the probability of deception is greater than .99, fewer than 1 examinee in 100 will exhibit such reactions and still be telling the truth. Any conclusions based on PolyScore® probabilities should be based only on the overall probability of deception.

The spot probabilities are to be viewed only with the overall conclusion in mind and are provided for insights. The examiner may use spot probabilities and channel weights to better understand the PolyScore® results.

The typical examiner will obtain an inconclusive result about 15% of the time, slightly more with MGQTs and less with Zones. It is tempting to select different charts or use trial-and-error retagging in hopes of forcing PolyScore® into a decision; or even worse, using spot scores. "Shopping" for a conclusive decision could also produce one which is incorrect.

Inconclusives are an unfortunate fact of life, even with computerized scoring. They can be minimized by testing using the Zone format whenever possible. Obviously, the pre-test and question formulation play a very large role in reducing inconclusives. The proper resolution of an inconclusive is a retest!

Use the information contained in the spot scores from the first inconclusive exam to assist in clarifying questions and focusing issues for the retest.

Preserving scoring reports

The Scoring Report is not saved to disk, so if you want to maintain a record of the scoring results, you must print a copy of the report prior to closing the Scoring Report window. To print a copy of the report while it is displayed on the screen, select **Print** from the File menu. The following dialog box is displayed:

Figure 46. Print Scoring Report Dialog Box
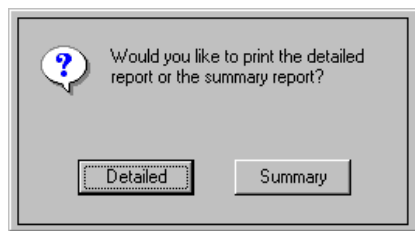
To print the entire scoring report, including detailed information about each question and chart, select **Detailed**. To print only the list of charts scored and a summary of the results, select **Summary**.

Automatic Scoring Using QuESt

After charts are recorded, they can be automatically scored using the Quantitative Evaluation System (QuESt) scoring algorithm. The QuESt scoring algorithm is not contained within the LXSoftware, but rather is a separate program that may be launched from within the LXSoftware. See the QuESt User Guide for instructions on using the QuESt scoring algorithm.

Reviewing and Editing Polygraph File Information

You can review and edit PF information at any time, provided a chart is not being recorded. For example, you need to enter the Final Call information into the Exam Info dialog box after a test is

complete. You also might want to revise the exam information, or change the current question set for a particular subject.

- To open the Personal History dialog box to review information about a particular PF or to update the information, select **Personal History** from the Exam menu.

- To revise the information pertaining to a particular exam:

    1. Open the appropriate PF by selecting **Open PF…** (Ctrl + O) from the File menu.

    2. Select **Exam *x* Info** from the Exam menu. Where *x* represents the number of the exam for the current PF.

- To use another list of questions, select either **Templates**, **PF Question Sets**, or **Chart Question Sets** from the Question menu, and then select the name of the question set to use.

Moving a Polygraph File to Another Directory

With the Move PF capability, you can move or copy PFs between any two directories visible to Windows. However, you can only open PFs that are stored in the current PF Directory specified in the System Preferences. To move or copy a PF, follow these steps:

1. Select **Move PF** from the File menu. The following dialog box appears:

Figure 47. Move PF Dialog Box
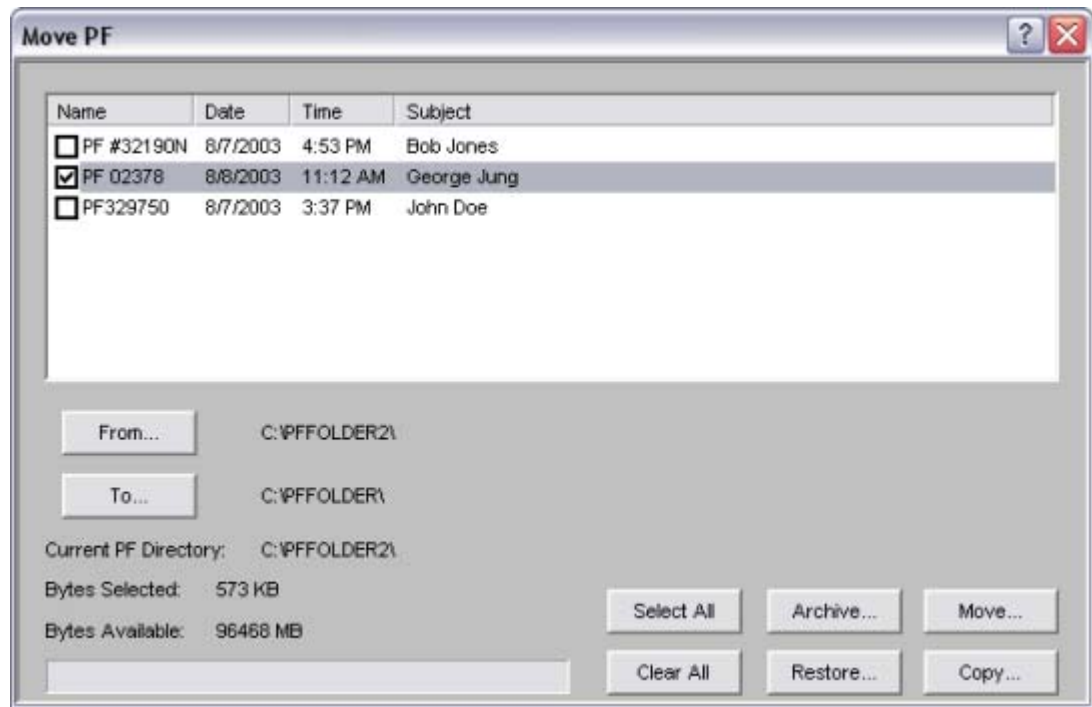
2. Select the **From** button to display a dialog box containing all drives visible to Windows. From this graphical directory structure browser, select the directory currently containing the PF.

3. Double-click each **PF** you want to move. The number of bytes selected to move is displayed as well as the number of bytes available on the target disk.

4. Select the **To** button to display a dialog box containing all drives visible to Windows. From this graphical directory structure browser, select the directory to which the PF should be moved.

5. Select the **Make backup copy** checkbox to make a copy of a PF without deleting it from the drive containing the PF.

6. Select the **Remove subject identification** checkbox to remove subject information from the PF being copied. This checkbox is only enabled when the **Make backup copy** checkbox is selected and the "**From**" directory is the current PF Directory.

7. Select **Move** to transfer the PF.

8. Select **Done** to close the dialog box when the Move is

Removing Subject Identification

As part of making a backup copy of a PF, the subject information can be removed, or stripped, from the PF. The dialog box shown in Figure 46 is displayed at the beginning of each strip operation.

As indicated in the dialog instructions, the Personal History information will be purged from the PF. Additionally, the remaining items listed will be removed from all other files contained in the PF. These files include charts, question sets, notepad, final reports, and exam information documents.

Enter any additional words to be removed from the PF in the space provided in the dialog.

Note   The entered words are searched for exactly as they are entered in a case-sensitive fashion. For example, if a word appears in one of the PF documents beginning with an upper case letter, enter it in upper case when prompted for additional words to remove.

Figure 48. Remove Subject Information
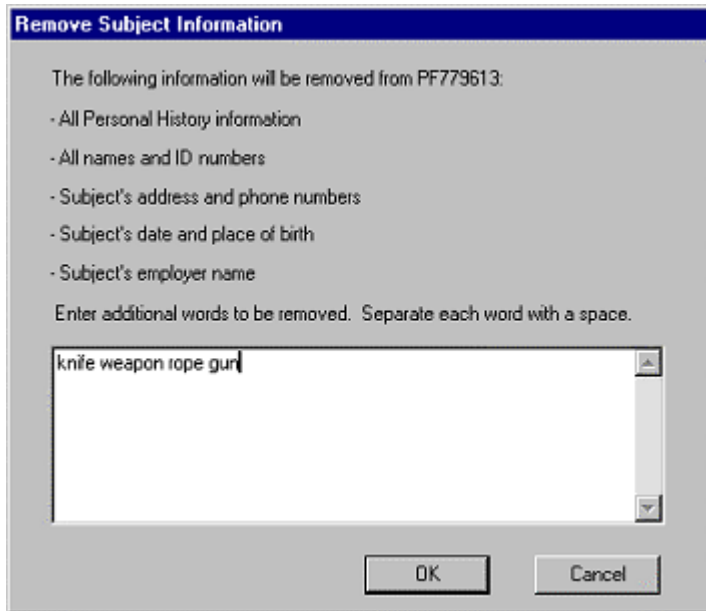
Renaming a Polygraph File

To rename an existing Polygraph File, open the PF by selecting **Open PF…** (Ctrl + O) from the File menu. Next, select **Rename PF…** from the File menu. In the displayed dialog box, enter the new PF name. All occurrences of the old PF name will be changed to the new PF name in all files comprising the Polygraph File.

Figure 49. Rename PF Dialog Box
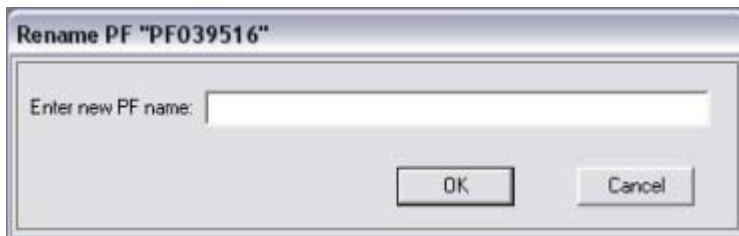
Creating a Report

To produce a final report recording the results of a polygraph chart:

1.	Select **Open PF…** (Ctrl + O) from the File menu (only if no PF is open).

2.	From the list of PFs, select the PF name for the report you want to create.

3.	Select **New Report** from the File menu. The Final Report dialog box appears.

Figure 50. Final Report Dialog Box
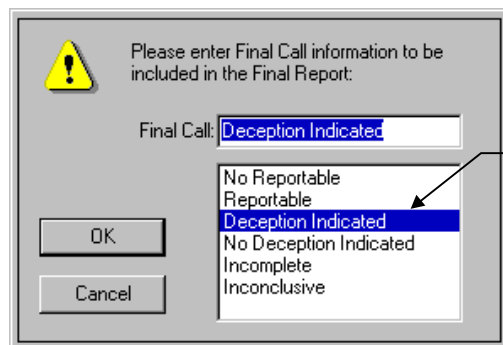
The **evaluation options** are listed here. Select one and click OK to enter your **Final Call**.

Note If a report already exists for the current PF when you select **New Report** from the File menu, you have the option to cancel the command. If you continue, the old report will be renamed automatically.

---

4.   Select an evaluation option from the list box (or type an option in the **Final Call** field).

Note LXSoftware updates the **Exam Info** dialog box for you by entering your selection in the **Final Call** field.

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5.   Select **OK** to save the changes and generate a report. The LXSoftware application window moves to the background, the word processing application window opens, and a Final Report template appears (see Figure 48).

Figure 51. Final Examination Report Template

LXSoftware extracts biographical data from the Personal History dialog box and puts it in the template. You must type the remaining information in the template. Use the first section of the Final Examination template to type the purpose, results, and other relevant details about the exam. Use the other section to type exam information and additional comments.

Including Notepad Comments in a Report

If comments about the subject or the test were recorded in Notepad during the exam, the notepad will open when you display the Final Examination Report. The comments that were made in the notepad are displayed in a separate document window. You can include the notepad comments in the final report using standard Copy, Cut, and Paste techniques.

Note   If you use *Microsoft WordPad*, this option is not available.

Opening a Report

If a report has already been created for a particular PF, you can open and revise it as necessary.

To open an existing report:

1.   Select **Open PF…** (Ctrl + O) from the File menu.

2.   From the list of PFs, select the PF name for the report you want to open.

3.   Select **Open Report** (Ctrl + R) from the File menu. The LXSoftware application window moves to the background, the word processor opens, and the report for the current PF appears.

When you are finished with the Final Examination Report and you're ready to close the word processor, follow these steps:

1.   Select **Save** from the File menu to save the report to disk.

2.   Double-click the **Control-menu box** in the top-left corner (Ctrl + F4) to close the window.

3.   Press (**Ctrl + Esc)** to open the Task List window.

4. Double-click the **LXSoftware Polygraph System** title.

Tip   Instead of choosing **Ctrl + Esc**, you can press **Alt + Tab** as a shortcut to toggle between the two applications.

Printing

Your LXSoftware workstation may be connected to a printer. The appropriate software printer driver operates the printer, and the spooler program enables you to print documents in the background while you continue with other work. If a printer is not currently available when you select the Print command, the spooler stores the documents in a queue until a printer becomes available. You can print examination information, comments recorded in the notepad, charts, or reports.

Printing the Entire Screen Display

To print the entire screen display exactly as it appears on the workstation monitor, select **Print Screen** from the **File** menu. This command sends everything you see on the screen to the printer; however, information extending beyond the window borders is not printed.

Printing the Active Window

To print the contents of the active window, select **Print** (Ctrl + P) from the File menu. All the information in the window, including information which extends beyond the window borders and is not in view, is sent to the printer.

Printing a Chart

You can print any chart that has been recorded. To print a chart, follow these steps:

1.   Open the PF associated with the chart you want to print. Select **Open PF...** (Ctrl + O) from the File menu.

2.   From the list of PFs, select the name corresponding to the PF you want to print.

3.   Select **Print Charts…** from the File menu. The following dialog box appears.

Figure 52. Print Charts Dialog Box

Print Charts...

Chart	Exam	Date Created	Time Created	Examiner ID
1	1	05/18/95	10:45A	admin
2	1	05/18/95	11:05A	admin
1	4	05/22/96	10:42A	admin
2	4	05/22/96	10:55A	admin
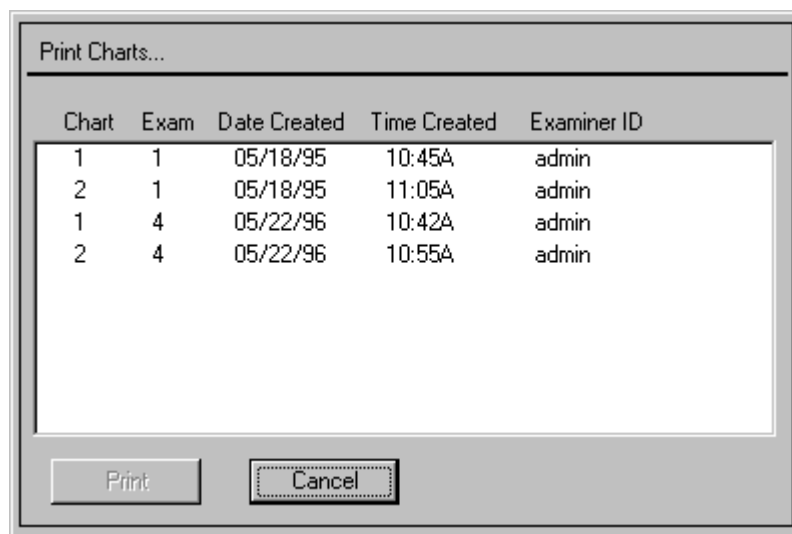
Print   Cancel

4.   Double-click on the name of the chart you want to print. A checkmark appears beside the chart.

5.   Select **Print** to print the chart; select **Cancel** to disregard the Print Charts command.

Printing a Report

To print a report, open the report and follow your word processor's printing instructions.

Learning Windows Basics A
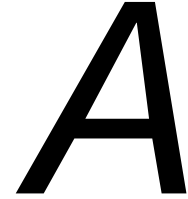
Overview

This appendix describes common Windows conventions and terms. It includes the following information:

- A list of common Windows terms

- Instructions for using the mouse

- An explanation of typical Windows procedures and the Windows interface

- An explanation of menus, dialog boxes, and multiple windows

- Instructions for editing screen information

Understanding Windows Terms

Throughout this manual, you will see a variety of Windows terms. You may want to go through the online Windows tutorial supplied with Microsoft Windows. A Microsoft Windows User's Guide comes with each workstation. See "Running the Microsoft Windows Tutorial " in Chapter 2, "Application Basics," for instructions.

The following Windows terms are used throughout the explanations in this manual:

Table 13. Windows Terms

Term	Definition
Active window	The top-most window on the desktop. Only one window can be active at a time. An active window's title bar changes color. Only the active window accepts menu or keyboard input.
Application	A program you use to do work, such as word processing.
Application icon	A pictorial representation of an application. An icon appears after you minimize the application.
Application window	The window containing the work area and menu bar for the application. The application's name appears at the top of the window in the title bar.
Background application	An application that is running but is not active. It cannot receive input from the keyboard or mouse.
Clipboard	A temporary storage location. You can store data on the Clipboard using the Copy or Cut command. You can retrieve data from the Clipboard using the Paste command.
Close	To remove a window or dialog box, or quit an application. You can close a window using the Close command on the Control menu. When you close an application window, you quit the application.
Close button	The small box in the top-right corner of a window containing an "X." Click the Close button to close a window or quit a program. (The command is also available from the Control menu.)
Confirmation message	A message that appears in a dialog box after you specify a certain action, prompting you to verify that you do want to continue or cancel.

Control menu	A menu that contains commands which let you "control" a window. Some dialog boxes also have a Control menu. To open the Control menu, click the Control-menu box located in the top-left corner of a window in the title bar.
Control-menu box	The icon that opens the Control menu for the window. It is always at the left of the title bar.
Copy	To duplicate selected information to the Clipboard.
Cut	To remove selected material and place it on the Clipboard so you can insert it somewhere else.
Default settings	Settings supplied with the application. You can change default settings to fit your needs.
Desktop	The screen background for Windows on which windows, icons, and dialog boxes appear.
Dialog box	A box that requests information. Many dialog boxes have options you must choose before Windows performs a command.
Dimmed	The light gray display of a button or command indicating that it is unavailable or disabled and cannot be chosen.
Directory	Part of a structure for organizing your files on a disk. A directory can contain files or other directories (subdirectories).
Directory icon	In File Manager, a graphic that represents a directory on your disk (a folder).
Explorer	The Windows Explorer window contains a graphical representation of all the folders and files on your hard disk. Double-click a folder to view its contents.
File	A collection of data that has been given a name and is stored on disk.
Filename	The name of a file.
Folder	A graphical representation of a directory as seen in the File Manager. A folder (or directory) can hold files, other folders, and applications.
Foreground application	The application that appears in the active window. It is the application you are working with.
Highlight	To indicate which object or text will be affected by the next command or action. Highlighted information is usually displayed in reverse video or a different color.

Icon	A pictorial representation of an item, such as a folder, file, application, utility, drive, etc.
Inactive window	Any open window that you are not currently using (background window).
Insertion point	The place where text will be inserted when you type.
List box	Within an application window or dialog box, a type of box that lists available choices. If all the choices do not fit in the list box, there is a scroll bar.
Maximize button	The small box in the top-right corner of a window containing a representation of a "screen." Click the Maximize button to enlarge a window to its maximum size. (The command is also available from the Control menu.)
Menu	A list of commands in the menu bar at the top of the screen. All menu items apply to the active window.
Minimize button	The small box in the top-right corner of a window containing an "underline." Click the Minimize button to reduce a window to an icon. (The command is also available from the Control menu.)
Mouse pointer	The arrow-shaped cursor that follows the movement of a mouse and indicates which area of the screen will be affected when you press the mouse button. The pointer may change shapes when you perform different tasks (e.g., it may look like an I-beam).
Network	A group of computers that are connected together allowing them to share information and resources (i.e., file servers, printers, etc.).
Option	In Windows, a choice in a dialog box.
Option button	A small, round button in a dialog box. When you select an option button, you choose to use that option.
Paste	To copy the contents of the Clipboard to an application window at the insertion point.

Scroll bar	A bar that appears at the bottom and/or right edge of a window when the entire contents of a window is not visible. The scroll bar contains a scroll box and two scroll arrows that let you scroll through the contents of a window or list box.
Start button	When you click the Start button, the Start menu appears. This menu contains everything you need to begin using Windows.
Title bar	The horizontal bar at the top of the window. Usually contains the Control-menu box and the Maximize and Minimize buttons.
Window	A rectangular area on the screen where a document appears.
Workspace	The area of the window that contains the information of the current document.

Using a Mouse

The pointing device you use to open menus, choose commands, mark the insertion point and move up and down in windows is called a "mouse."

As you move the mouse pointer around the screen, the pointer is displayed as an arrow which you can use to select a command or function.

As you move the mouse into a document area or text field, the pointer is displayed as an I-beam and you can mark the place where you want to begin typing.

If you are a new Windows user, refer to the following table to become familiar with the terms associated with using the mouse.

Table 14. Mouse Terms

To…	Use this method…
Point	Move the mouse until the tip of the pointer is positioned within the border of the item.
Click	Quickly press and release the mouse button.
Double-click	Click the mouse button twice. Double-clicking the mouse button usually invokes an action.
Select	Position the pointer within the border of the item and click the mouse.

Drag	Point at an object, press and hold down the mouse button while moving the mouse. The object moves across the screen as you move the mouse. When you have positioned the object at the desired location, release the mouse button.
Scroll	Point the mouse at the down scroll arrow and click. Information scrolls up one line. To scroll continuously, hold down the mouse button as you point at the up, down, left, or right scroll arrow. (You can also drag the scroll box.)

Learning About the Parts of a Window

If you are new to the Windows environment, review the following descriptions of the Windows interface and some of the typical procedures you'll use when running the LXSoftware application. Windows applications all have a similar look and feel. When you run an application, a window appears similar to the following:

Figure 53. Parts of a Window
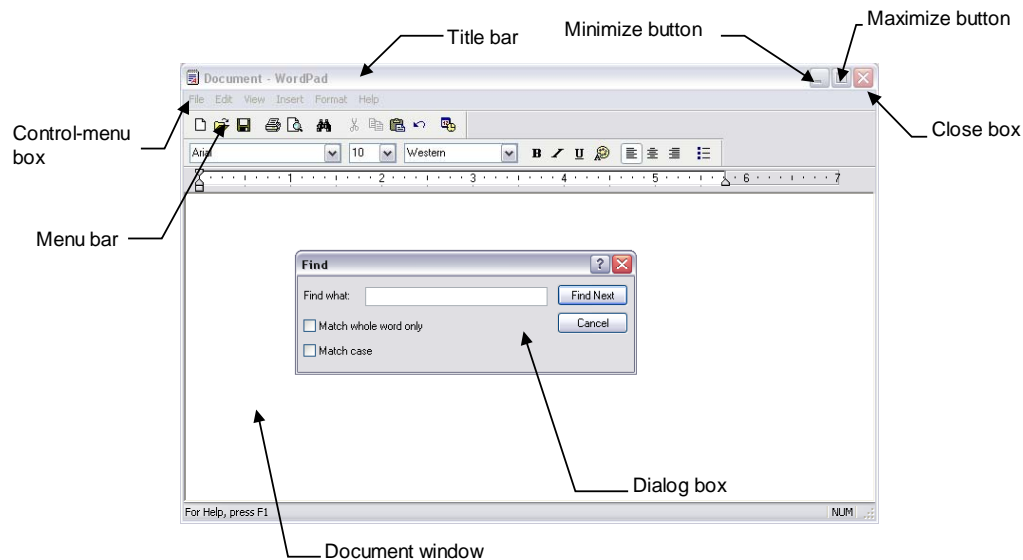
Table 15. Basic Window Elements

This component...	Is used to...
Control menu	Restore, move, size, minimize, maximize, and close a window. To open the Control menu, click the Control-menu box located in the top-left corner of a window.
Close button	Close a window or quit a program.

Dialog box   Enter information and select settings which instruct the application
                            how to respond in specific circumstances. A dialog box appears
                            whenever more information is requested.

Maximize button   Enlarge a window to its full size when you click on the box. To
                            return the window to its previous size, click the Restore button.

Menu bar   Display a series of menus which provide access to the application's
                            commands. It is the horizontal bar at the top of the screen.

Minimize button   Reduce a window to an icon when you click on the box. To reopen
                            the window, double-click the icon.

Restore button   Returns a window to its previous size. The Restore button appears
                            only after you've enlarged a window to its full size.

Scroll bar   Navigate within a window or list box. The vertical scroll bar
                            advances the work area one line at a time in the direction of the
                            arrow. The horizontal scroll bar lets you shift the work area to the
                            right or to the left.

Scroll box   Advance to a particular location within a window or list box as you
                            drag it up, down, right or left.

Size border   Change the size and shape of a window. Drag the window's border
                            or corners to adjust the size.

Status bar   A line of information located at the bottom of a window. The status
                            bar describes each menu item when highlighted by the mouse
                            pointer.

Title bar   Display the name of the document in the window. It is the horizontal
                            bar at the top of the window. It contains the Control-menu box and
                            the Maximize and Minimize buttons.

These common components are found in most Windows applications. For more information
about how to use menus and dialog boxes, refer to "Using Menus" and "Understanding Dialog
Box Elements."

Opening and Closing a Menu

You choose commands from a menu. Commands that carry out similar actions are grouped on the same menu. The menus are listed on the menu bar near the top of the application window. You can open a menu using the mouse or the keyboard.

Figure 54. Sample Menu
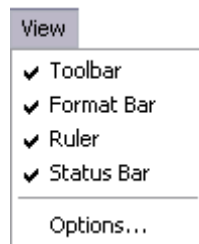
Opening a Menu Using the Mouse

To open a menu using the mouse:

1. Position the mouse pointer on the menu name and click the mouse button.

    The menu opens. You may choose any command not dimmed on the menu. See "Choosing a menu command," later in this chapter, for instructions.

Figure 55. Opening Menu Box
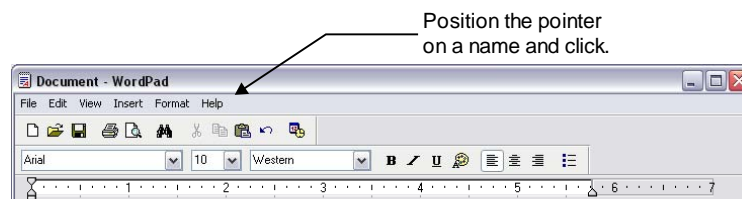
Opening a Menu Using the Keyboard

To open a menu using the keyboard:

1. Press **Alt** (or **F10**) to move to the menu bar.

2. Press the **Left Arrow** or **Right Arrow** key to move to the menu you want.

    As you move from menu to menu the title becomes highlighted.

3. Press **Enter** when you've highlighted the correct menu.

   The menu opens. You may choose any command not dimmed on the menu. See "Choosing a menu command," later in this chapter, for instructions.

Tip   If a letter in the menu title is underlined, you can press **Alt** to move to the menu bar and then press the **underlined letter** to open that menu. For example, if the "F" in <u>F</u>ile is underlined, you can press **Alt + F** to open the File menu.

Closing a Menu

You can close a menu using any of the following methods:

- Click the menu name or anywhere outside the menu.

- Press **Alt** or **F10** to cancel the menu and return to the workspace.

- Press **Esc** to close the menu but stay on the menu bar so you can select another menu.

Choosing a Command from a Menu

Menu items represent commands. You can choose an item from an **open menu** using any of the following methods:

- Click the item name

- Type the letter that is underlined in the item name.

- Use the up arrow and down arrow keys until you reach the item you want to choose; then press <**enter**>.

Opening a Menu and Choosing a Command with the Mouse

To open a menu and choose a menu item at the same time:

1. Hold down the mouse button and point at the menu name.

2. Continue to hold down the mouse button, and drag the pointer down through the list until the menu item you want is highlighted.

3. Release the mouse button.

Tip   To close a menu without choosing a command:

1. Move the pointer outside the perimeter of the menu so that none of the items are highlighted.

2. Release the mouse button.

Opening a Menu and Choosing a Command Using the Keyboard

If a letter in the menu title is underlined, and a letter in the menu item is underlined, you can press **Alt** to move to the menu bar and then press a combination of the **underlined letters** to open that menu and choose a command at the same time. For example, if the "F" in F̲ile is underlined, and the "O" in the menu item O̲pen is underlined, you can press **Alt + F + O** to open the File menu and choose the Open command at the same time.

Understanding Menu Command Conventions

You should be familiar with the following windows menu conventions:

Convention	Description
DIMMED COMMAND	Menu items displayed in black are available for selection. Menu items displayed as **dimmed (gray) characters** are unavailable. Often, menu items will change from black to dimmed and back again, depending on the context in which you are trying to use them.
ELLIPSIS (…)	A dialog box appears when you choose a command followed by an ellipsis (...). Some items require more information to accurately implement the command. Use the dialog box to choose the appropriate options and then initiate the command, or cancel if you change your mind.
CHECK MARK	Indicates the command is in effect. When you remove the check mark (by choosing the command), the command is no longer in effect.
KEY COMBINATION	The key combination listed next to the menu item is a **shortcut** for the command. You can use the key combination to choose the command.
TRIANGLE	Indicates a submenu. When you choose a command with a triangle beside it, a submenu appears with more menu items.

Opening and Closing the Control Menu

Application windows, document windows, icons, and some dialog boxes have a **Control menu**. This topic describes how to use the Control menu in each situation.

Figure 56. Control Menu Box

The Control menu lets you "control" a window.
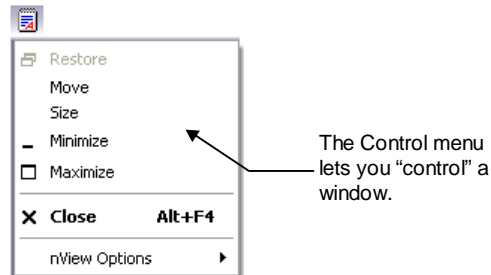
Opening the Control Menu Using the Mouse

For a window   Click the **Control-menu box** in the upper-left corner of the window. (If you double-click the Control-menu box, the window closes).

Figure 57. Open Control Menu

Click here to open the Control Menu.
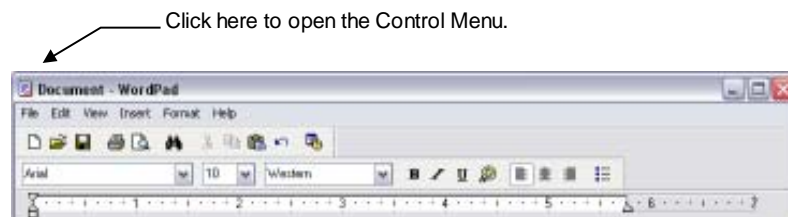
For an icon   Click the **icon**. (If you double-click the icon, the icon is restored to a window.)

Opening the Control Menu Using the Keyboard

For an application window/icon   Press **Alt** + **spacebar**. (Press **Alt** to close the menu without choosing a command.)

For a document window/icon   Press **Alt** + **hyphen** (-). (Press **Alt** to close the menu without choosing a command.)

A-11

Using a Dialog Box

Whenever you need to provide more information to instruct the application what action to take, a dialog box appears. Dialog boxes usually contain descriptive text, options, and controls.

Figure 58. Sample Dialog Box
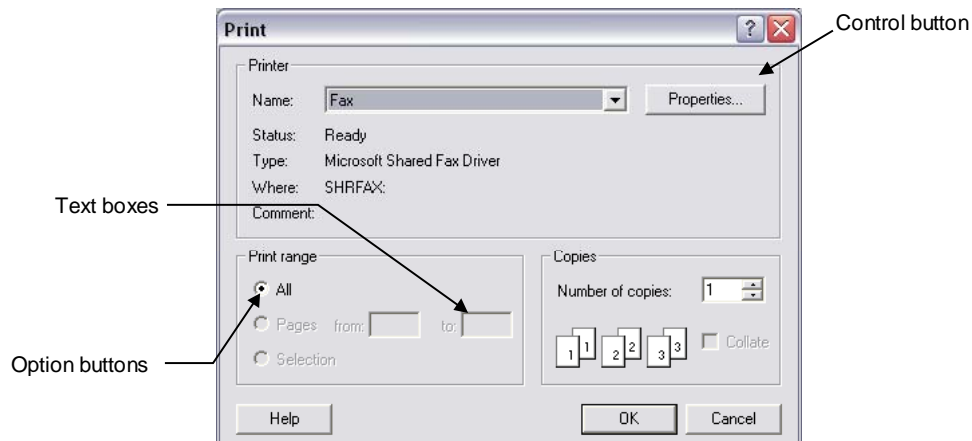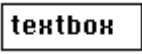
Table 16. Dialog Box Elements

Element	Graphic	Function
Check box		A small square box in a dialog box you select to turn on an option. When selected, a check mark appears in the box. You can select multiple check boxes at the same time.
Control button	OK Cancel	A rectangular button in a dialog box that initiates an immediate action. Typical control buttons are **OK** and **Cancel**. Default control buttons appear with a bold rectangular border and can be selected by pressing <return>.
List box	New York Palatino Symbol Times Times New Roman Wingdings Zapf Chancery Zapf Dingbats	A scrollable box that lists available choices.
Pop-Up menu	Format Font... Bullet Style Paragraph... Tabs...	A menu that appears when you click an option. Pop-up menus present a list of options to select from.

Option button	⦿ ◯	A small round button you select to turn an option on or off. You can select only one option button in a group. Selected option buttons have black centers, unselected option buttons are empty circles.
Text box	**textbox**	A box where you type information needed to activate a command. The insertion point is a flashing I-bar.

To move between text boxes in a dialog box, use the mouse or press the <Tab> key.

If you need to enter text, move the mouse over the text box and the pointer appears as an I-beam. Click the mouse button to mark the insertion point for entering text.

Selecting **OK** accepts the dialog box input and performs the command. Selecting **Cancel** disregards any changes, closes the dialog box, and does not perform the command.

Note You can choose the default control button, such as **OK**, by pressing the <**return**> key; choose the **Cancel** button by pressing the **Esc** key.

Using Multiple Windows

Windows are used to display and retrieve information. You can have more than one window open at a time. Each document or application you open appears in a separate window and its name appears in the title bar.
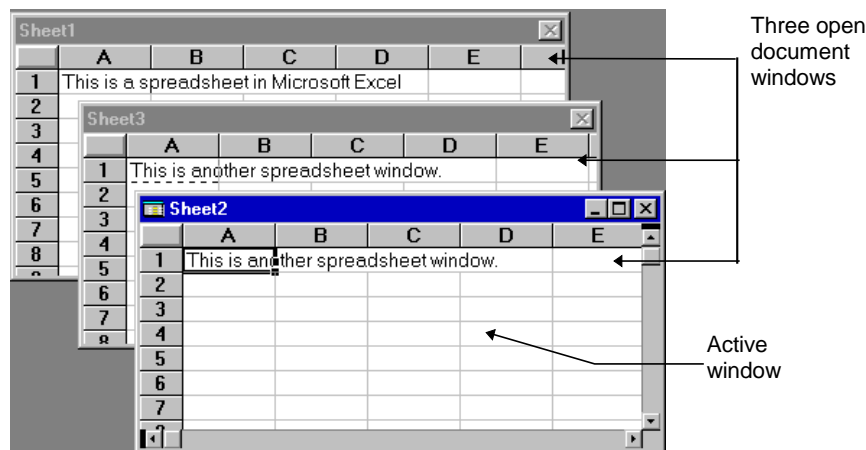
The window you are currently working in is called the "active" window. Only one window can be active at a time. The scroll bars and title bar in an active window are highlighted, and the insertion point is available only for the active window.

If you have more than one window open, you can activate a window by:

• Clicking the mouse on the desired window.

To move a window:

1. Position the mouse pointer in the title bar.

2. Click the mouse button and drag the selection box to the area of the screen where you want the window displayed.

3. Release the mouse button.

To size a window :

1. Position the mouse pointer on the border of the window.

2. Click the mouse button and drag the mouse until the selection box is the desired size of the window.

3. Release the mouse button.

Correcting Errors

If you make a mistake entering information in a dialog box or document window, you can use one of the following methods to correct the error.

Table 17. Error Correction Methods

To…	Use this method…
Reverse the last action	Select **Undo** from the Edit menu or press **Ctrl** + **Z**.
Delete the last character typed	Press the <**delete**> key.
Change a large amount of text	Highlight all of the text, then either begin typing the correct information, or press <**delete**> first, then enter the changes.
Correct one word	Double-click on the word to highlight it, then type the correction.
Close dialog box; ignore changes	Choose **Cancel**.
Ignore a dialog box parameter	Make sure the corresponding option button or check box is not selected.

Editing Screen Information

Editing text information on the LXSoftware screens is the same as for other Windows applications. The editing functions available are: Copy, Cut, Paste, Delete.

Copying Screen Data

If you want to duplicate information from one place to another, you can use the Copy command. To copy text:

1. Highlight the text you want to copy.

2. Select **Copy** from the Edit menu (**Ctrl** + **C**). The selected text is placed on the Clipboard and you can paste it somewhere else.

Cutting Screen Data

If you want to delete some information from a screen, but think that you might want to insert it at some other location, use the Cut command. To cut information from the screen:

1. Highlight the text you want to cut.

2. Select **Cut** from the Edit menu (**Ctrl** + **X**). The selected text is placed on the Clipboard and you can paste it somewhere else.

Pasting Copied or Cut Data

To insert or replace information in a document with what has been copied or cut and stored on the Clipboard, follow this procedure:

1. Position the I-beam where you want to insert the text, or highlight the information you want to replace.

2. Select **Paste** (**Ctrl** + **V**) from the Edit menu. The contents of the Clipboard is inserted at the pointer location.

Note   Information on the Clipboard remains intact until newly copied or cut information replaces it.

Erasing Selected Data

If you want to remove some information from the screen, but do not want to save it on the Clipboard, use the Delete command.

To delete information from the screen:

1. Highlight the text that you want to erase.

2. Select **Delete** from the Edit menu (**Del** key).

Reversing an Edit Command

If you accidentally activate a command, you can use the Undo command to restore your document to the state it was prior to selecting the last command.

How is Information Stored?

All the information on your workstation is stored on the hard disk. Think of a hard disk as a type of filing cabinet. Files and folders are used to organize information so it is easy to access.
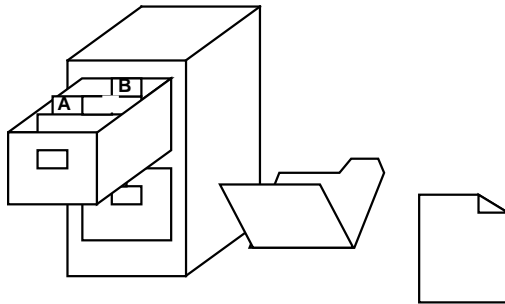
A folder in Windows is used to store groups of similar information, much like a folder in a filing cabinet. Each folder can contain one or more files or other folders. You can store different types of files in the same folder, such as text documents, graphics, and applications. A folder is also called a **directory**.

The LXSoftware files are organized in several folders on the hard disk. For example, question template files are stored in the folder labeled **QUESTMPL**. The Final Report Template is stored in the folder called **RPTINFO**. For a graphical representation of your hard disk, open the File Manager. See "Using the File Manager," next, for instructions.

LXSoftware

QUESTMPL   **RPTINFO**
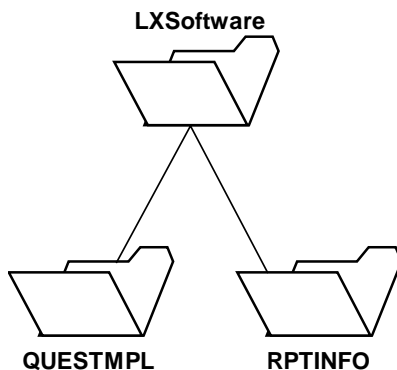
Using the Windows Explorer

For a graphical representation of your hard disk, switch to the **Windows Explorer**:

1. From the Windows desktop, use the right mouse button to click on the **My Computer** icon.

    Figure 59. My Computer Menu

Click here with the right mouse button...

...to open this menu.
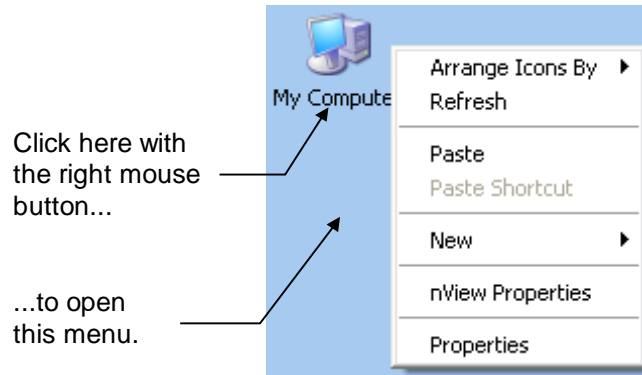
2. Select the **Explore** menu item.

    The **Windows Explorer** window opens with a graphical representation of all the folders and files on your hard disk. Double-click a folder to view its contents.

    Figure 60. My Computer Window
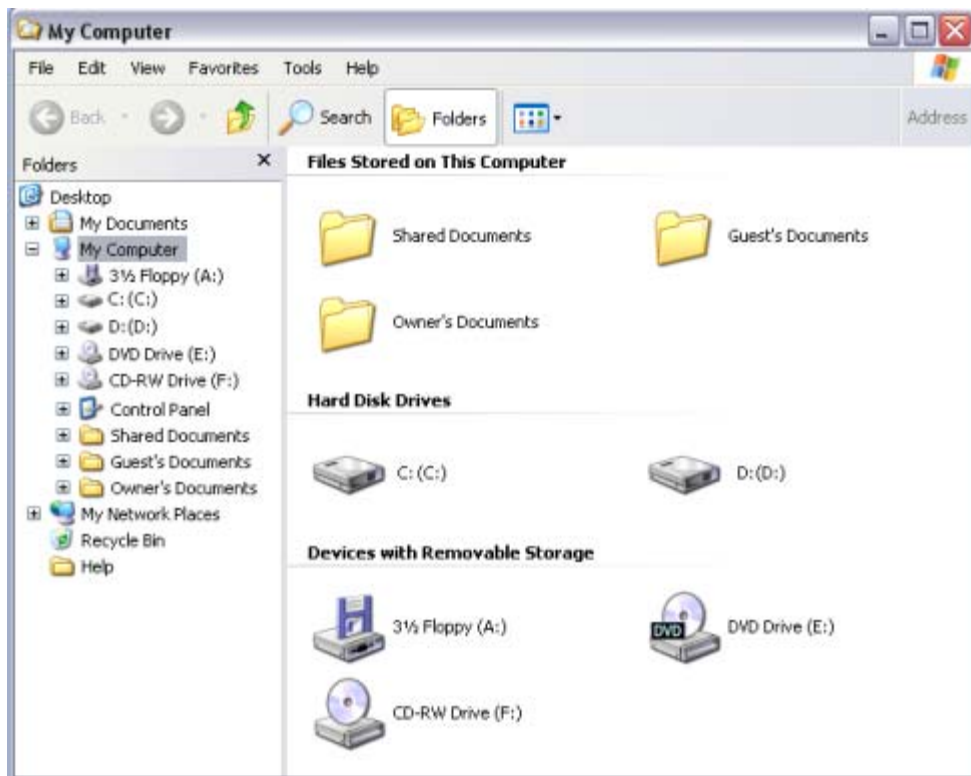
Locating a File in a Windows Application

To locate a file from within an application such as Microsoft Word:

1. Select **Open...** from the application's File menu. A dialog box appears. A list box on the left lists the files in the current folder. A list box on the right shows a graphical representation of the hard drive. The current folder is highlighted and is indicated by an open folder.

2. Look through the list of files until you find the one you want to open.

Note   If you need files in another directory, double-click the correct folder in the list box on the right.

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3. Double-click on the file name, or highlight the name and press **OK.**

LXSoftware Commands and Functions

B

Overview

This appendix lists and describes all LXSoftware commands.

The following table lists the LXSoftware commands and provides brief function descriptions.

Table 18. LXSoftware Command Descriptions

Select	From this menu	To
Audit Trail	System	Review the audit trail log of system events, such as self-test failure and system errors.
Chart *x* E*x*	Chart	Select a specific chart for a specific exam for review.
Chart Question Sets *name* Chart *x* E*x*	Question	Display a hierarchical menu from which to select a question set for a specific chart and specific exam.
Check Spelling	Tools	Check spelling in Notepad, question editor, or other location where the examiner is required to enter data.
Close PF	File	Close the current PF.
Close Window	File	Close the active window.
Copy	Edit	Duplicate selected information and place it on the Clipboard.
Cut	Edit	Remove selected information from the screen and place it on the Clipboard.
Delete Questions	Question	Displays dialog box with all question sets listed. Deletes selected question sets.
Delete PF	File	Display a dialog that may be used to delete polygraph files.
Drug Reference	Tools	The Lafayette Polygraph Drug Reference can be used to determine the effect of a drug on the physiologic markers most relevant for polygraph testing assessments.
Duplicate	Question	Copy a whole question set into a new file.
E-mail PF	File	Send a PF to another location via e-mail.
Exam *x* Info	Exam	View information about a previously recorded exam.
Exit	File	Close and save all open documents, and exit the LXSoftware application.
Move PF	File	Transfer a PF from one storage location to another.

New PF	File	Create a new PF.
New Questions	Questions	Create a new set of questions to use while recording a chart.
New Report	File	Generate a new report for the current PF based on the information obtained while recording a chart.

Select	From this menu	To
New Exam	Exam	Document exam information for the current PF.
Notepad	Exam	Display the text editor for recording comments about the PF, such as charts, Personal History Info, Exam Info, etc.
Open PF	File	Open an existing PF.
Open Report	File	Open a previously generated report.
Paste	Edit	Insert the contents of the Clipboard at the cursor location.
Personal History	Exam	Record biographical information about the subject, such as name, date of birth, social security number, etc.
PF Question Sets	Question	Display a hierarchical menu from which to select a question template belonging to the current PF.
Preferences	Tools	Modify the default settings for sensor traces and system parameters.
Print	File	Print the active window.
Print Charts	File	Display a dialog box from which to select one or more charts to print.
Print Screen	File	Print the entire screen display, exactly as it appears on the workstation monitor.
Rename PF	File	Rename the current PF.
Score	Exam	Score charts using the automatic APL scoring algorithm, QuESt, Objective Scoring System (OSS), or the examiner's score sheet (hand-scoring).
Screen Lock	File	Blank out the screen and locks the display from unauthorized access.

Select	From this menu	To
Templates	Question	Display a hierarchical menu from which to select a standard question template.
Toolbars	Tools	Display a dialog to show, hide, create, or delete toolbars. Additionally, a toolbar can be customized or reset to its default state.
Undo	Edit	Reverse the last command or action.
User List	System	Display the list of users who can access the LXSoftware Polygraph System. This list displays the User IDs assigned by the system administrator. The user list can only be changed by the system administrator.

Installation and Maintenance C
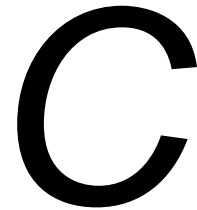
Overview

This appendix describes how to install and maintain the Lafayette Polygraph System. It includes the following information:

- Instructions for unpacking the LXSoftware components

- Instructions for setting up your workstation

- Instructions for setting up your printer

- Instructions for installing the software

Everything included as part of the complete Lafayette Polygraph System is listed in Chapter 1 of this manual.

Unpacking the Lafayette Polygraph System Components

As you carefully unpack each component, verify against the list presented in Chapter 1 that each item was received and is in good condition. If any item is damaged or missing, notify Lafayette Instrument Company. Keep the original packing containers to use when shipping or storing the equipment.

If you need to ship equipment and the original containers aren't available:

- Pack the equipment in separate containers capable of bearing the contents' weight.

- Surround the equipment with a suitable packing material.

Note   Store equipment in a dry, protected, and temperate environment.

Setting Up the Workstation

This section includes instructions for both the PC desktop and laptop:

Desktop   Lay out the polygraph system components on a sturdy, flat surface. Make sure the PC is turned off before connecting or disconnecting any cables or components.

Laptop   The keyboard, mouse, display screen, and hard disk are built in. All you need to do is plug the USB cable into the back of the laptop and into the USB connector on the DAS.

When connecting the cables, keep the following points in mind:

- Handle cables by the connectors, not the cords.

- Never force a cable connection; connectors should join together easily.

- Plug power cables into a surge suppressor, not directly into the wall outlet.

Selecting a Testing Area

When positioning your workstation, you need to consider the location of the DAS, the computer, and the subject. Cables of various lengths connect to different parts of the polygraph system. The DAS may be placed on a nearby table. Keep in mind that you need to be able to connect the sensors to the DAS connectors easily.

Table 19. Cable Connections

This cable	Is this long	And connects
USB	3 feet	the computer to the USB DAS
Sensors	7 feet	the DAS to the subject
Power Cord	6 feet	the workstation to the surge suppressor

To set up the PC, refer to the following illustration:

Figure 61. PC Rear Panel
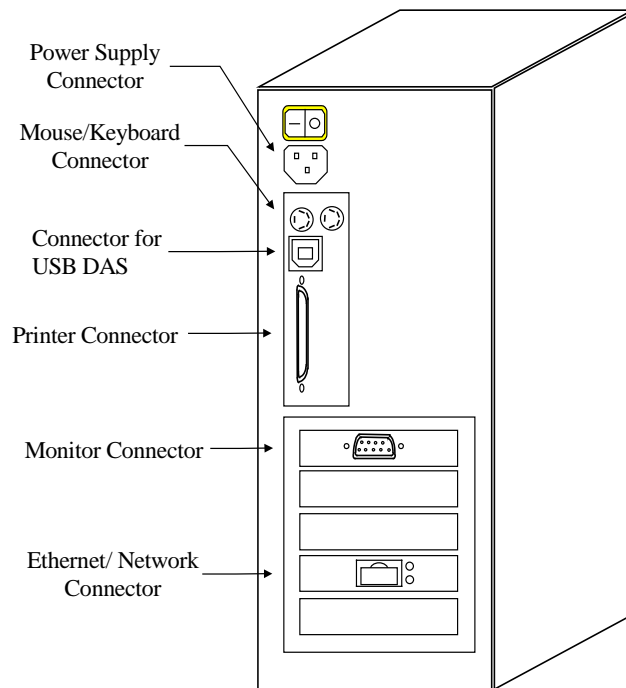
Connecting the Keyboard, Monitor, and Mouse

Connect the keyboard, monitor, and mouse according to the following instructions:

1. Turn off the power switches to the surge suppressor, PC, monitor, and hard disk.

2. Connect the keyboard cable to the keyboard connector on the rear panel of the PC.

3. Connect the video cable connector to the 15-pin 'D' monitor socket on the rear panel of the PC.

4. Connect the mouse cable connector to the rear of the PC.

Connecting the USB DAS

Connect the USB DAS according to the following instructions.

Figure 62. USB Data Acquisition Subsystem (DAS)
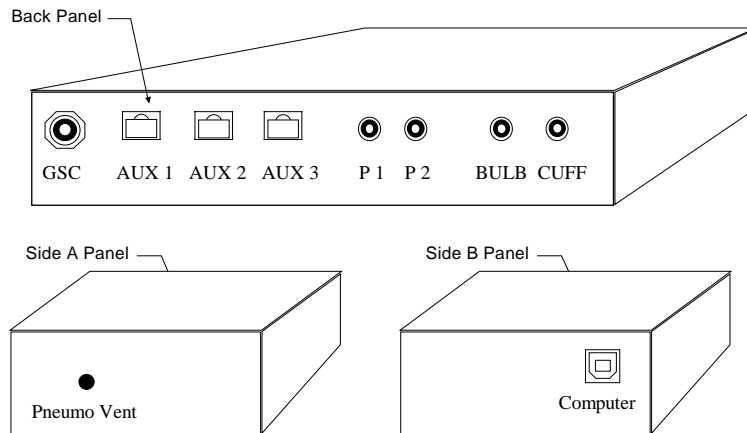
Connecting the USB Cable

When connecting the USB DAS, first connect the USB cable to the DAS and then the PC (desktop or laptop).

1. Connect one end of the USB cable to the series B socket on the DAS.

2. Connect the other end of the USB cable to the series A socket on the rear of the computer.

Connecting the Sensors

After the USB cable is connected to the DAS, connect the sensors to the DAS.

1. Connect the combined Bulb/Pressure gauge to the "Bulb" connector on the DAS. Press the hose connector onto the fitting until firmly seated.

2. Connect the Kovacic Cuff to the "Cuff" connector on the DAS. Press the hose connector onto the fitting until firmly seated.

3. Connect the Abdominal bellows pneumograph (with gold caps and connectors) to the gold "P1" connector on the DAS. Press the hose connector onto the fitting until firmly seated.

4. Connect the Thoracic bellows pneumograph (with bronze caps and connector) to the bronze "P2" connector on the DAS. Press the hose connector onto the fitting until firmly seated.

5. Connect the Galvanic Skin Conductance sensor to the "GSC" connector on the DAS. Press the GSC sensor plug into the connector until firmly seated.

6. Connect the optional Activity sensor to the "Aux1" connector on the DAS

Setting Up the Printer

Refer to the documentation supplied with the printer for more detailed information.

Installing the Software

Word Processing Software

With the LXSoftware Polygraph System, you can use Microsoft Word, Microsoft WordPad, or WordPerfect for Windows. For installation instructions, refer to the documentation provided with those packages. Microsoft WordPad is included free with all versions of Windows.

LXSoftware

The following instructions should be used to install the LXSoftware under various Windows operating systems.

Windows XP only

1. **Do NOT insert the LXSoftware Installation Disk (CD-ROM) until instructed to do so.**

2. Connect the LX-4000 to your computer using a USB cable.

3. The "Found New Hardware Wizard" will be displayed as shown below:
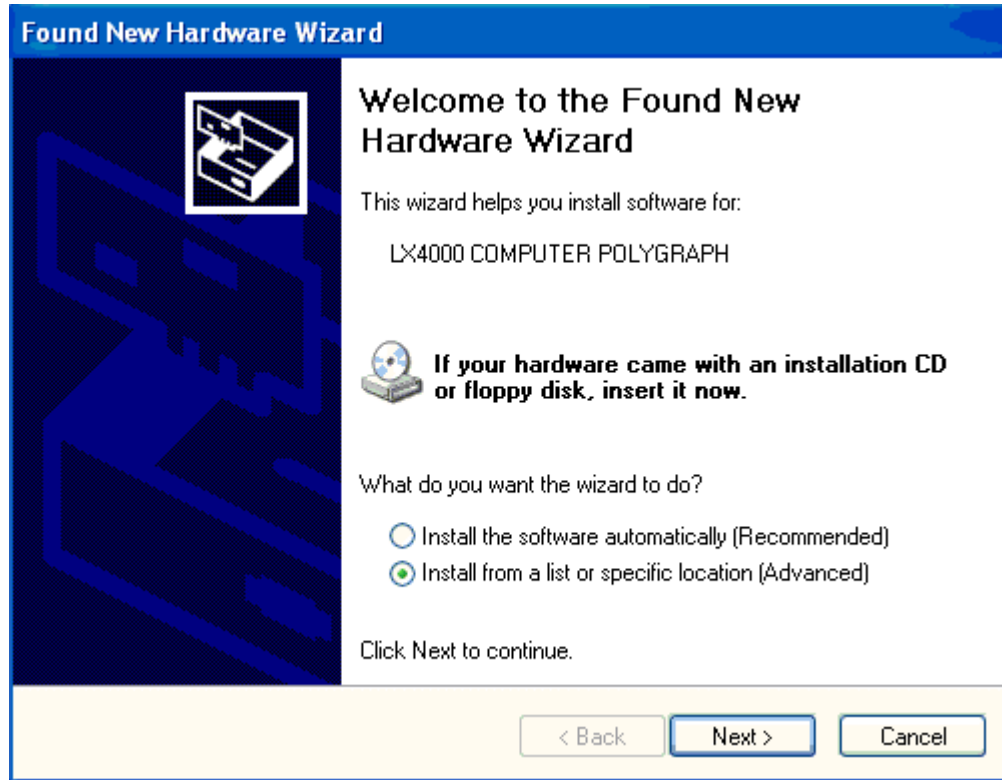
4.   Select "Install from a list or specific location (Advanced)" as indicated

5.   Select the "Next >" button. The following dialog will be displayed
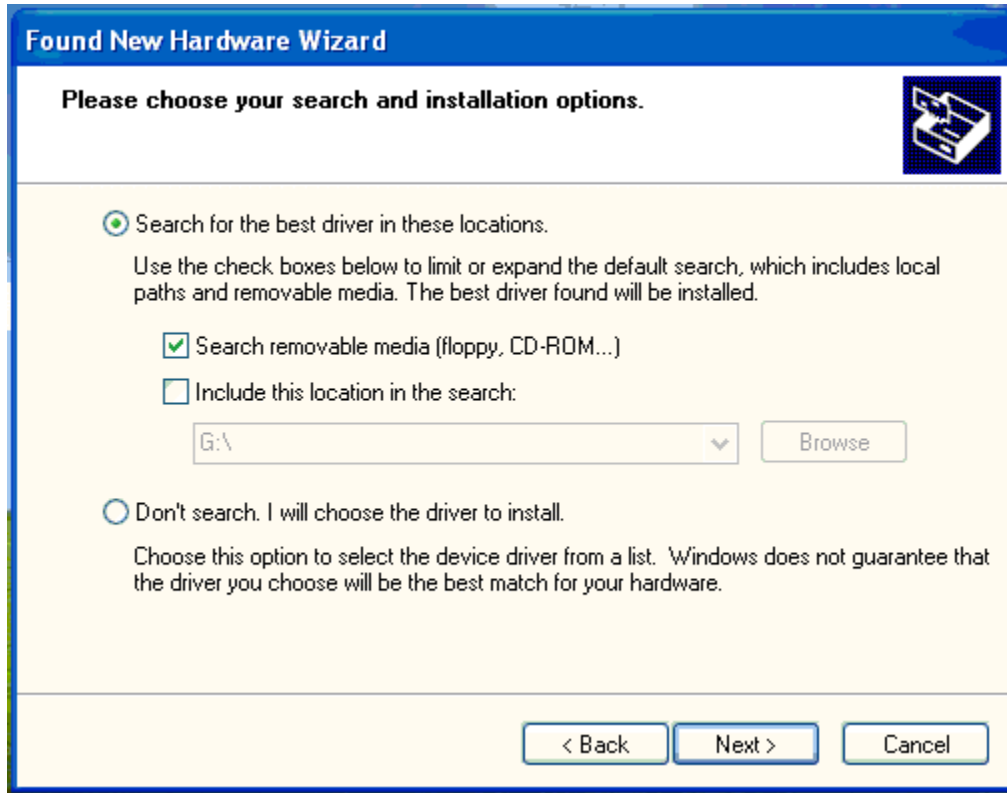
6. Select "Search for the best driver in these locations." and "Search removable media (floppy, CD-ROM…).

7. Insert the LXSoftware Installation Disk and wait a few seconds for the disk to spin up.

8. Select the "Next >" button. The following dialog will be displayed.

9. Select the "Continue Anyway" button. The following dialog will be displayed
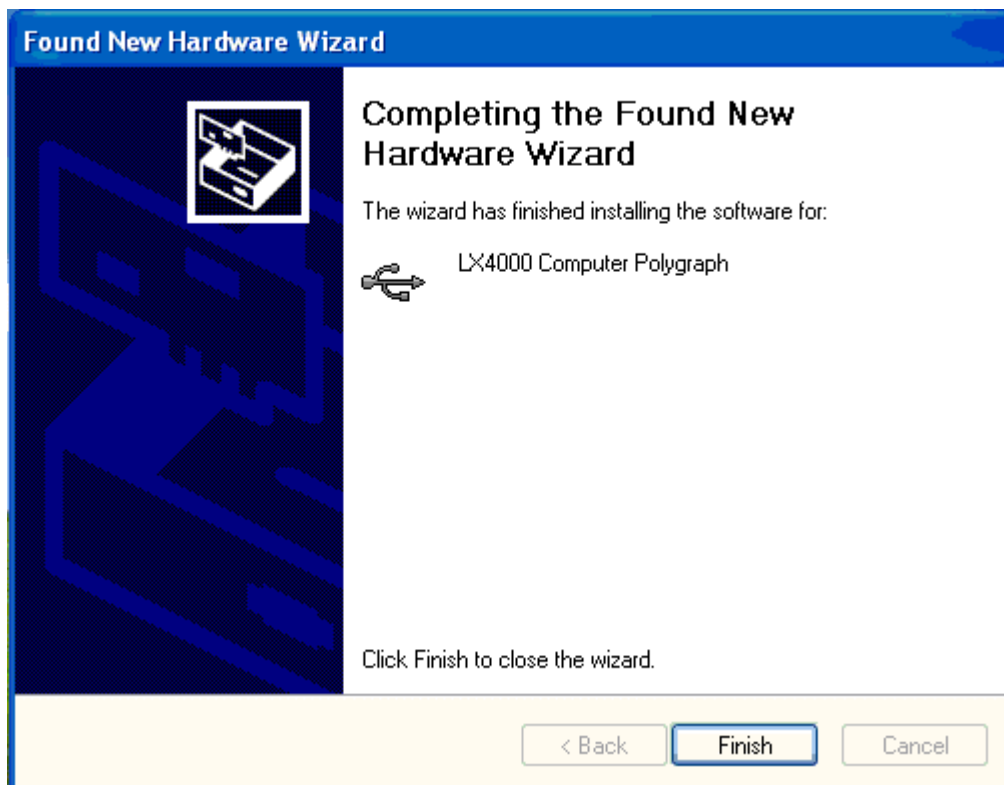
10. Select the "Finish" button.

11. Eject the LXSoftware Installation Disk from the CD-ROM drive.

12. Reinsert the LXSoftware Installation Disk. The installation program will run automatically. Follow the prompts to install the LXSoftware.

Windows XP Service Pack 1 only

1. **Do NOT insert the LXSoftware Installation Disk (CD-ROM) until instructed to do so.**

2. Connect the LX4000 to your computer using a USB cable.

3. The "Found New Hardware Wizard" will be displayed as shown below.

4. Cancel the dialog.

5. Go to Device Manager and uninstall USB Serial Port.

6. In Device Manger, select Universal Serial Bus controllers. Select USB High Speed Serial Converter.

7. Select Update Driver. The following dialog is displayed.

8. Select "Install from a list or specific location."

9. Select "Search for the best driver in these locations" as indicated.

10. Select "Include this location in search:" and specify the following path on the LXSoftware installation disk: Program Files\Lafayette Instrument\LXSoftware\Driver.

11. Select the "Next >" button.

12. Insert the LXSoftware Installation Disk and wait a few seconds for the disk to spin up.

13. This will fail. Select the back button to return to the dialog shown above.

14. Select "Don't search. I will choose the driver to install."

15. Select the "Next >" button. The following dialog will be displayed.

16. Select the "Continue Anyway" button. The following dialog will be displayed.

17. Select the "Finish" button.

18. Eject the LXSoftware Installation Disk from the CD-ROM drive.

19. Reinsert the LXSoftware Installation Disk. The installation program will run automatically. Follow the prompts to install the LXSoftware.

20. Disconnect and reconnect the LX-4000 USB cable prior to running the software the first time.

Windows Me and Windows 2000 only

1. **Do NOT connect the LX4000 to your computer using the USB cable until instructed to do so.**

2. Insert the LXSoftware Installation Disk. The installation program will run automatically. Follow the prompts to install the LXSoftware.

3. After the installation has completed, connect the LX4000 to the computer using a USB cable. The device driver will be automatically installed.

4. The software is ready to run from either the desktop icon or the Start menu.

Windows 98 only

1. **Do NOT connect the LX4000 to your computer using the USB cable until instructed to do so.**

2. Insert the LXSoftware Installation Disk. The installation program will run automatically. Follow the prompts to install the LXSoftware.

3. During the installation, you may receive the following prompt:
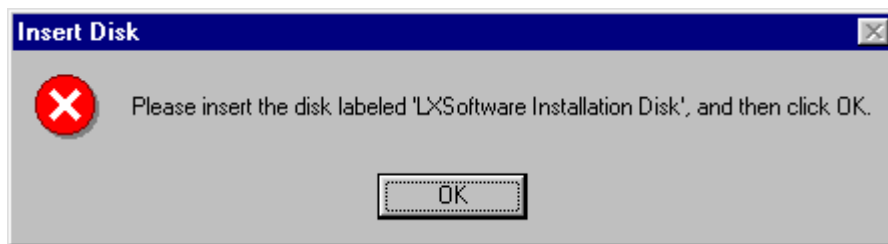
4. Select OK since the LXSoftware Installation Disk is already in the drive.

5. If the preceding dialog is displayed, the following dialog will also be displayed:

6. Windows 98 will automatically locate the required file. Select the OK button to proceed.

7. After the installation has completed, connect the LX4000 to the computer using a USB cable. The device driver will be automatically installed.

8. The software is ready to run from either the desktop icon or the Start menu.

Troubleshooting D

Overview

This appendix contains troubleshooting tips that will help you use your Windows workstation more efficiently. If you experience recurring problems that are hardware or software related, contact Lafayette Instrument for further instructions.

Table 20. Troubleshooting Tips

Problem	Solution
During the self-test, a dialog box appears stating the DAS is not available.	Ensure the cabling between the DAS and workstation has been properly connected.
During the self-test, a dialog box appears stating there is a GSC failure.	Make sure the two GSC probes are not touching each other. Click the Retry button.
During the self-test, a dialog box appears stating there is PNEUMO A (P1) or PNEUMO T (P2) failure.	Disconnect and reconnect the P1 or P2 connector on the DAS or press the "pneumo vent" button on the DAS. Click the Retry button.
The password is not accepted as entered.	Check with the system administrator and validate the user ID/password pair.
Cannot deactivate screen lock function with the password as entered.	The password entered does not correspond to the user ID displayed in the dialog box. Re-type the password or contact the system administrator to verify the user ID/password pair.
One or more sensor data lines fail to appear even though the subject is hooked up.	Make sure the sensor connectors are firmly in place for each of the DAS connectors. Select the center button to center traces around the sensor controls.
All chart lines appear normal on the screen except the cardio trace.	Make sure the cardio bladder has been inflated. Check that the cardio pressure is between 50 mmHg and 135 mmHg.
PF files cannot be moved to the secondary drive.	For floppy disks, make sure the disk is not locked (i.e., write-protected). Remove the disk, make sure the write-protect tab is closed (unlocked).
A dialog box appears stating a certain PF is corrupt.	Contact the System Administrator to archive that PF file to floppy disk or other media.
A dialog box appears stating the command could not be completed because there is not enough memory.	Close any open charts or other files and try the operation again.
A dialog box appears stating memory is low and some commands are disabled.	Close any open charts or other files and try the operation again. If scoring, choose fewer charts to score simultaneously.
Information is sent to the printer but there is no printer output.	Ensure the printer is turned on and is online. Check the printer paper supply.
The LXVideo application displays a dialog box indicating that video capture hardware was not found and exits	• Ensure the video camera is correctly installed and is properly connected to the computer • Ensure the video camera is Microsoft DirectX/DirectShow compatible • Ensure the USB/Firewire port is enabled on the computer • Is the camera defective? If another camera is available, try it to see if it works properly

Video works properly but audio is not recorded	• Ensure the microphone is not muted (select the computer's volume control application, view the recording settings, and enable or increase the microphone gain) • If the video camera has a built-in microphone, try using a microphone attached to the computer's sound card instead.
Audio/video recording terminates prematurely.	• Check available hard disk drive space • Ensure the camera's connector was not bumped or loosened accidentally • If recording on a laptop computer, ensure the battery is charged and/or the computer is plugged in.

The Development of the POLYSCORE® System

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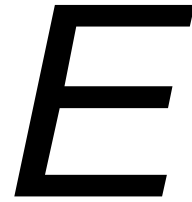
Introduction

This appendix provides technical background to help the examiner understand how POLYSCORE® operates. It describes the development of the Zone algorithm; the development of the other algorithms is similar. Significant to the discussion are two key points points:

- Although the developers of POLYSCORE® know traditional polygraph scoring procedures, the automated scoring procedures developed were based entirely on optimal statistical procedures applied to a polygraph database and do not necessarily mimic traditional procedures. As a result, its evaluations will be different.

- The purpose of research reported here was to develop the best possible procedures for discriminating between polygraph data from deceptive and nondeceptive subjects.

Background

Statistical methods for polygraph evaluation or computerization have been suggested by several investigators (Kubis, 1962,1973; Yankee, 1968; Szucko and Kleinmuntz, 1981). Kircher (1983) developed the first computerized scoring system. Recently, an effort has been made to collect digitized polygraph data from law enforcement cases so that statistically optimum scoring criteria could be developed, implemented in software, and evaluated. The resulting computerized scoring system removes nearly all variation among polygraph readers. In addition, the available computerized preprocessing of the data makes the tracings easier to evaluate than unprocessed charts evaluated using traditional methods. This Appendix describes the research.

The Algorithm Development Approach

The purpose of APL research was to learn how to effectively distinguish the reactions of those who are attempting deception from the reactions of those who are not. The first requirement was to collect data from a target population suspected of criminal activity. To do this APL researchers first narrowed their research to the Zone Comparison examination, but used a variety of examiners and case types. Since the interest was in real criminal cases, mock crime data was not used.

APL researchers used the computer to first calibrate and condition the data and then calculate thousands of different characterizations of the reactions. Figure 63 provides a sample of computerized polygraph tracings of the responses to two questions.

Figure 63. Control and Relevant Reactions for a Deceptive Subject
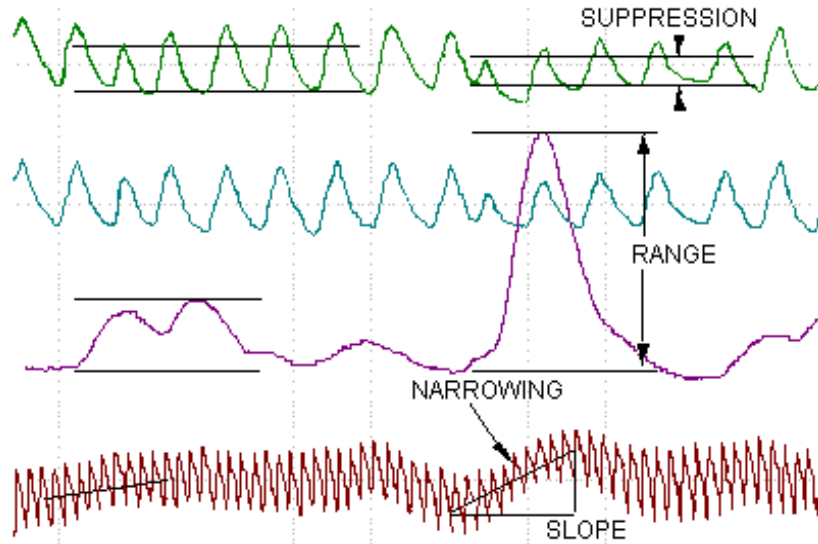
The first response is a response to a control question; the second is believed to be typical of a response from a deceptive subject to a relevant question.

Digital data can be processed in many ways to facilitate interpretation. There are many ways to characterize reactions, assign a numeric value to those characterizations, and combine assigned values to reach a conclusion. The aim of APL researchers was to determine which processing steps and methods of characterizing reactions could be used most effectively to determine which subjects were deceptive and which were not. The idea is to find a set of scoring criteria, called features, which will allow separation of deceptive and nondeceptive subjects as clearly as possible. Figure 64 is a two-feature scatter plot of measured Electrodermal and Cardiovascular responses. Circles represent the reactions of subjects identified as deceptive (Deception Indicated or DI), and squares represent those reactions identified as nondeceptive (No Deception Indicated or NDI).

Figure 64. Scatter Plot of Electrodermal and Blood Volume Change Features
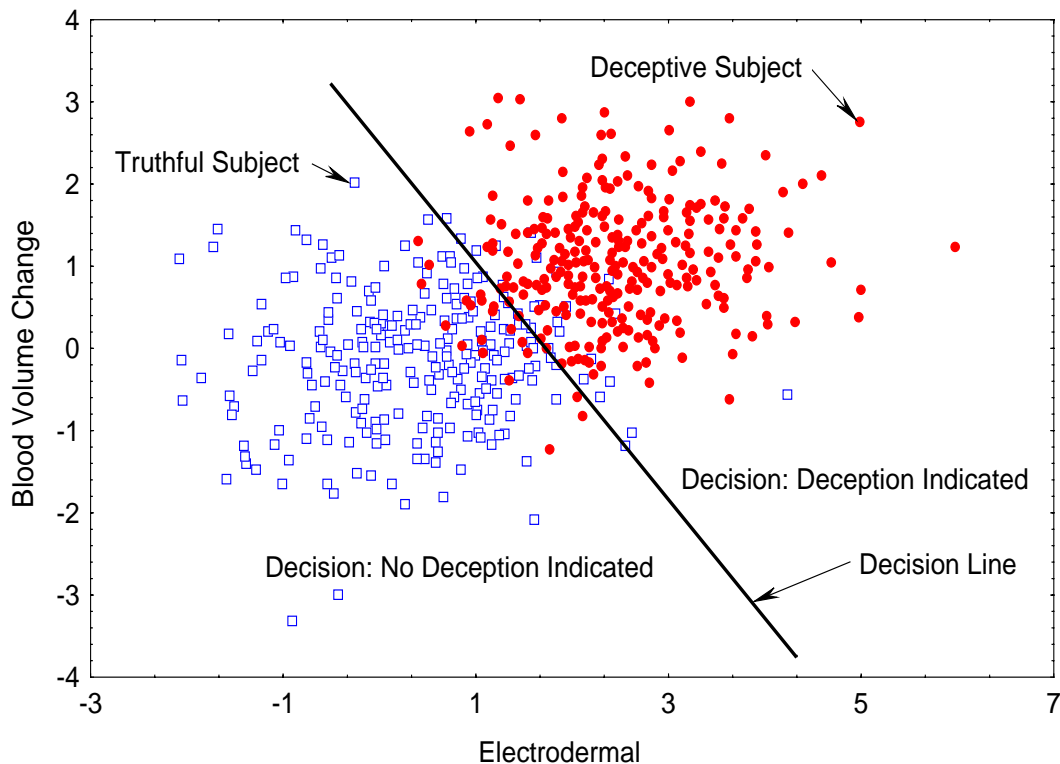
This figure shows separation of DI and NDI subjects by the decision line. Ideally, the DI and NDI sets would not overlap, and a clear distinction between the two sets would result. However, the two data sets *do* overlap, indicating that we cannot cleanly separate the two sets using just these two features or characterizations alone. By using other features that help to detect deception, we can better separate the two populations. For example, a subject incorrectly classified as NDI using just the two plotted features may be clearly in the DI portion of the plot when a Respiration feature is used.

To learn how to best separate the DI and NDI data, APL researchers began by collecting data that were representative of the polygraph applications of interest.

Field Examinations

Computerized systems were purchased and placed with two federal, two state, and two county law enforcement agencies as well as one city agency. Ten examiners provided most of the cases, but others also contributed. The examiners were located in the eastern United States from Vermont to Florida. The sample represented a resonable mix of law enforcement cases involving such crimes as larceny, murder, forgery, arson, assault, bribery, child molestation, incest, patient abuse, kidnapping, and drug violations. A few single issue pre-employment screening cases were also used. Examiners had to meet two significant criteria: (1) they had to have received their training from the Department of Defense Polygraph Institute, and (2) they had to use the Zone Comparison question sequence. After selection, examiners received an additional week of training in the use of the computerized instrument at the Polygraph Institute.

The Data

Since the purpose of the effort was not to determine the accuracy of polygraph examinations, but rather to determine how polygraph data could best be used to separate deceptive and nondeceptive sets of reactions, researchers did not have to use every case received to develop the algorithm. A random sample of cases is desirable but not required for learning how to discriminate reactions. The only requirement was that the subject's true status (deceptive or nondeceptive) be known conclusively or that the polygraph results be clear to experienced examiners. From these data, researchers could then identify traits that could be used to discriminate between responses. By March 31, 1994, APL researchers had received data from 852 cases. The deceptive or nondeceptive status of the subject was determined in one of two ways: (1) a confession or guilty plea by the subject was obtained or a confession or guilty plea by someone else was obtained, which thereby cleared the subject; or (2) agreement was obtained among the original and two "blind" examiners on the interpretation of the charts.

Of the 852 cases, 228 were discarded. The most common reason for not using the data (37% of the 228 cases) was that two or more examiners called the charts inconclusive or INC (see Table 21). In 34% of the unused cases, a consensus could not be reached. For example, one examiner may have scored the charts as INC, while the others scored them as DI. In a few of these cases all three examiners made different calls -- NDI, DI, and INC. Researchers used cases that one or more examiners called inconclusive but that were eventually confirmed.

Initial work indicated that Respiration reactions can last longer than 18 seconds, so examiners were required to wait at least 25 seconds between questions. However, data with as few as 18 seconds between questions were used to develop the algorithm.

Table 21. Disposition of Cases Not Used in the Algorithm Development

Reason for discarding cases	Number of cases	Unused cases (%)	All cases (%)
Inconclusive for two or more examiners	85	37.0	10.0
No consensus	77	34.0	9.0
Excessive movements	19	8.0	2.0
Instrumentation malfunction or no electrodermal responses	17	8.0	2.0
Less than 18 seconds between questions	7	3.0	0.8
Improper question sequence	7	3.0	0.8
Countermeasures	6	3.0	0.7
Only one or two poor-quality charts	5	2.0	0.6
Examination discontinued before complete	3	1.0	0.3
No respiration channel	1	0.5	0.1
Unfit subject	1	0.5	0.1
Total	228	100.0	26.4

Data collection began in April 1991. Just under half of the 228 unused cases were collected in the first 4 months when examiners were becoming familiar with the computerized collection systems. POLYSCORE[R] version 3.0 was developed with 624 cases; of those, 301 were nondeceptive and 323 were deceptive.

The number of charts for each subject varied from three to five, with three charts for most subjects. Typically there were three relevant responses on each of three charts, producing nine relevant responses per subject, in addition to nine control question responses.

Extreme control or relevant responses are classified as outliers and were therefore not used to develop the algorithm. (To be classified as extreme, the one reaction must account for more than 89% of the variability among the 18 responses.) Reactions are sometimes distorted by movements of the subject or other events. These distorted reactions are called artifacts. An artifact detection algorithm was built so that components of reactions to those artifacts could be eliminated. Other than dropping these artifacts and outliers, no data editing was performed.

Processing Steps

The algorithm was developed using seven basic steps. (Similar procedures have also been employed to develop a seizure detection algorithm and can be used to develop other detection, discrimination and imaging matching systems.)

1. *Condition the Data.* The digitized polygraph data or signals are transformed into other useful signals.

2. *Standardize the Data.* The signals are scaled so that the various tracings have similar amplitude scales.

3. *Develop Data Features.* Many different characterizations of each question response are calculated. These quantified descriptions of the responses are called features.

4. *Standardize Features.* The features for all relevant questions are standardized by subtracting the average of control question responses and dividing by a standard deviation developed using the features from both control and relevant questions.

5. *Evaluate Features.* The features are evaluated to determine which combination can best be used to detect deception.

6. *Develop the Decision Rule.* A logistic regression decision rule (Cox and Snell, 1989; Hosmer and Lemeshow, 1989) converts these features into a probability of deception.

7. *Evaluate the Algorithm.* The algorithm-produced probabilities are compared to verified results and examiner decisions.

Condition the Data

As part of the first step, the algorithm transforms the signals to separate those portions that contain the information to be characterized. For example, the Cardio signal (bottom tracing in Figure 65) contains both a high-frequency component corresponding to Pulse and a low-frequency component corresponding to overall Blood Volume. To make feature extraction easier, these signals are split into their frequency parts. The signal is passed through a finite impulse response filter to divide it at 0.25 Hz, producing the two signals shown in the middle of Figure 65. Although the scales differ somewhat, the Blood Volume signal overlies the middle of the original Cardio signal, and the Pulse signal is the movement about this middle. Thus, Pulse and Blood Volume can now be characterized independently. Still another signal is produced by measuring how fast the blood volume signal is changing. This Blood Volume derivative signal is shown at the top of Figure 65. When the Blood Volume is increasing, this channel takes on positive values and is at its highest when the volume is increasing most rapidly. It is negative when the volume is falling and at its lowest when dropping most rapidly.

Figure 65. A Typical Cardio Signal Processed to Obtain Three New Channels
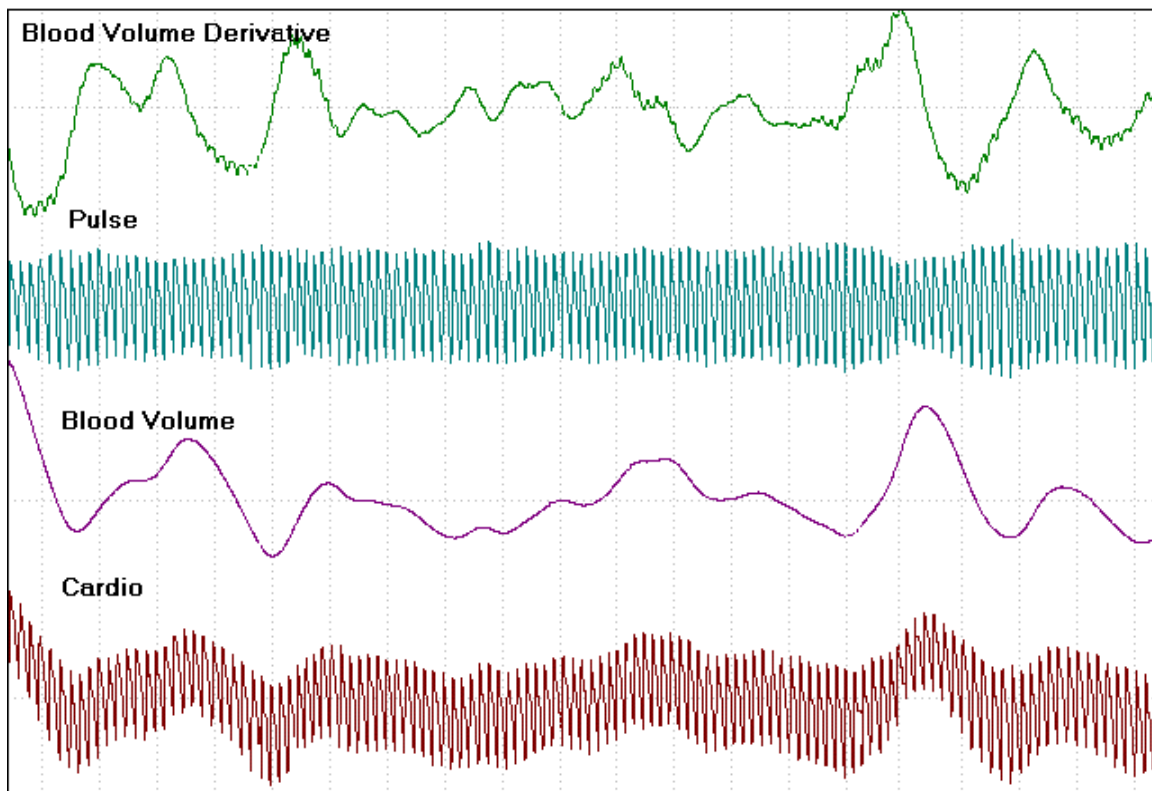
Detrending is also used to condition the data and is a technique employed for removing gradual signal changes or trends unrelated to a particular question. A downward trend in the Cardio signal may be caused by changes in the subject's physiology or by a leaking blood pressure cuff. Trends often cause the centering adjustments that examiners make during the examination. Detrending is important for developing the best signals for processing by algorithm. It also makes it easier to accurately evaluate charts using traditional scoring. Figure 66 shows a sample of standard polygraph data and Figure 66 shows the same data after detrending. The Electrodermal signal (shown as the center tracing) is much easier to visually evaluate after detrending. (The segment of data shown in Figures 64 and 65 contains distortions and should not be used for scoring.)

Figure 66. Sample of Undetrended Polygraph Signals
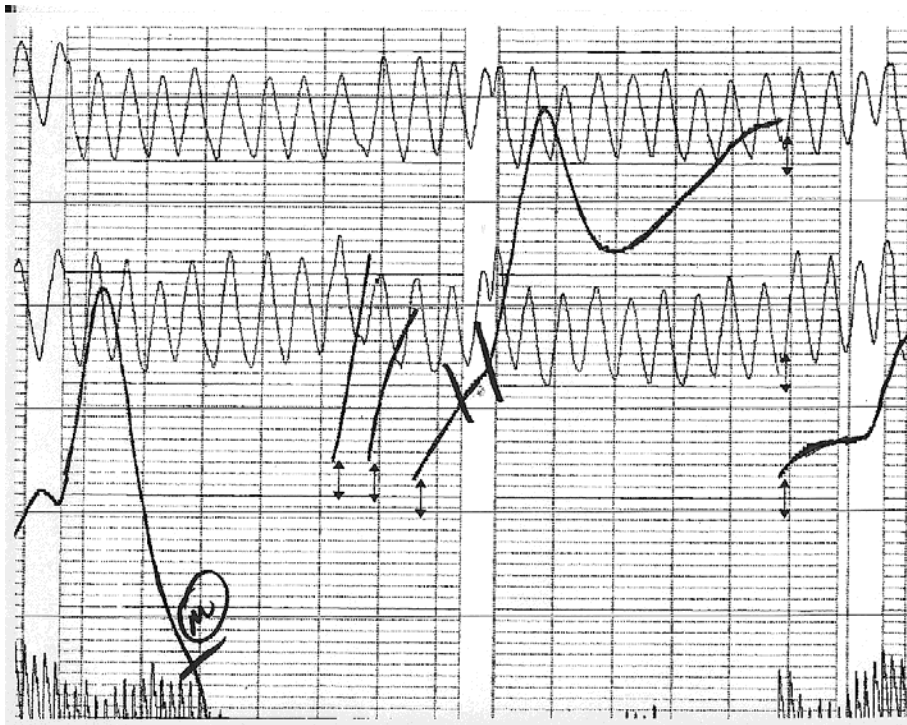
Figure 67. Sample of Signals After Detrending
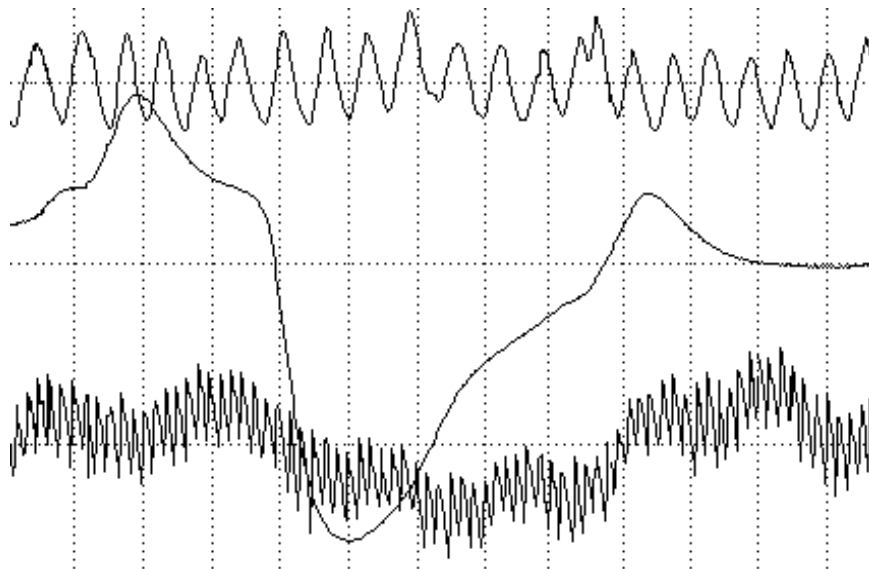
Typically, examiners must record Electrodermal data in either Manual or Automatic mode. POLYSCORE® can construct an Automatic mode channel from the Manual mode data which is stored in the chart document. Figure 68 shows the significant difference between data collected simultaneously in both modes. Both channels are used by POLYSCORE® in evaluating charts.

Figure 68. Identical Electrodermal Input Plotted in Both Manual and Automatic Modes
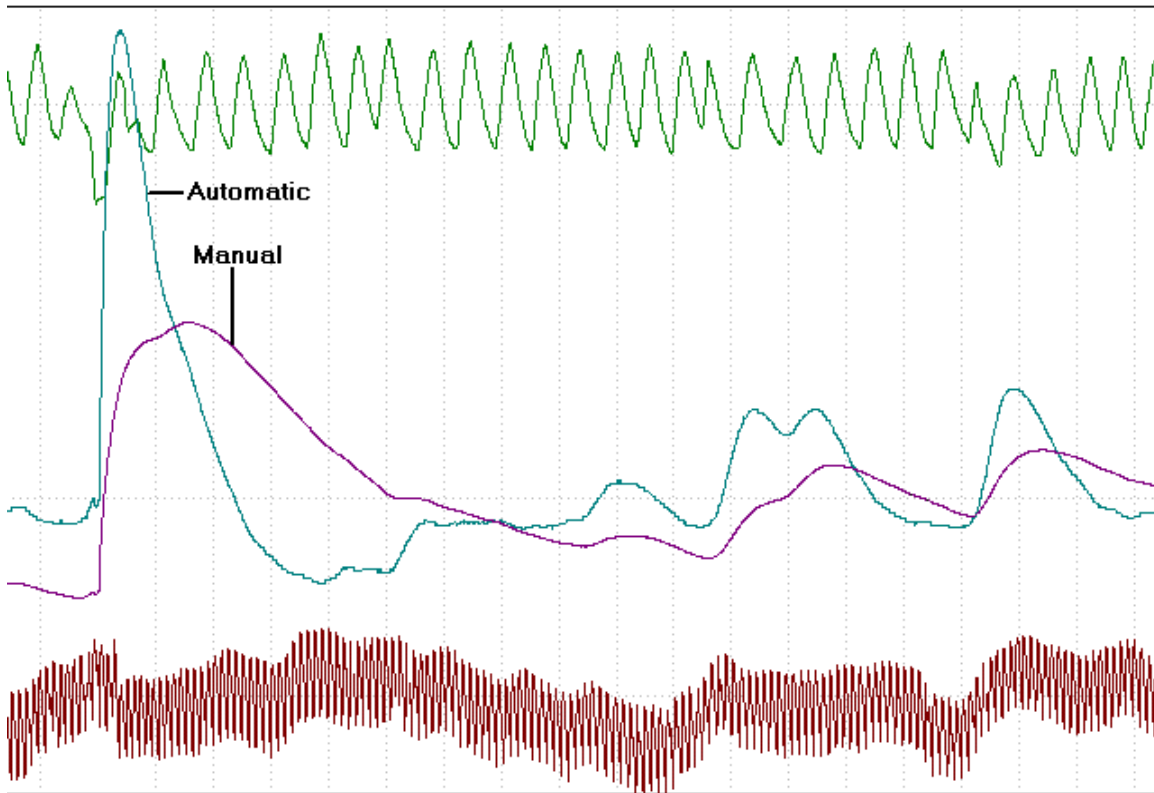
In the preprocessing step, POLYSCORE® develops and uses nine channels: four Electrodermal, two Pulse, two Blood Volume and one Respiration.

Standardize the Data

Signal standardization allows the channels from different subjects or different charts from one subject to be evaluated using a common algorithm. The idea is to calibrate all instruments and people as nearly as possible to the same level. Typically, the mean of the signal is subtracted from each signal data point, and the difference is divided by the standard deviation. However, that method produces poor results when the data are not symmetric about some point. Since polygraph data are not symmetric, the extreme values (large or small) are not used when scaling the data.

Standardization can affect a channel. When data are collected using conventional analog equipment, reactions can be missed. Even with the gain turned up, the Electrodermal tracing sometimes appears to contain only a few small seemingly unimportant responses, similar to the bottom tracing in Figure 69.

Compare the two Electrodermal tracings shown in Figure 69; the tracings are plots of the same data, except one is placed on a different scale. The vertical lines indicate the beginning of a question. Many examiners would identify significant reactions in the top tracing, but many would not attribute any significance to the bottom one. This problem commonly occurs when analog equipment produces relatively flat Electrodermal signals. When using analog instruments, the problem cannot be rectified after the charts are created. When using digital equipment, the standardization step scales the signals so that the reactions in the lower tracing (Figure 69) will be obvious, and these two identical signals will appear identical.

Figure 69. Identical Electrodermal Reactions on Different Scales
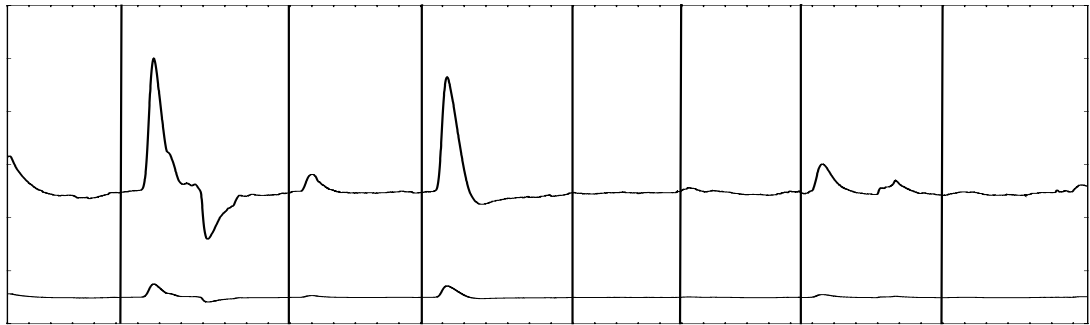
Develop Features

Once the scaled signals have been stored, they can be characterized numerically in many different ways. These characterizations (e.g., slope, area under the curve, length of the line) are called features. APL researchers developed hundreds of features and evaluated them using different windows of data to determine the most effective intervals for characterizing a response. For example, to find the best response interval or window to characterize Respiration data (see Figure 70), an initial guess of the beginning of the interval was set to 1 second, and various interval endings from 8 to 15 seconds were evaluated. Then various times for the start of the interval were evaluated. The resulting response intervals produced thousands of features to be evaluated. The optimum windows used by the algorithm depend on the feature and the processing. They are not used by examiners and should not be used by those evaluating charts using traditional scoring methods.

Figure 70. Contrasts Indicating Deception and Respiration and Electrodermal Windows
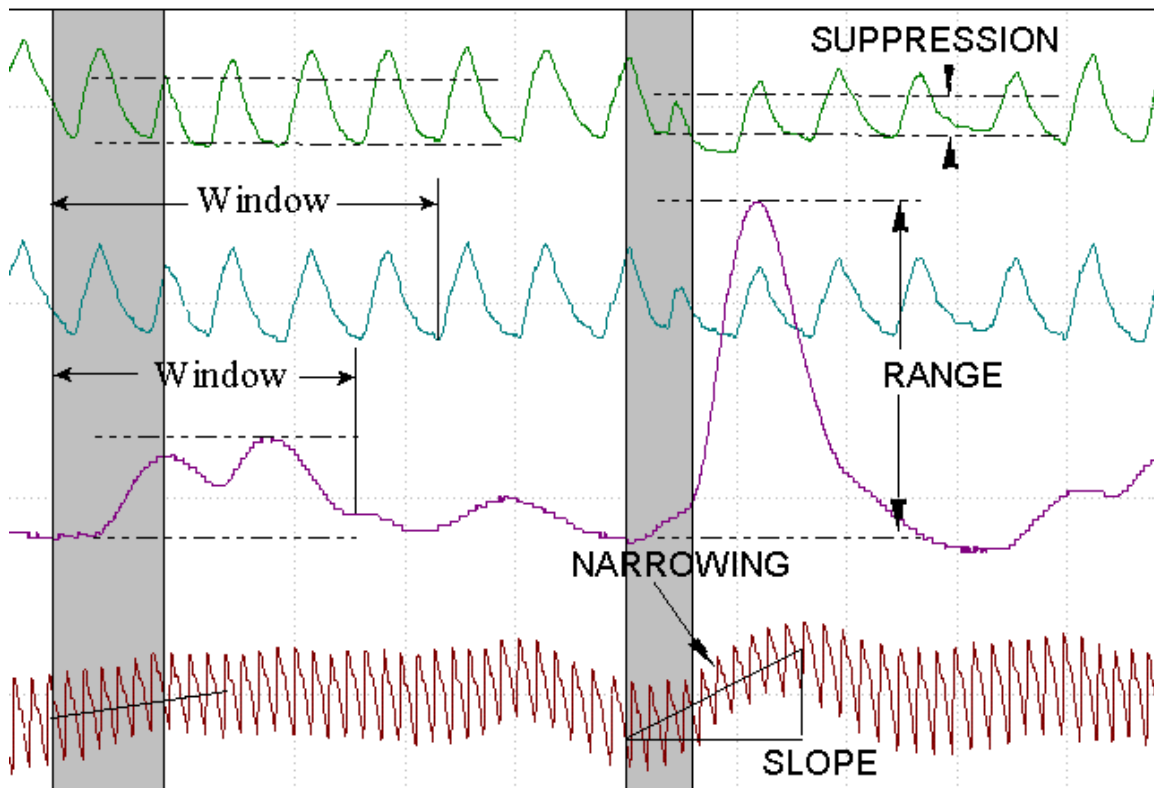
Most of the features were obtained by evaluating how high the signal was a certain percentage of the time during the window. These features, called the percentile features, were obtained by first sorting all of the data in the window. Figure 71 shows sample reactions and two windows of data before sorting.

Figure 71 shows the same reactions (only one respiration channel) after the data in the window were sorted. Using these sorted signals, researchers were able to find how high the signal was 50 or 75% of the window time.

When the sorted signal is relatively flat, the 75th percentile will be relatively low. When the sorted signal rises rapidly, this percentile will be high and the difference between the 75th percentile and the 50th percentile will be larger. However, if it rises rapidly and remains high, both the 50th and the 75th percentiles can be large, so the difference between them can be small. Percentile and percentile differences are used extensively by POLYSCORE®.

Figure 71. Polygraph Tracings with the Data in the Response Window Sorted
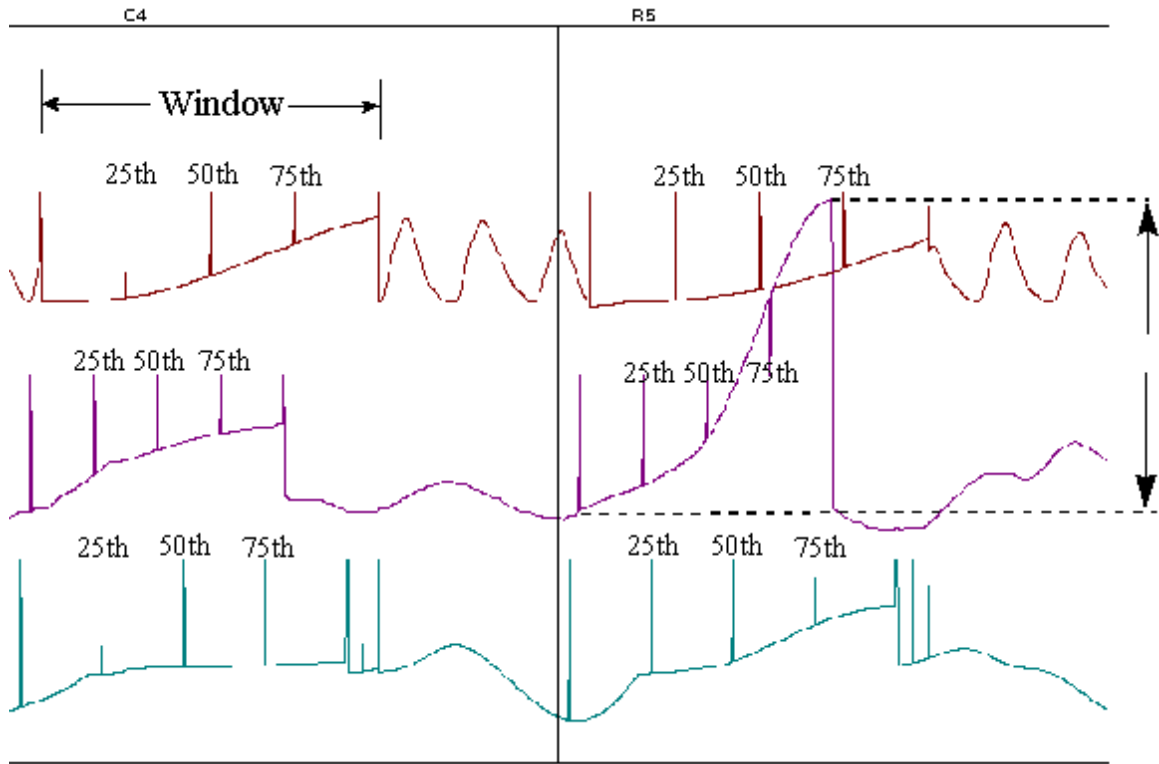
Standardize Features

The next step in selecting the best group of features for the discrimination rule is feature standardization. Like signal standardization, feature standardization is intended to calibrate different subjects to the same scale. In addition, this step uses responses to control questions to determine a response standard of comparison.

Both control and relevant questions were used to determine the natural variability of the subject's responses. Standardization of the responses was achieved by first calculating the mean of the control responses for the feature and the pooled control and relevant standard deviation. The pooled standard deviation was calculated from the variability of the control questions about their mean and the relevant questions about their mean. Standardization of the ith relevant response was then accomplished using the equation,

$$\text{Calibrated Relevant}_i = \frac{\text{Original Relevant}_i - \text{Average Control}}{\text{Standard Deviation (Variability) of Controls and Relevants}}$$

To clarify the importance of dividing by the standard deviation, consider the two sets of responses shown in Figure 72. Subject 1 has inconsistent reactions; large and small reactions appear in

response to both control and relevant questions. Almost by chance, the subject has one more large response to the relevant question. The varying responses produce a larger standard deviation. Subject 2 has consistent reactions; every relevant response is larger than all of the control responses. This produces a smaller standard deviation. Even though the average responses for the two subjects are the same, there is stronger evidence that the second is deceptive. By dividing the responses by the standard deviation, we account for these differences.

Figure 72. Consistent and Inconsistent Reactions to Control and Relevant Questions

Subject 1—inconsistent reactions

Control Reactions   Relevant Reactions

Subject 2—consistent reactions

Control Reactions   Relevant Reactions
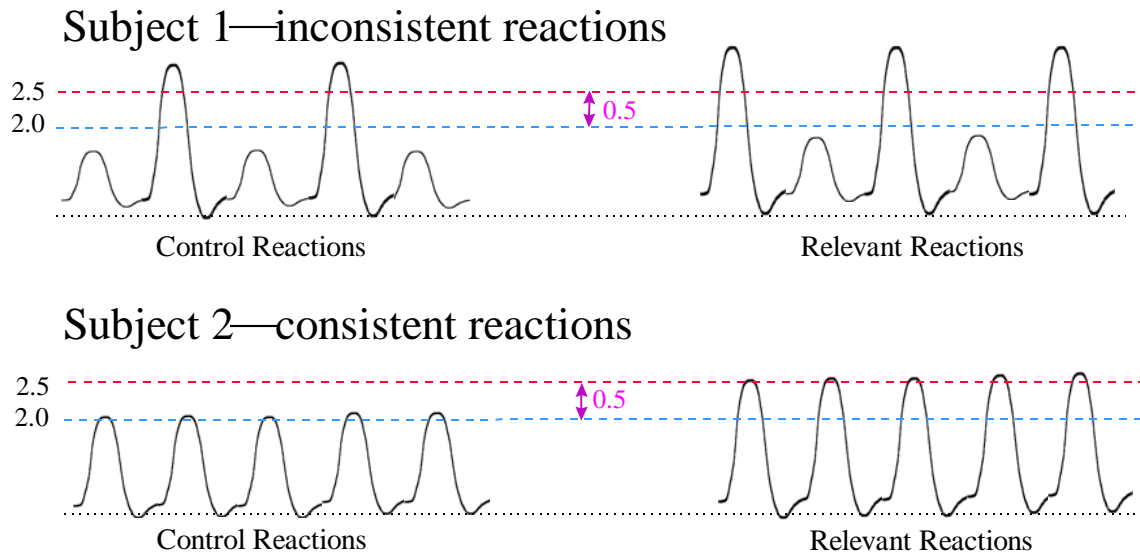
There is an important difference between traditional scoring and algorithm evaluation: whereas traditional scoring compares the relevant question reaction to nearby control question reactions, APL researchers found it best to compare each relevant reaction to all of the control question reactions. This comparison was made possible by the standardization of the data from different charts and the use of the pooled standard deviation to learn how a subject would react. If these preprocessing steps are not taken, information from control questions from different charts cannot be used to evaluate the relevant reactions.

Evaluate Features

Features were evaluated by testing them in a logistic regression-produced decision rule (Cox and Snell, 1989; Hosmer and Lemeshow, 1989). The use of this process ensures that the features are selected in a manner consistent with the properties of the decision rule and enables the development of an effective algorithm based on a minimum number of features.

Ten features are used in version 3.0 of the POLYSCORE® model. Because of the way the algorithm was developed, this combination of 10 features is particularly useful in separating DI and NDI data. Many features not used by this algorithm, including those relating to traditional scoring criteria, are valuable for discrimination by themselves but do not improve the algorithm. For example, during the Respiration baseline rises in Figure 73, the subject is keeping more air in the lungs. Examiners would treat this change in baseline as an important reaction. The algorithm does not use this change in respiration directly as a scoring feature. The essential information in the Respiration signal is contained in other features, none of which are associated directly with a change in Respiration baseline. Just the opposite is true for a few of the 10 features used by

POLYSCORE®. They may not be particularly effective by themselves in detecting deception, but do, in combination with other features, help to separate the two groups of subjects. Traditional chart interpretation assigns a value for each identified scoring criterion and adds those values together, often without regard to what other criteria appear. The approach of evaluating features in combination is fundamentally different from that of traditional chart interpretation.

Figure 73. Sample of Respiration Change in Baseline
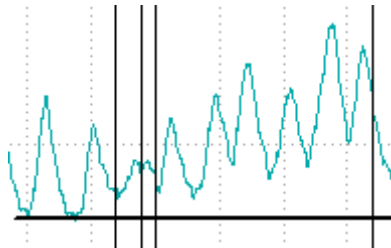
The features used by the POLYSCORE® algorithm require a digitized signal and a computer for calculation. These features are complex, and the data must be extensively processed; they can, however, be related to traditional scoring criteria. Three features are used to characterize Electrodermal reactions and typically contribute the most to a decision. Relatively large and long reactions to relevant questions, as shown in Figure 74, indicate deception.

Figure 74. Electrodermal Responses
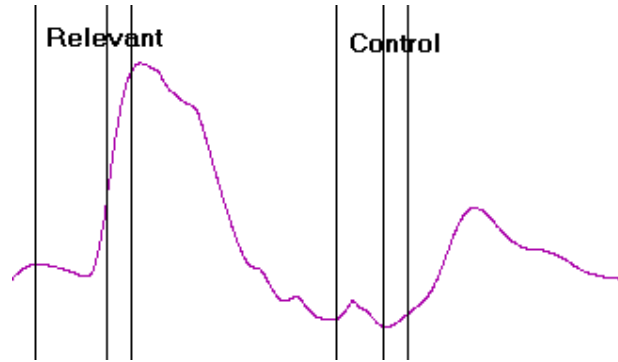
A rapid increase in Blood Volume in the arm, as shown in Figure 75, is also a significant indication of deception and is characterized using three features. Pulse and Respiration are each characterized using two features. The amplitude of the deceptive subject's pulse will often decrease as shown in Figure 75.

Figure 75. Cardio Response
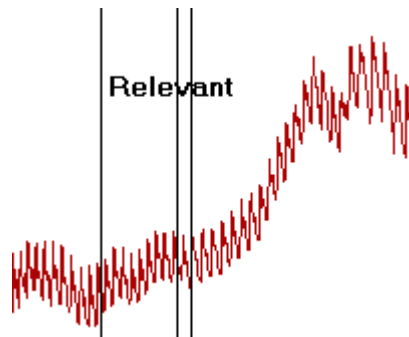
Such a subject is also more likely to suppress his or her breathing when responding to a relevant question, as shown in Figure 74.

Figure 76. Respiration Suppression
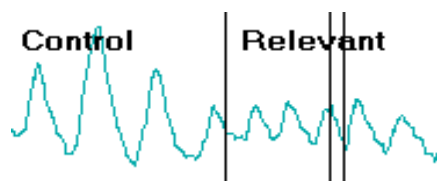
Develop the Decision Rule

APL researchers used the logistic regression model to create a decision rule having two parts. The first is to linearly weight combinations of the features to produce a "score." A statistical

technique called maximum likelihood was used to obtain the optimal weights, (β_i's), of the features to form the score, which is given by:

$$\text{Score} = \text{Intercept} + \beta_1 \cdot \text{feature}(1) + \ldots + \beta_{10} \cdot \text{feature}(10)$$

The score was developed using methods that allowed it to be converted to a probability of deception. The second part of the rule uses the "logit" conversion function to calculate a probability.

$$\text{Probability of deception} = \frac{e^{\text{Score}}}{1 + e^{\text{Score}}}.$$

Probability of deception depends on the measured features. An example of the relationship between an Electrodermal feature and the probability of deception is provided in Figure 77.

Figure 77. Plot of the Probability of Deception as a Function of an Electrodermal Feature

Logistic Probability as a Function of Electrodermal Features
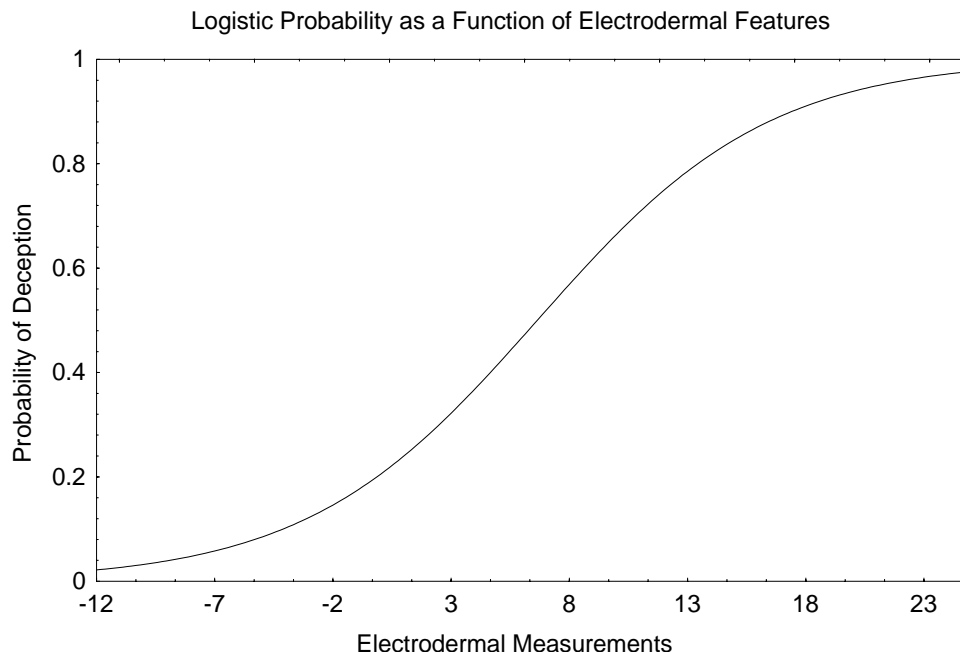
This logit conversion function models many naturally occurring phenomena and is widely used. It produces a number between 0 and 1 that reflects the probability that the given set of reactions comes from a subject attempting deception. Unlike some methods, the logistic regression rule produces numbers that are valid probabilities rather than merely a number between 0 and 1. If a measure from the exam is the number 0.95, the correct interpretation is that, based on the data in the database, deception has been attempted 95 % of the time when similar features are present.

The seventh procesing step, Evaluate the Algorithm, is discussed in depth in the following section.

Algorithm Evaluation

The intent in developing the computerized scoring algorithm was to produce a system that could objectively and consistently evaluate polygraph examination data. However, the system would be worthless if it did not produce results that, by some measure, were accurate. Because APL researchers were working with criminal cases, sampling problems and the inability to establish the subject's status (deceptive, nondeceptive) with certainty made it impossible to quantitatively determine the accuracy of the system. Even if it were possible to address these two problems, the accuracy would still depend on examiner skill. APL researchers were nevertheless able to determine how well POLYSCORE® performs relative to traditional examiner evaluation. In evaluating the algorithm, APL researchers drew four conclusions. Described here are some weaknesses they encountered with the procedures used to perform their evaluation.

First, the algorithm was used to score the cases from which it was built. Since the algorithm used only 10 features, it could not memorize the 624 cases; it was not, however, expected to perform as well on an independent data set. Since the algorithm produces a probability of deception, it will, on occasions, produce probabilities near 0.5. Any score between 0.20 and 0.80 is identified as INC, scores at or above 0.80 are interpreted as DI; and scores at or below 0.20 are interpreted as NDI.

The algorithm scored 8% (50 cases) as inconclusive and agreed with truth or examiner decision in 99.8% (573) of the remaining cases. The algorithm disagreed with the examiners in one case. As shown in Figure 78, most of the cases were scored with probabilities of less than 0.01 or greater than 0.99.

Figure 78. Histogram of Probabilities from 624 Cases Using Zone Comparison Algorithm

Histogram of Probabilities from 624 Cases
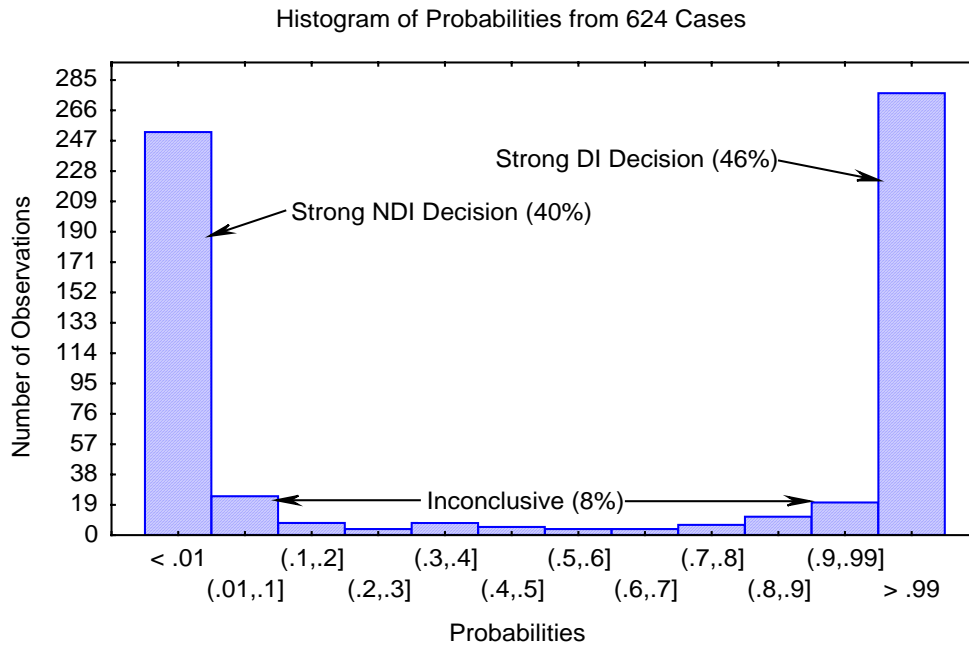
A jackknife procedure was used to drop one subject from the database, refit a model with the same features, and then classify the subject that was dropped from the data set using the modified algorithm. This process was repeated for all 624 subjects. Table 22 contrasts the jackknife results and those obtained from scoring the data using version 3 of POLYSCORE®.

Table 22. A Comparison of Jackknife and POLYSCORE® Version 3

Result	Jackknife	Version 3
Correct	570	573
Inconclusive	52	50
Incorrect	2	1

Conclusion 1: Since the subject status for many of the cases in the data set was determined by examiner decision, these results demonstrate that the algorithm is consistent with experienced examiner decisions.

Of the 624 cases, just over 33% (218) were confirmed. Most of these subjects were deceptive: only 20.6% (45) of the 218 confirmed subjects were not attempting deception. For these confirmed cases, 25 were scored as inconclusive producing a rate of 11.5%. All of the other cases (193 subjects) were scored correctly.

The confirmed cases did not represent a random sample of criminal cases. Since many of these cases were confirmed subsequent to a confession given to the examiner shortly after the examination, it was less likely that a person called nondeceptive would eventually confess.

Confirmation of the result depends on the examiner's decision in many cases, and this introduces a sampling bias in favor of the polygraph. It is also true that for the 45 truthful subjects, no errors were made and for those subjects confirmation is made through other means. Although APL researchers were surprised that none of these subjects were incorrectly scored, they cannot use these results to estimate the accuracy of the computerized system. However, there were 218 chances for the algorithm to make an error and it made none.

Conclusion 2: Results indicate that POLYSCORE® can separate the confirmed truthful and deceptive subjects in this database.

The computerized evaluation system differs fundamentally from systems used by examiners. The two methods of chart evaluation use different scoring criteria and weight the channels differently. To determine if the computerized algorithm mimics examiners, eight cases that were scored as inconclusive by the original examiner and were later confirmed were analyzed. Six of those subjects were deceptive and two were not. To make this evaluation independent of the training data, these eight examinations were dropped from the database, and the model was refit using the same features. For these difficult cases, the refit algorithm probabilities and the POLYSCORE® probabilities are shown in Table 23.

Table 23. POLYSCORE® and Refit Results for Subjects Scored Inconclusive by the Examiner and Later Confirmed

Subject Status	Refit Algorithm	POLYSCORE®	Decision
Innocent	0.009	0.009	NDI
Innocent	0.025	0.026	NDI
Guilty	0.273	0.326	INC
Guilty	0.957	0.961	DI
Guilty	0.999	0.999	DI
Guilty	1.000	1.000	DI
Guilty	1.000	1.000	DI
Guilty	1.000	1.000	DI

A clear decision was made in seven of the eight cases, and all of these decisions were correct. For one case, the result was inconclusive. The rules used by examiners and those used by the algorithm led to a different set of inconclusive cases.

Since POLYSCORE® and traditional methods process data in a fundamentally different way, APL researchers were able to reach a third conclusion without empirical support, but it is reassuring that the algorithm did properly evaluate these seven difficult cases. This result also suggests that the algorithm could be effective in reducing examiner inconclusive decisions.

Conclusion 3: The algorithm does not mimic traditional chart interpretation.

The South Carolina State Law Enforcement Division (SLED) uses polygraph examinations with care. Every chart is reviewed by an independent examiner and all scores must be justified. Subjects scored as nondeceptive or inconclusive are not interrogated. Detailed records are kept, allowing APL researchers to compare results both with and without POLYSCORE®.

During 1992, the SLED used only conventional equipment. Version 2.1 of POLYSCORE® was used from February 1, 1993 until June 30, 1993. This software contained an early version of the algorithm and was used to acceptance-test the system. Results from using version 2.3 of the algorithm were collected and tabulated from July 1, 1993 until December 31, 1993. All the polygraph examinations were conducted by the same two examiners throughout the various periods. The results (Table 24) show a dramatic drop in the inconclusive rate.

Table 24. South Carolina State Law Enforcement Division Examination Results

	1992 Traditional		1993 Version 2.1		1993 Version 2.3	
Result	Number	%	Number	%	Number	%
DI	181	37	132	52	100	48
NDI	214	43	96	38	93	44
INC	100	**20**	26	**10**	16	**8**
Total	495	100	254	100	209	100

Conclusion 4: The use of the algorithm can resolve some inconclusive cases and reduce the overall inconclusive rate for some law enforcement agencies.

Summary

It must be emphasized that POLYSCORE® can only effectively evaluate properly collected data. If the subject is not a suitable candidate for testing, if the issue is not clearly defined, or if proper Zone Comparison procedures are not used, accuracy will suffer.

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Index