

PsychoSig 1.1 User's Guide
Revision A

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Preface

Software Philosophy

TDT's philosophy on software development is simple. We design comprehensive drivers that control all aspects of the hardware from common, high-level programming languages. With minimal programming, TDT's hardware drivers enable scientists to design customized experiments. This approach works quite well in most research environments. With TDT's software, scientists no longer face the arduous task of programming each experiment in low-level machine code. Furthermore, they avoid the limitations imposed by "turn-key" software.

However, there has been an increasing demand for an interactive environment that allows the auditory researcher to design custom signals, present stimulus signals, and gather response data. In response to this need, TDT has raised its approach to software development to a higher level by designing a suite of powerful and flexible software packages. This suite includes *SigGen*, *BioSig* and *PsychoSig*. *SigGen* offers a signal generation environment that is above the level of 'C' or Pascal programming. It is a complete stimulus design application that will become the basis for a suite of TDT programs specifically developed for auditory research. *BioSig*, the first of this suite of programs, provides the user with an easy-to-use, yet flexible, means for presenting stimulus signals and collecting response data. *PsychoSig* provides a quick and easy means of designing and running forced-choice psychoacoustic experiments.

Traditionally, systems designed to present stimulus signals and acquire response data have been of two types: "turn-key" clinical systems and custom systems written from scratch. With "turn-key" systems, type and frequency of stimulus signals are restricted. Such systems are good for clinical settings, but are too restricted for auditory research. Custom systems, while providing the ability to control all aspects of stimulus presentation and data acquisition, often require tedious hours spent programming and debugging software. Because *PsychoSig* utilizes custom signals generated in *SigGen*, it allows users to design and present complex stimulus signals without writing a line of code.

As with all software applications, the *SigGen* suite of applications have their inherent limitations. For this reason, TDT still maintains as its highest priority continued support of its software drivers.

PsychoSig versus Experimenter

PsychoSig was designed to be a Windows 95 alternative to TDT's experiment development software, Experimenter. The software allows researchers to quickly design forced-choice psychoacoustic experiments through the use of point and click graphical user interface.

Using this Manual

The *PsychoSig User's Guide* is divided into two parts:

- Part 1 PsychoSig Fundamentals
- Part 2 Illustrative Examples

PsychoSig Fundamentals

Part 1, PsychoSig Fundamentals, presents all the basic PsychoSig concepts necessary to design and run forced-choice psychoacoustic experiments. The document guides you through the process of experiment configuration and execution. It also serves as a general reference tool. The guide provides:

- General information about PsychoSig
- Basic information about PsychoSig's features
- A detailed explanation of the processes of experiment setup and execution

General Information

General Information includes a description of the purpose and uses of PsychoSig, an overview of the experiment configuration and execution process, and PsychoSig installation instructions. General information is presented in the following chapter:

- *Chapter 1* Introduction

Basic Information

Basic information includes definition of terms, "Getting Started" instructions, and a brief tour of the PsychoSig main window. Basic information is provided in the following section:

- *Chapter 2* Learning the Basics

Study Design, Execution, and Data Analysis

The steps required to design and run an experiment are listed below along with their associated chapter.

Step	Chapter
1. Designing the experiment	<i>Chapter 3</i> Designing Experiments
2. Running the experiment	<i>Chapter 4</i> Running Experiments
3. Data Collection and Storage	<i>Chapter 5</i> Data Collection

Illustrative Examples

Some typical examples of forced-choice experiment design and execution are presented in:

- *Chapter 6* Quick Start Examples

Document Conventions

This manual uses conventions that make it easy to locate information.

The Table of Contents

The Table of contents contains the top three levels of section headings. It is a quick way to reference the topics covered in this manual.

Important Points

!

Key points are emphasized with an exclamation point in the margin.

References

See section x for further details

References to other sections are made in the left margin for quick access.

How to...

Step-by-step instructions for performing a task are always headed by a “To...” line. Single-line instructions use the ► bullet, while multiple-line instructions are numbered.

To find a topic in this manual

- Locate the topic in the Table of Contents.

or

1. Open to the first page.
2. Read until the topic is found.

Other Sources of Information

If you cannot find the information you need in this manual, there are several other sources for information.

The PsychoSig Help File

*See **Using PsychoSig Help** in Chapter 2 for further details*

The PsychoSig on-line help file contains answers to the most commonly asked questions about the program. This file is updated regularly by TDT, and can be downloaded from our ftp site.

ReadMe File

Look in the PsychoSig directory for a README.TXT file. This file has information about the version of PsychoSig that you have installed, including known bugs and information that came too late to be included in this manual.

Technical Support

TDT provides phone and electronic mail support for users of PsychoSig. Please be near your computer when you call so we can best assist you with your questions.

Part

1

*PsychoSig
Fundamentals*

Chapter 1 Introduction

Welcome to PsychoSig, TDT's windows-based tool for forced-choice psychoacoustic experiment setup and execution.

What Is PsychoSig?

PsychoSig is a windows-based software package designed to configure forced-choice psychoacoustic experiments quickly and easily.

PsychoSig Capabilities

PsychoSig has been designed to meet the needs of experimenters working in the area of forced-choice psychoacoustics. PsychoSig has been designed with the following features:

- Multiple intervals
- Dynamic tracking
- Additive and multiplicative tracking
- Step size control
- Multiple conditions
- Auditory and visual feedback
- Binaural stimuli
- Statistical analysis of data
- System calibration
- System security
- SigGen file support

Multiple Intervals

PsychoSig allows you to design experiments that present two to six intervals per trial.

Dynamic Tracking

PsychoSig employs dynamic tracking of the experimental variable. You specify the initial variable value, the maximum variable value, the minimum variable value, the tracking method, the step size, and the number of correct and incorrect responses required to increment or decrement the variable. PsychoSig will automatically vary the stimulus based on your specifications and the subject's responses.

Additive and Multiplicative Tracking

PsychoSig allows you to vary the experimental stimulus in a linear fashion using additive tracking. PsychoSig also provides a method for varying the experimental stimulus in an exponential fashion through the use of multiplicative tracking.

Step Size Control

PsychoSig provides two step sizes: initial step size and final step size. PsychoSig modifies the experimental stimulus according to the initial step size until a user-specified number of reversals occur, upon which PsychoSig implements the final step size.

Multiple Conditions

PsychoSig allows for the presentation of the experiment in multiple conditions. Conditions are defined through use of SigGen variables.

Auditory and Visual Feedback

Using PsychoSig, you may customize optional feedback for both correct and incorrect responses. You can present auditory feedback, visual feedback, or both in your experiments.

Binaural Stimuli

PsychoSig allows you to present one or two channels of stimuli. You can easily create monaural and binaural experiments.

Statistical Analysis

As data are collected, summary statistics such as mean, standard deviation, and standard error are computed and stored in a data file (*.dat* file).

System Calibration

PsychoSig's Calibration dialog box provides a means for calibrating your system through use of a pure tone or through use of the actual stimulus signal.

System Security

PsychoSig may be operated in one of two modes: *run* mode or *configure* mode. When in run mode, PsychoSig allows the user to run experiments, only. When in configure mode, users may configure experiments. Access to configure mode is restricted through the use of a configure mode password.

SigGen File Support

PsychoSig has been designed to work with TDT's signal generation package, SigGen. Stimulus signals may be created easily via SigGen and assigned to PsychoSig experiments.

Hardware Support

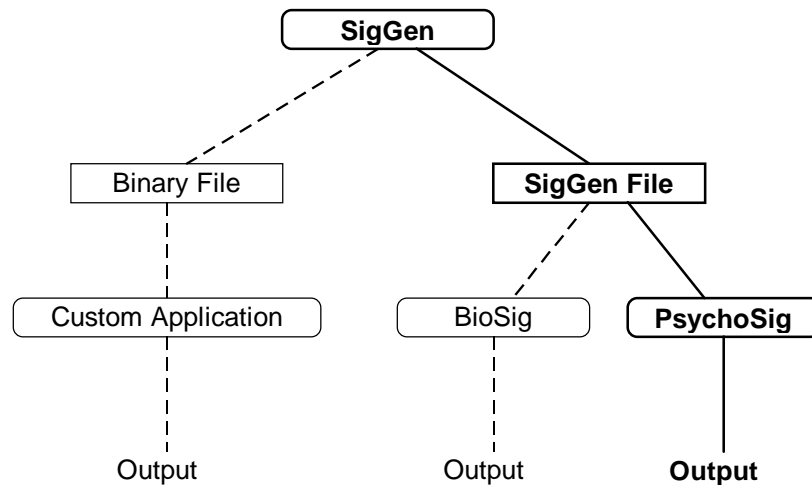
PsychoSig supports TDT's System II instrumentation. The minimal system consists of a digital to analog converter (DA1, DD1, PX1(PD1), or DA3) and either a speaker (MS1) or a headphone buffer (HB6). An anti-aliasing filter (FT5 or FT6) and a programmable attenuator (PA4) are highly recommended.

Who Can Use PsychoSig?

Anyone with a PC, Windows 95, TDT System II instrumentation, and SigGen can use PsychoSig. PsychoSig was designed to meet the needs of auditory scientists performing forced-choice psychoacoustic experiments.

How to Use PsychoSig

PsychoSig is used in conjunction with TDT's signal generation package, SigGen.



PsychoSig enables you to quickly design and execute forced-choice psychoacoustic experiments. The process is as follows:

1. Design the stimulus signal using SigGen.

TDT's signal generation package, SigGen, provides a simple, yet powerful, means for designing your stimulus signals. Signals generated with SigGen may be saved as SigGen files (.sig files) for use with other TDT signal processing applications, including PsychoSig.

2. Design the psychoacoustic experiment using PsychoSig.

PsychoSig is an easy-to-use tool for designing and executing forced-choice psychoacoustic experiments. The process is relatively simple:

- a. Assign the SigGen stimulus signal.
- b. Configure the experiment in PsychoSig.
- c. Run the experiment.
- d. Analyze and process the response data.

Before You Begin

With a bit of preparation, designing experiments with PsychoSig is quick and easy.

See your Microsoft Windows 95 documentation.

See [Digital Signal Processing Applications](#), Chapter 1

See [SigGen User's Guide](#), Chapter 2, "How to Build and Present SigGen Signals."

What You Need

- Windows 95 fundamentals*
- You should be comfortable with Windows basics.
- Signal processing
- A basic knowledge of signal processing is necessary. You should understand the parameters necessary for specification of a signal in the frequency and time domains.
- Basic SigGen concepts
- You should be comfortable with signal design using SigGen and should recognize the terms *SigGen Index* (SGI) and *dynamic variable*.

Installing the Software

Requirements

In order to run PsychoSig, you must have the following:

- TDT's AP2 Array Processor
- APOS ONBOARD software (latest version available)
- Microsoft Windows 95*
- Super VGA graphics adapter (800 x 600) (1024 x 768 recommended)
- TDT's XBUS hardware (see *Hardware Configuration*, below)
- TDT's SigGen software

Installation

To install PsychoSig

- Run `a:\install.exe`.

* PsychoSig will run under Windows 3.1 with the installation of Win32S.DLL. A bug in Win32S, however, does not display bitmaps correctly. Contact TDT if you wish to operate PsychoSig under Windows 3.1.

Hardware Configuration

PsychoSig was designed to work with TDT's powerful and flexible System II hardware. In addition to the AP2 Array Processor, to run PsychoSig, your System II configuration must include the following XBUS equipment:

- Digital to analog converter (DA1, DD1, PX1(PD1), or DA3)
- Headphone buffer (HB6) or monitor speaker (MS1)

The following additional XBUS devices are highly recommended for best performance of your experimental setup:

- Anti-aliasing filter (FT5 or FT6)
- Programmable attenuator (PA4)

Chapter 2 Learning the Basics

Basic Terminology

Before using PsychoSig, you must be familiar with basic psychoacoustic terms. These terms are defined in this section, beginning with the lowest level terms such as *experimental variable* and proceeding to higher level terms such as *condition*.

Experimental Variable

For more information about dynamic variables, see the [SigGen User's Guide](#).

The *experimental variable* is the signal parameter of interest in the experiment. For each *condition*, the experimental variable is systematically varied across *trials*. The experimental variable is defined in SigGen as a *dynamic variable*.

Experimental Stimulus

The *experimental stimulus* is the stimulus signal which varies the *experimental variable* over successive *trials*.

Standard Stimulus

A *standard stimulus* is any signal which holds all of its parameters constant over successive *trials* within a specific *condition*.

Interval

An *interval* corresponds to the temporal presentation of a stimulus within each *trial*. For example, if a trial consists of the presentation of two stimuli, an experimental stimulus and a standard stimulus, it must consist of two intervals. That is, there must be a temporal location for a first stimulus and a second stimulus. Intervals are graphically presented to the user in PsychoSig through interval buttons. Thus, there is one interval button for each stimulus presented.

Trial

In PsychoSig, a *trial* consists of two or more *intervals*. Typically, a trial consists of two intervals, to which the experimental stimulus and the standard stimulus are randomly assigned. During each trial, both stimuli are presented to the subject and a response is elicited. Thus, for each trial there is one corresponding subject response. In PsychoSig, the subject responds by selecting the interval that is believed to be correct.

Condition

For more information about the SigGen Index, see the [SigGen User's Guide](#).

An experiment may be conducted in one or more *condition*. Conditions are created by systematically varying stimulus parameters of the standard stimulus. The parameters of the standard stimulus are held constant during a specific condition while the experimental stimulus varies. A condition is analogous to the *SigGen Index* (SGI).

How PsychoSig Works

PsychoSig enables you to set up and run forced-choice psychoacoustic experiments using custom designed stimulus signals. The process is as follows:

1. Design the stimulus signal using SigGen.
2. Set up and run the experiment using PsychoSig.

Designing the Stimulus Signal

For more information about designing SigGen Signals, see the [SigGen User's Guide](#).

TDT's signal generation package, SigGen, provides a simple, yet powerful, means for designing your stimulus signals. Signals generated with SigGen may be saved as SigGen files (.sig files) for use with other TDT signal processing applications, including PsychoSig.

Setting-up and Running Experiments

PsychoSig is an easy-to-use tool for setting-up and running psychoacoustic experiments. The process is relatively simple:

1. Configure PsychoSig.
2. Present the stimulus conditions.
3. Acquire response data.
4. Analyze and process the response data.

Configure PsychoSig

Configuration settings include:

- Specification of stimulus signal
- Variable definition
- Specification of experiment parameters
- Specification of interval parameters
- Feedback specification
- Subject identification

For definition of terms used in this section, see the previous section "Basic Terminology."

Present the Stimulus Conditions

PsychoSig allows the user to design experiments that dynamically vary an experimental variable in one or more experimental conditions. PsychoSig reads the SigGen stimulus file and determines the number of conditions (SGIs) based on the variable definitions contained in the file. You may choose which experimental conditions will be executed for a given experiment. PsychoSig will execute conditions until all conditions have been presented or until the experiment is aborted.

Begin Acquiring Response Data

PsychoSig collects response data for each *trial*. Summary data for each *condition* is saved in a data file (*.dat* file).

Analyze the Response Data

Response data is saved in a PsychoSig data file (*.dat* file). You may:

- View data graphically as it accumulates.
- View data in text format as it accumulates.
- View data in any text editor.

Getting Started

Starting PsychoSig



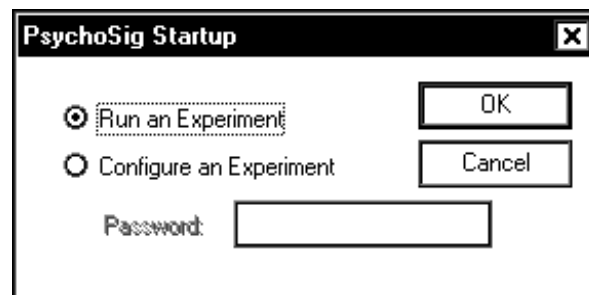
To start PsychoSig.

- Choose PsychoSig from the Windows 95 Start menu.

or

- Double-click the PsychoSig icon.

The PsychoSig Startup dialog box opens.



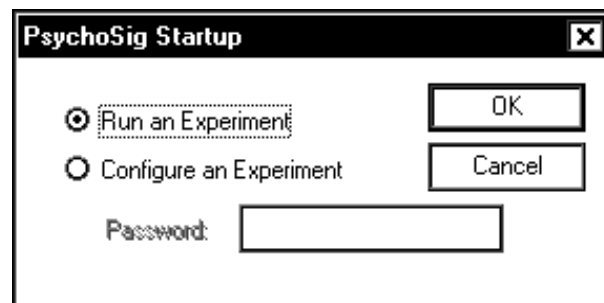
PsychoSig Modes

PsychoSig works in two modes: *run mode* and *configure mode*.

Run Mode

Run mode is designed to meet the needs of subjects. In run mode, the following functions are enabled:

- Open an experiment
- Calibrate the system
- Run an experiment
- Exit PsychoSig



To run PsychoSig in Run Mode

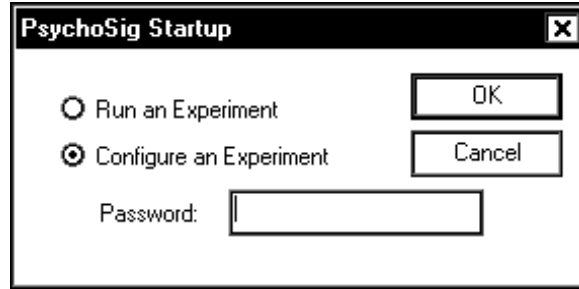
1. Click Run an Experiment.
2. Click OK.

The PsychoSig Run Experiment window will appear.

Configure Mode

Configure mode is designed to meet the needs of experimenters. Only those users with access to the configure mode password can log in to configure mode. When in configure mode, the user can perform all of the functions available in run mode, plus the following:

- Assign stimulus signals to an experiment
- Define the experimental variable
- Define intervals
- Set experiment parameters
- Define feedback
- Enter subject information



To log in to configure mode

1. Click Configure an Experiment.
2. Enter the configure mode password.
3. Click OK.

The PsychoSig Configure Experiment window will appear. You now will have access to all PsychoSig experiment design functions.

The Configure Mode Password

PsychoSig uses a simple security system to restrict access to experiment configuration. To obtain access to all experiment setup functions, the user must log in using the *configure mode password*.

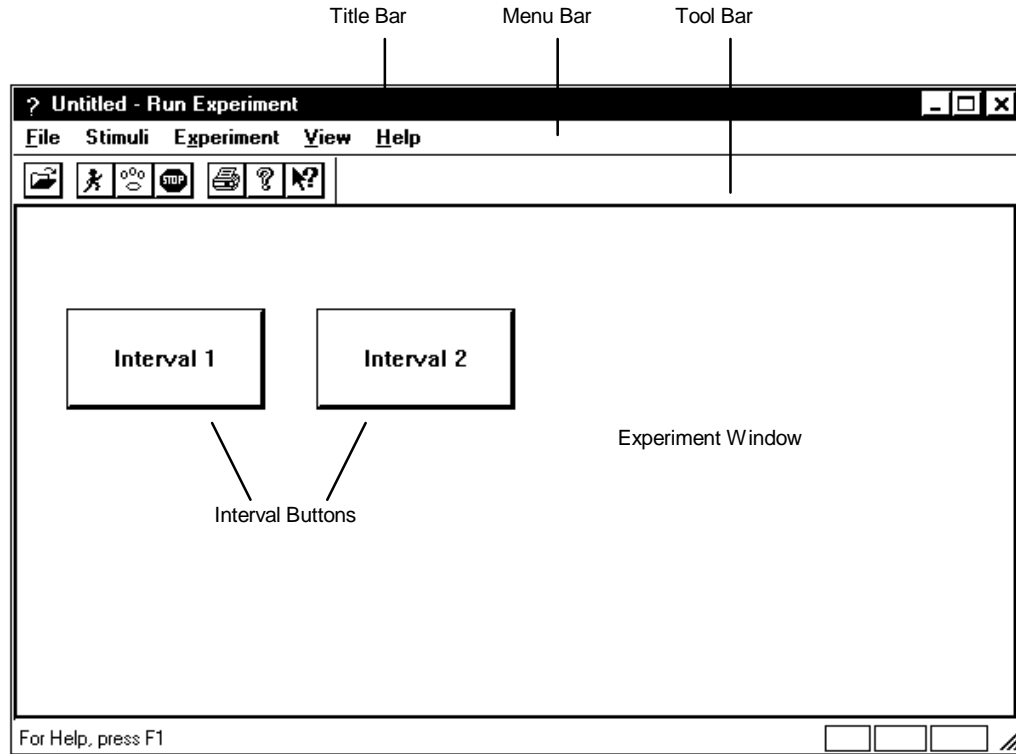
The configure mode password is “TDT”. Share this password only with those to whom you wish to grant configure mode access.

**Important
information for new
users!**

Getting to Know the PsychoSig Main Windows

The Run Experiment Window

Upon opening, the Run Experiment window appears as below.



The Run Experiment window contains the following sections:

Title Bar Displays the current PsychoSig file followed by “Run Experiment.”

Menu Bar Contains a list of menus used to run experiments.

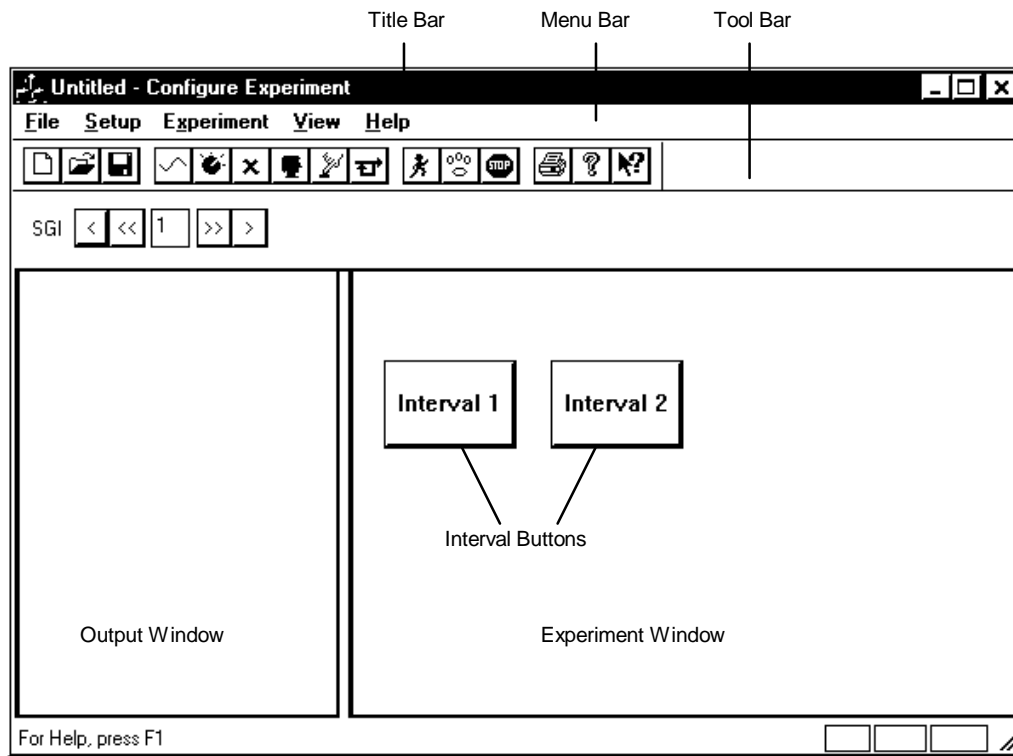
Tool Bar Provides easy-to-use buttons for most menu functions.

Experiment Window Presents the experiment as seen by the subject.

Interval Buttons Included in the Experiment Window are interval buttons. Each button represents a trial interval and may be used by the subject to select a response.

The Configure Experiment Window

Upon opening, the Configure Experiment window appears as below.



The Configure Experiment window contains the following sections:

Title Bar Displays the current PsychoSig file followed by “Configure Experiment.”

Menu Bar Contains a list of menus used to configure and run experiments.

Tool Bar Provides easy-to-use buttons for most menu functions.

Output Window Displays the results of an experiment.

Experiment Window Presents the experiment as seen by the subject.

Interval Buttons Included in the Experiment Window are interval buttons. Each button represents a trial interval and may be used by the subject to select a response.

Using the PsychoSig Menus

PsychoSig provides the user with a full set of menu commands. From these menu commands, you can configure and run experiments.

The File Menu

Running Mode	Configure Mode																																				
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From the File menu, you may create new experiments, open existing experiments, save experiments, and print result data.

New Creates a new PsychoSig file.

Open Opens an existing PsychoSig file.

Save/Save As... Saves a PsychoSig File.

Print Prints the data text file.

Print Preview Displays how the data text file will be printed.

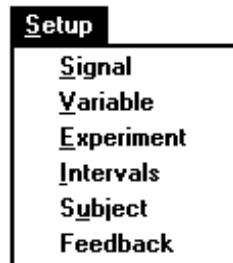
Print Setup Accesses the Windows Print Setup dialog box, from which you may configure your printer.

List of Most Recently Used Files Displays the most recently used PsychoSig files so that you may quickly access frequently run experiments.

Exit Exits PsychoSig.

The Setup Menu

Configure Mode Only



The Setup menu provides commands that allow you to set up and run an experiment.

Signal Opens the Open dialog box, from which you specify the SigGen signal (.sig file) for use in the experiment.

Variable Opens the Dynamic Variable Settings dialog box. From this dialog box you enter variable and tracking information.

Experiment Opens the General Experiment Parameters dialog box, from which you may define general experiment parameters, timing intervals, and result files.

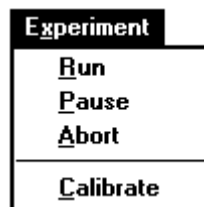
Intervals Opens the Interval Properties dialog box. From this dialog box you may block a signal for a particular interval, define the location and appearance each interval button, map a button response to a keyboard key, or set up a parallel interface such as an LED.

Subject Opens the Subject dialog box, from which you may enter the subject name and optional comments.

Feedback Opens the Feedback dialog box, from which you may defined feedback parameters.

The Experiment Menu

Running Mode and Configure Mode



The Experiment Menu allows you to run, pause, or abort an experiment.

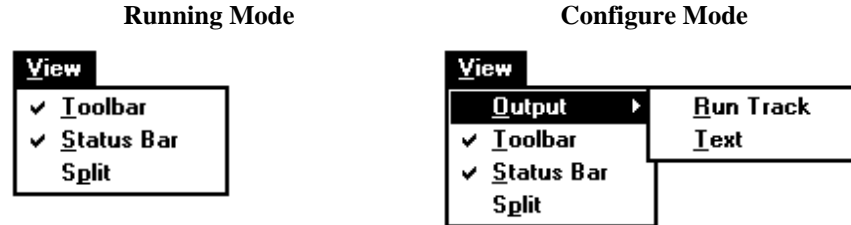
Run Runs the current experiment.

Pause Pauses the current experiment.

Abort Aborts the current experiment.

Calibrate Opens the Calibration dialog box, from which you may specify a calibration signal.

The View Menu



From the View menu, you may configure the appearance of PsychoSig.

Output Allows you to specify the content of the output window.

Run Track Displays a running graph of the variable value during an experiment.

Text Displays experiment data in text format.

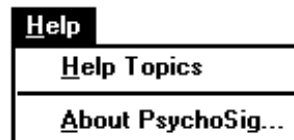
Toolbar Displays/hides the Toolbar.

Status Bar Displays/hides the Status Bar.

Split Places the mouse pointer in a position that allows you to easily resize the output and experiment windows.

The Help Menu

Running Mode and Configure Mode



From the Help Menu, you can access on-line help and the About PsychoSig dialog box.

*For details, see
"Using PsychoSig Help"
later in this chapter*

Help Topics Displays a list of help topics available

About PsychoSig Displays version and copyright information

The Toolbar
















On the PsychoSig Toolbar, you can find quick point-and-click access to the most common PsychoSig commands.

Run Mode



Configure Mode



Click		To
	New	Clear the Output Window and reset PsychoSig to its default settings.
	Open	Open an existing PsychoSig file
	Save	Save the PsychoSig file
	Setup Signal	Select and load the .sig file
	Setup Variable	Define variable parameters
	Setup Experiment	Define experiment parameters
	Setup Intervals	Define interval parameters
	Setup Subject	Enter subject information
	Setup Feedback	Define feedback
	Experiment Run	Run an experiment
	Experiment Pause	Pause an experiment
	Experiment Abort	Abort an experiment
	File Print	Print the currently displayed result data
	Help About	Access the About PsychoSig dialog box
	Help	Invoke context help

Using PsychoSig Help

The PsychoSig help files provide context-sensitive help, usage tips, and troubleshooting information that may not be in this manual. Understanding how to use the help system will help you to best tailor PsychoSig to your research.

Context-Sensitive Help

When you invoke the help system, information is displayed that corresponds to the function you are presently performing.

To invoke context-sensitive help

► Press **F1** from within any dialog or while any menu item is selected.

or



1. Click the context help icon
2. Select a menu item or click the mouse on an object on the screen.

Help information will be displayed about the selected item.

To get information about how to use Windows Help, press **F1** from within any help topic.

The On-line Troubleshooting Guide

The PsychoSig help system includes a troubleshooting guide that answers the most commonly asked questions about the program. Consult this section if you have questions.

To use the On-line Troubleshooting Guide

1. Select Help Topics from the Help menu
2. Double-click the “Troubleshooting Guide” topic.

The PsychoSig Troubleshooting Guide will appear. Select the troubleshooting topic of interest to you.

Chapter 3 Designing Experiments

Those users with access to the configure mode password may log in to configuration mode. While in configuration mode, the user may design experiments. A step-by-step description of the experiment design process appears below.

1. Build and save the SigGen stimulus signal.
2. Run PsychoSig in configure mode.
3. Assign the SigGen signal.
4. Define the experimental variable (dynamic variable) parameters.
5. Specify experiment parameters.
6. Customize each interval.
7. Define feedback.
8. Enter subject information.
9. Save the PsychoSig file.

Building the SigGen Signal

New Users –
Read this section before you design your SigGen signal.

Prior to designing your experiment in PsychoSig, you must build a stimulus signal in SigGen. SigGen is a very powerful package that allows users to build many types of complex stimuli.

!

For the most part, the process of designing a SigGen stimulus for use with PsychoSig follows the instructions presented in the *SigGen User's Guide*. Differences particular to PsychoSig are noted with an exclamation mark in the margin.

The instructions below will take you through the basic steps of signal design in SigGen. For more detailed instructions, see the *SigGen User's Guide*.

Defining the Experimental Stimulus

The basic steps necessary to design a SigGen signal for use with PsychoSig are presented below.

1. Run SigGen
2. Define signal parameters.
3. Define experimental and condition variables.
4. Define segment parameters.
5. Save the SigGen file.

!

Defining the Experimental Variable

The experimental variable is the signal parameter that will vary across experimental trials. Because PsychoSig varies the experimental variable according to the subject's responses, it must be defined in SigGen as a *dynamic variable*.

Define the experimental variable as a dynamic variable in the Signal Variable dialog box.

Signal Variable

General

Name: Units:

Method:

Prompt/Comment:

File Name:

Value Limits

Default/Start:

Step Size:

Minimum:

Maximum:

No. of Steps:

Combination Variable

Variable:

Operation: Value:

SGI Modifiers

Offset:

Repeat Factor:

Skip Factor:

Termination Control

Normal/None

Boundary Control

Loop

To define the experimental variable

1. Enter the name of the variable in the Name field.
2. Enter the units of the variable in the Units field.
3. Choose Dynamic from the Method list box.
4. Enter the initial value for the variable in the Default/Start field.
This will be the variable value for the first trial of every condition.
5. Skip step size.
You will define initial and final step sizes in PsychoSig.
6. Enter the minimum allowable variable value in the Minimum field.
7. Enter the maximum allowable variable value in the Maximum field.
8. Click OK.

Note: PsychoSig requires that one and only one dynamic variable be defined in the SigGen files it uses.

Defining a Condition Variable

A condition is analogous to a SigGen Index.

You may want to conduct your PsychoSig experiment in multiple conditions. It is possible to set up multiple conditions through use of one or more additional SigGen variables.

Condition variables may be defined using any SigGen method but dynamic. SigGen and PsychoSig both understand that when a non-dynamic variable and a dynamic variable are defined, the non-dynamic variable varies systematically across conditions while the dynamic variable varies based on the subject's response across trials.

Condition variables are defined in the Signal Variable dialog box. The following is an example of defining a single condition variable.

To define a condition variable

1. Enter the name of the variable in the Name field.
2. Enter the units of the variable in the Units field.
3. Choose any method but Dynamic from the Method list box.
4. Enter the initial value for the variable in the Default/Start field.
This will be the variable value for the first condition.
5. Enter the step size, if appropriate for the chosen method.
6. Enter the minimum allowable variable value in the Minimum field.
7. Enter the maximum allowable variable value in the Maximum field.

8. Click Boundary Control.

This will cause the experiment to terminate when the number of conditions defined by this variable have been presented.

9. Click OK.

Note: PsychoSig expects that at least one condition variable will be defined with Boundary Control so that the experiment has 100 or fewer conditions. If you do not need any condition variables for your experiment, create a dummy variable that uses boundary control to limit the number of conditions to 100.

To preview conditions

- Click the Preview Variables button located on the SigGen main window.

SGI	[Frequency]	Level
1	3000	80
2	2500	80
3	2000	80
4	1500	80
5	1000	80
6	500	80
Term.	*500	80

In the above example, *Frequency* has been defined as a Linear Step variable while *Level* has been defined as a dynamic variable. SigGen has constructed 6 conditions, or SigGen Indices (SGIs) based on the definition of the variable *Frequency*. For each condition (SGI), the dynamic variable *Level* is initially set to 80 dB and varies according to user response.

Defining Multiple Condition Variables

You may want to vary more than one parameter across conditions. To do so, you must control each parameter with a separate condition variable. In order to present all possible variations, multiple condition variables must be nested.

In the example that follows, two condition variables have been created, *DeltaT*, the onset of a tone following a masker, and *Frequency*, the frequency of the tone. The variable *Frequency* is nested within the variable *DeltaT*. Notice how the value of *DeltaT* remains constant for the first three conditions (SGIs) while the value of *Frequency* is allowed to vary from 500 to 1000 to 3000. The value of *DeltaT* changes at condition (SGI) 4 and remains constant for three conditions while *Frequency* again varies from 500 to 1000 to 3000. Finally, *DeltaT* takes the value of 300 while *Frequency* varies one last time from 500 to 1000 to 3000.

SGL	[DeltaT]	Freq.	Level
1	330	500	80		
2	330	1000	80		
3	330	3000	80		
4	310	500	80		
5	310	1000	80		
6	310	3000	80		
7	300	500	80		
8	300	1000	80		
9	300	3000	80		
Term.	*300	3000	80		

<<< >>> Show Combined Values Done

Loop. In this example, the variable *Frequency* has been defined with a Termination Control of Loop. This causes SigGen to loop through all possible values until the final boundary conditions have been met. When condition variables are nested, all condition variables except the highest level variable must be defined with a Termination Control of Loop.

Repeat Factor. In the example, the variable *DeltaT* has been defined with a Repeat Factor of 3. This causes SigGen to hold this value constant for three conditions while allowing the variable *Frequency* to cycle through its three values. All nested condition variables except the lowest level variable must have a repeat factor that specifies the number of conditions for which the variable should be held constant.

Defining the Standard Stimulus

The standard stimulus holds the experimental variable constant throughout the experiment. In many cases, an element of the experiment is eliminated by setting the experimental variable to zero.

The value of the experimental variable during standard stimulus presentation is set in PsychoSig. The manner in which this is accomplished is discussed in a later section, “Defining the Experimental Variable.”

Designing Multi-channel Experiments

PsychoSig allows you to design experiments that play stimuli to one or two channels. One-channel experiments are referred to as *monotic* or *diotic*; two-channel experiments are *dichotic*.

Two-channel (dichotic) experiments are reported as “Binaural” in the PsychoSig output file.

Monotic: Stimulus Played to One Ear

Monotic experiments are the simplest and most common experiments. Define the SigGen stimulus and utilize it in the PsychoSig. Connect the output signal to either channel of the headphone buffer.

Diotic: One Stimulus Played to Both Ears

Diotic experiments are identical to monotic experiments except that the signal is played to both ears. Connect the signal to both input channels of the headphone buffer.

Dichotic: Different Stimuli to Each Ear

Dichotic experiments present different stimuli to each ear. PsychoSig uses separate SigGen files to define the stimuli. The two files must have the exact same variable definitions, however, as the second stimulus uses variables defined in the first.

Note: Though allowable, it is recommended that calibration values *not* be different between the SigGen files used in a dichotic experiment. The following procedure is recommended for creating dichotic experiments.

To prepare a dichotic experiment

1. Create the SigGen stimulus for the first channel.
 - Include calibration information and define any variables that may be used in the second file, even if they are not used by the first.
2. Save the file.
3. Use Save As to save the file under a new name.
4. Change the segment parameters to create the second stimulus.
 - Do not alter the signal parameters or the variables.
5. Save the second stimulus.

You can then use these files as the Channel 1 and Channel 2 signals in PsychoSig.

Note: The A/D channel assignments made in the SigGen Signal Setup dialog box are ignored by PsychoSig. PsychoSig uses channels 1 and 2 of your A/D as shown in the Load Signal Files dialog box of the next section.

Running PsychoSig in Configure Mode

In order to set up an experiment, you must run PsychoSig in configure mode.

To run PsychoSig in configure mode

1. Run PsychoSig
2. Click Configure an Experiment.
3. Enter the configure mode password.
4. Click OK.

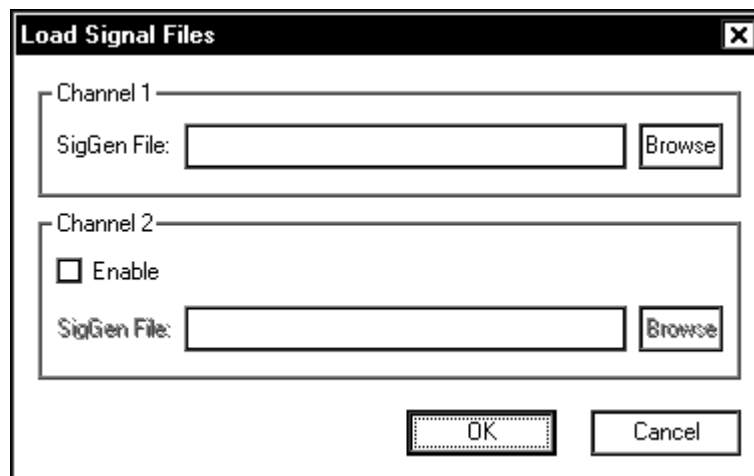
The PsychoSig Configure Experiment window will appear. You now will have access to all PsychoSig experiment design functions.

Assigning a SigGen Signal

Your first step in PsychoSig is a simple one. You must assign one or two SigGen signals as your stimulus.

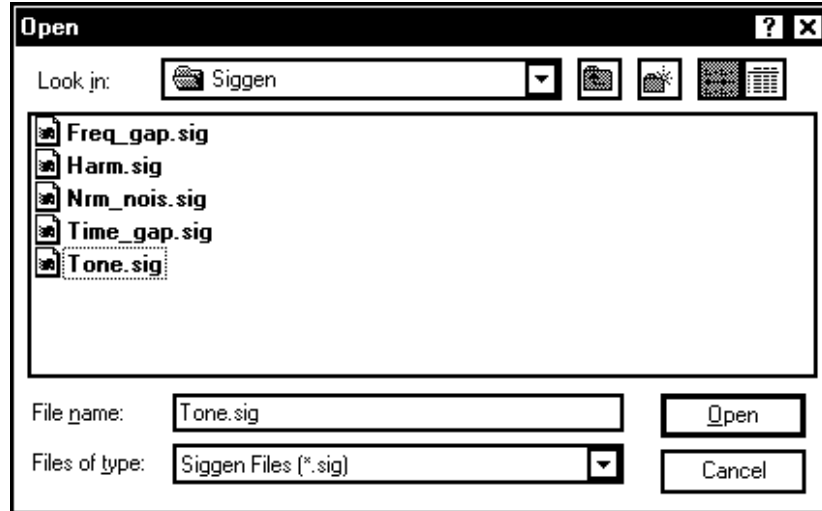
To assign a SigGen signal

1. Choose Signal from the Setup menu.
2. You will see the Load Signal Files dialog box.



3. Enter the file name of the SigGen file to play out of Channel 1.

If you click the Browse button, you will see the Open dialog box. Select a SigGen file as you do with all other Windows applications.



See the earlier section, **Designing Multi-channel Experiments** for details on how to create the second SigGen file.

3. Define the experimental variable as described in the next section.
4. If you are creating a dichotic experiment, click the Channel 2 enable box and enter the SigGen file name to play out the second channel.

You can select the second file name by clicking on the Browse button.

Defining the Experimental Variable

Experimental variable parameters are defined from the Dynamic Variable Setting dialog box. This dialog box automatically appears when a new SigGen signal file is assigned to Channel 1 of the experiment. This dialog box can also be accessed manually.

To manually access the Dynamic Variable Settings dialog box

- Choose Variable from the Setup menu.

Dynamic Variable Settings [X]

Variable: Level

Units: dB

Signal Parameters

Values

Initial Value: 60

Max Value: 100

Min Value: 0

Tracking

Method: Additive [v]

Initial Step Size: 5

Final Step Size: 2

Increment: 1 Incorrect

Decrement: 2 Correct

Use Final Step: 3 Reversals

Stop: 60 Trials
or 12 Reversals

Standard Parameters

Variable Value: 0

General Parameters

Variable. This field displays the name of the dynamic variable as defined in the SigGen file.

Units. This field displays the units associated with the dynamic variable as defined in the SigGen file.

Experimental Signal Parameters

The parameters defined in the Signal Parameters group box determine the starting value and allowable range of variation for the experimental variable.

Variable Values

Parameters that determine the value of the experimental variable may be found in the Values group box.

Initial Value. This field specifies the initial value of the experimental variable. The value specified in this field will be assigned to the experimental variable for trial 1 of each experimental condition. The Initial Value field defaults to the SigGen Default/Start variable value. You may override the default value.

Max Value. This field defines the maximum possible value of the experimental variable. The Max Value field defaults to the SigGen Maximum variable value. You may override the default value.

Min Value. The Min Value field specifies the minimum possible value of the experimental variable. The Min Value field defaults to the SigGen Minimum variable value. You may override the default value.

Note: PsychoSig keeps the value of the experimental variable within the range specified by Min Value and Max Value.

Tracking Parameters

In the Tracking group box, you will find parameters that define how PsychoSig will track the experimental variable.

Method



Additive Tracking. Choosing this option causes the experimental variable to be incremented or decremented through addition or subtraction of the current step size, respectively. Such tracking results in linear changes in experimental variable values.

Multiplicative Tracking. Choosing this option causes the experimental variable to be increased or decreased through multiplication or division by the current step size, respectively, resulting in exponential changes in experimental variable values.

Initial Step Size. This field defines the change in the experimental variable at the beginning of each trial.

Final Step Size. This field defines the change in experimental variable value across trials once the Use Final Step number of reversals has occurred.

Increment. The Increment field defines the number of incorrect responses required for an increase (addition or multiplication) by the current step size of the experimental variable.

Decrement. This field specifies the number of correct responses required for a decrease (subtraction or division) by the current step size of the experimental variable.

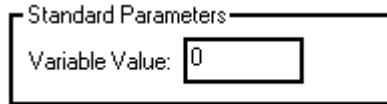
Use Final Step. This field defines the number of reversals required to change the step size from the initial step size to the final step size.

Stop. The two Stop fields define parameters used to specify when to end an experimental condition.

Trials. The experimental condition will end when the number of trials executed equals this value.

Reversals. The experimental condition will end when the number of reversals equals this value.

Standard Signal Parameters



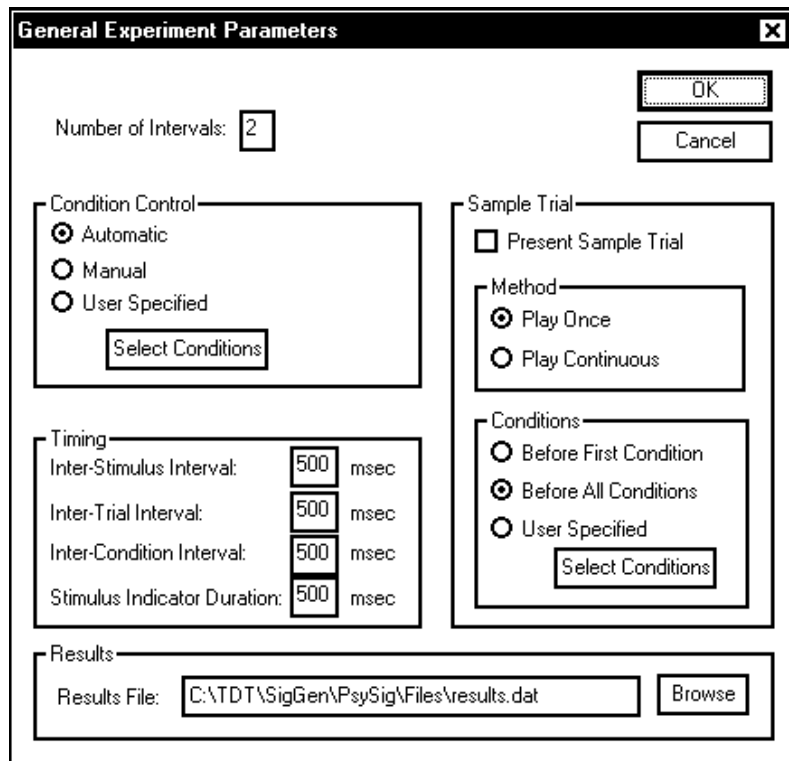
Variable Value. The experimental variable will be set to this value during intervals presenting a standard signal.

Defining Experiment Parameters

Once you have assigned a SigGen stimulus signal and specified dynamic variable parameters, you may define experimental parameters. Experimental parameters are defined from the General Experiment Parameters dialog box.

To access the General Experiment Parameters dialog box

- Choose Experiment from the Setup menu.



General Parameters

Number of Intervals. This field defines the number of intervals per trial. You may have from two to six intervals.

Condition Control

Conditions in PsychoSig correspond to SGIs in SigGen. Typically, an experimental variable will be manipulated in multiple conditions. The manner in which conditions are presented during an experiment is controlled from the Condition Control group box located in the General Experiment Parameters dialog box.

Automatic. Choosing Automatic causes the experiment to automatically execute all conditions, or SGIs, consecutively at experiment runtime. This is the default experiment execution parameter.

Manual. Choosing this parameter allows the researcher to manually select which conditions (SGIs) will be presented. Such selection is made at experiment runtime.

User Specified. By choosing this option, the researcher may select one or more conditions (SGIs) from the list of all conditions. Only the selected conditions will be presented at experiment runtime.

User Specified Condition Control

Condition Control

Automatic

Manual

User Specified

Select Conditions

You may select specific conditions (SGIs) for each experiment. Conditions are selected from the Manually Specify Conditions dialog box.

To access the Manually Specify Conditions dialog box

1. Select User Specified Condition Control.
2. Click the Select Conditions button.

SGI	Duration	Level
1	500.00	60.00	0.00	0.00	0.00
2	475.00	60.00	0.00	0.00	0.00
3	450.00	60.00	0.00	0.00	0.00
4	425.00	60.00	0.00	0.00	0.00
5	400.00	60.00	0.00	0.00	0.00
6	375.00	60.00	0.00	0.00	0.00
7	350.00	60.00	0.00	0.00	0.00
8	325.00	60.00	0.00	0.00	0.00
9	300.00	60.00	0.00	0.00	0.00
10	275.00	60.00	0.00	0.00	0.00
11	250.00	60.00	0.00	0.00	0.00
12	225.00	60.00	0.00	0.00	0.00
13	200.00	60.00	0.00	0.00	0.00
14	175.00	60.00	0.00	0.00	0.00
15	150.00	60.00	0.00	0.00	0.00
16	125.00	60.00	0.00	0.00	0.00
17	100.00	60.00	0.00	0.00	0.00

Repeat Factor:

Repeat Factor. PsychoSig executes all selected conditions in ascending numerical order. This sequence is performed the number of times specified in the Repeat Factor field.

To select a single condition

- Click the desired condition.

To select multiple conditions

- Ctrl-Click the desired conditions.

To select multiple contiguous conditions

- Drag the mouse over the desired conditions while depressing the left mouse button.

or

1. Click the first condition.
2. Shift-Click the last condition.

To select even-numbered conditions

- Click Do Even.

To select odd-numbered conditions

- Click Do Odd.

To de-select all conditions

- Click Clear.

To clear individual conditions

- Ctrl-Click the desired conditions.

To accept conditions and exit

- Click OK.

Timing

Timing		
Inter-Stimulus Interval:	<input type="text" value="500"/>	msec
Inter-Trial Interval:	<input type="text" value="500"/>	msec
Inter-Condition Interval:	<input type="text" value="500"/>	msec
Stimulus Indicator Duration:	<input type="text" value="500"/>	msec

Timing parameters are used to specify the timing of events during the experiment. Timing parameters are located in the Timing group box.

Inter-Stimulus Interval. This field defines the time in milliseconds between stimulus presentations.

Inter-Trial Interval. This field defines the time in milliseconds between trials.

Inter-Condition Interval. This field specifies in milliseconds the duration between successive conditions (SGIs).

Stimulus Indicator Duration. This field defines in milliseconds the duration of an optional external stimulus indicator.

Sample Trial

Sample Trial

Present Sample Trial

Method

Play Once

Play Continuous

Conditions

Before First Condition

Before All Conditions

User Specified

Select Conditions

You may present the subject with a sample trial prior to the beginning of data collection. Sample trial parameters are specified in the Sample Trial group box.

Present Sample Trial. Checking this box enables the presentation of a sample trial.

Method

A sample trial is simply a preview of the first trial. The sample trial may be played once or played continuously. During presentation of sample trial, the background of the Experiment window is orange. The subject's response to the sample trial is not recorded in the output file.

Play Once. Choosing this option causes a single sample trial to be played.

Play Continuously. Choosing this option causes the sample trial to play continuously until the subject responds.

Conditions

Before First Condition. Choosing this parameter causes the sample trial to occur only before the first experimental condition (SGI).

Before All Conditions. Choosing this parameter causes the sample trial to occur before each experimental condition (SGI).

User Specified. Choosing this parameter allows the user to specify which conditions the preview trial will precede.

User Specified Condition Control

You may preview a trial before specific conditions (SGIs). Conditions are selected from the Manually Specify Conditions dialog box.

To access the Manually Specify Conditions dialog box

1. Select User Specified Conditions.
2. Click the Select Conditions button.

You will see the Condition Control dialog.

Note: The Repeat Factor field in the Manually Specify Conditions dialog has no significance for sample trial presentation.

See the previous section, **Condition Control**, for details on selecting conditions for which to present sample trials.

Results

The format of the data file is described in **Chapter 5 –Data Collection**. A sample .dat file is also shown.

Results from PsychoSig experiments are automatically written to a PsychoSig data file in text format. The default extension used by PsychoSig data files is .dat.

If the file specified already exists, data is appended to the end of that file. Otherwise, a new file is created with the specified name.

Note: You must specify a results file prior to running an experiment.

To specify a PsychoSig data file

- Enter the file name in the Results File field,

or

1. Click Browse.
2. Enter or choose the desired path and file name.
3. Click OK.

Specifying Intervals

Interval parameters may be defined from the Interval Properties dialog box.

To access the Interval Properties dialog box

- Choose Interval from the Setup menu.

Previously, you defined the number of intervals in the General Experiment Parameters dialog box. The interval properties dialog box consists of index cards that correspond to each defined interval.

To change intervals

Click the file tab label with the desired interval button number.

Stimulus

Standard Signal Only. Checking this box causes the standard stimulus only to be played during this interval.

This feature is useful if you wish to have an interval (button) that is always “wrong.” Such a button might be labeled “Can’t tell” or “Don’t know” as described below.

Button Appearance

The Experiment Window is divided into 100 x-axis units and 100 y-axis units. Button locations and sizes are defined in terms of x-axis and y-axis coordinates. Values from 0 to 100 are valid.

Upper Left Corner

X. This value defines the x-axis coordinate of the interval button's upper left corner. The x-axis coordinate is defined in terms of the number of units to the right of the Experiment Window left boundary.

Y. This value defines the y-axis coordinate of the interval button's upper left corner. The y-axis coordinate is defined in terms of the number of units below the Experiment Window top boundary.

Size

Width. This value defines the width of the interval button.

Height. This value defines the height of the interval button.

Style

Text. When this button is chosen, text entered in the Text field will appear on the interval button.

Bitmap. When this button is chosen, the bitmap entered in the Bitmap field will appear on the interval button. You may type in the bitmap file name or click Browse and select the file name from the directory listing. Only .BMP files can be displayed.

Keyboard Interface

PsychoSig allows users to respond via a keyboard interface. Users may respond with any numeric key (0-9).

Map to Key. The value in this field corresponds to a numeric key (0-9) which users may press to indicate a response.

Parallel Interface

PsychoSig supports the use of a parallel interface through TDT's PI2.

Output Bit. This field specifies the output bit (1-8) used to communicate to an external device. To use negative logic, check Use Negative Logic. Standard TDT response boxes have positive logic outputs.

Input Bit. This field specifies the input bit (1-8) used to receive data from an external device. To use negative logic, check Use Negative Logic. Standard TDT response boxes have negative logic inputs.

Specifying Feedback

You may wish to provide feedback to subjects for correct or incorrect responses. Feedback may be specified from the Feedback dialog box.

To access the Feedback dialog box

- Choose Feedback from the Setup menu.

Feedback [X]

Feedback Duration: msec

Show a Bitmap

Upper Left Corner: X: Y:

Size: Width: Height:

Bitmap Files:

Correct:

Incorrect:

Play a Sound

Sound Files:

Correct:

Incorrect:

Light an Led

PI2 Bits:

Correct: Use Negative Logic

Incorrect: Use Negative Logic

PsychoSig provides for three types of feedback:

- Show a bitmap
- Play a sound
- Light an LED

You may implement any combination of these three types of feedback or choose no feedback at all.

General Parameters

Feedback Duration. This field defines the duration of feedback in milliseconds.

Show a Bitmap

PsychoSig allows you to allocate an area of the screen for visual presentation of feedback. Visual feedback is created by assigning a bitmap file (*.bmp* file) to this screen area. You may assign separate *.bmp* files for correct and incorrect responses.

The Experiment Window is divided into 100 x-axis and 100 y-axis coordinates. The feedback screen area is specified using these coordinates.

Show a Bitmap. Checking this field causes the bitmaps defined in the Correct and Incorrect fields to be displayed in the feedback screen area when subjects respond correctly and incorrectly, respectively. You must specify *.bmp* files for both correct and incorrect responses if this box is checked.

Upper Left Corner

X. This field specifies the x-axis coordinate of the feedback area's upper left corner. The x-axis coordinate is defined in terms of number of units to the right of the Experiment Window left boundary.

Y. This field specifies the y-axis coordinate of the feedback area's upper left corner. The y-axis coordinate is defined in terms of number of units below the Experiment Window upper boundary.

Size

Width. This field defines the width of the feedback area.

Height. This field defines the height of the feedback area.

Bitmap Files

If you have checked, Show a Bitmap, you must enter *.bmp* files for both correct and incorrect subject responses.

Correct. Define a *.bmp* file as feedback for correct responses by typing in the file name or clicking Browse and selecting from the directory listing.

Incorrect. Define a *.bmp* file as feedback for incorrect responses by typing in the file name or clicking Browse and selecting from the directory listing.

Play a Sound

Play a Sound

Sound Files:

Correct:	<input type="text"/>	Browse
Incorrect:	<input type="text"/>	Browse

You can create a 16-bit binary file with the Save Wave command on the SigGen File menu.

PsychoSig allows you to assign sound files for use as feedback. Sound files must be in 16-bit binary format (.16). PsychoSig will not play wave files (.wav files) correctly.

Note: The sampling rate of the binary sound file must be the same as the sampling rate defined when building the stimulus signal in SigGen. PsychoSig will automatically play all signals at the SigGen sampling rate.

Play a Sound. Checking this field causes the binary sound files defined in the Correct and Incorrect fields to be played as feedback when subject responds correctly and incorrectly, respectively. You must specify binary sound files for both correct and incorrect responses if this box is checked.

Sound Files

If you have checked, Play a Sound, you must enter sound files for both correct and incorrect subject responses.

Correct. Define a sound file as feedback for correct responses by typing in the file name or clicking Browse and selecting from the directory listing.

Incorrect. Define a sound file as feedback for incorrect responses by typing in the file name or clicking Browse and selecting from the directory listing.

Light an LED

Light an Led

PI2 Bits:

Correct:	<input type="text" value="5"/>	<input type="checkbox"/> Use Negative Logic
Incorrect:	<input type="text" value="8"/>	<input type="checkbox"/> Use Negative Logic

You may wish to light an external LED. Such a device may be controlled through use of TDT's parallel interface module, the PI2.

PI2 Bits

You must define which bit (1-8) will be used to control feedback via an LED.

Correct. Defines the bit (1-8) used to signal a correct response. To use negative logic, check Use Negative Logic.

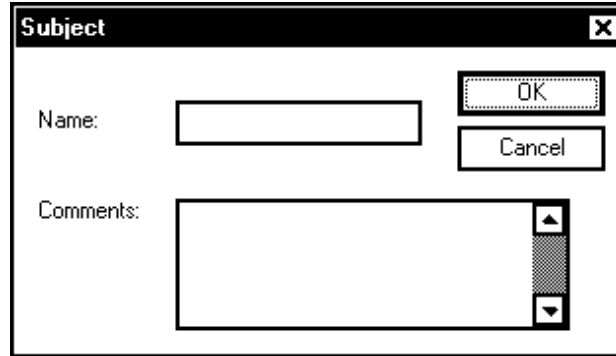
Incorrect. Defines the bit (1-8) used to signal an incorrect response. To use negative logic, check Use Negative Logic.

Specifying Subject Information

Subject information is defined through the Subject dialog box.

To access the Subject dialog box

- Choose Subject from the Setup menu.



Name. Enter the subject name or other identifying information in this field. You will not be allowed to run an experiment until an entry in this field is made.

Comments. You may enter any optional comments in this field.

Saving the PsychoSig File

Once all PsychoSig parameters have been entered, you must save the PsychoSig file.

PsychoSig files use the default extension, *.pa*. You should use this extension when saving all PsychoSig files.

To save the PsychoSig file

- Choose Save or Save As... from the File menu.

Chapter 4 Running Experiments

Once you have designed the PsychoSig experiment and entered subject information you are ready to calibrate your system and run the experiment.

Choosing an Experiment Mode

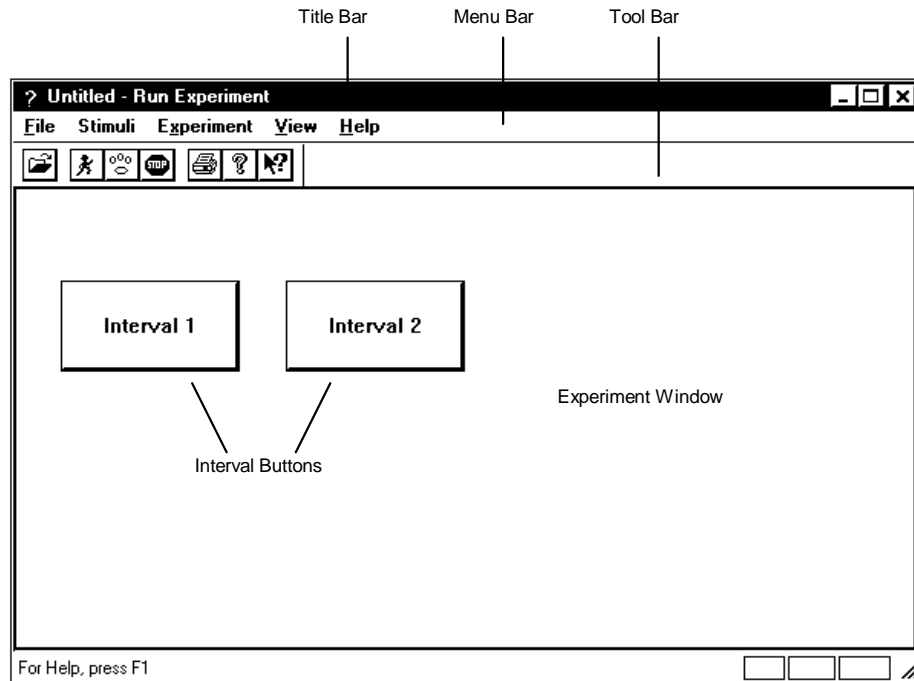
Experiments may be run from either PsychoSig modes:

- Run mode
- Configure mode

As mentioned in a previous section, users may not configure experiments when in run mode. Users may, however, run experiments from both run mode and configure mode.

The process of running an experiment is identical in both run mode and configure mode. The only difference lies in the screen display.

Run Mode

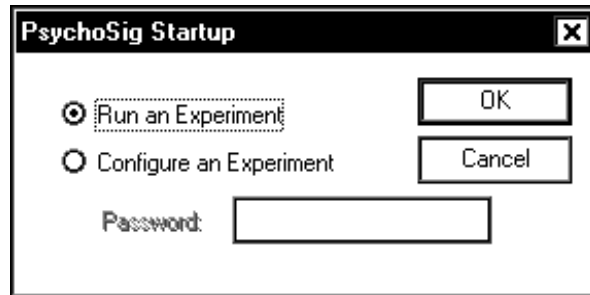


Run mode is designed for subjects. The screen consists of the Experiment Window, only. There is no Output Window. Interval buttons are displayed in the Experiment Window. The subject may respond to stimuli by selecting an interval button. No data are displayed during the experiment.

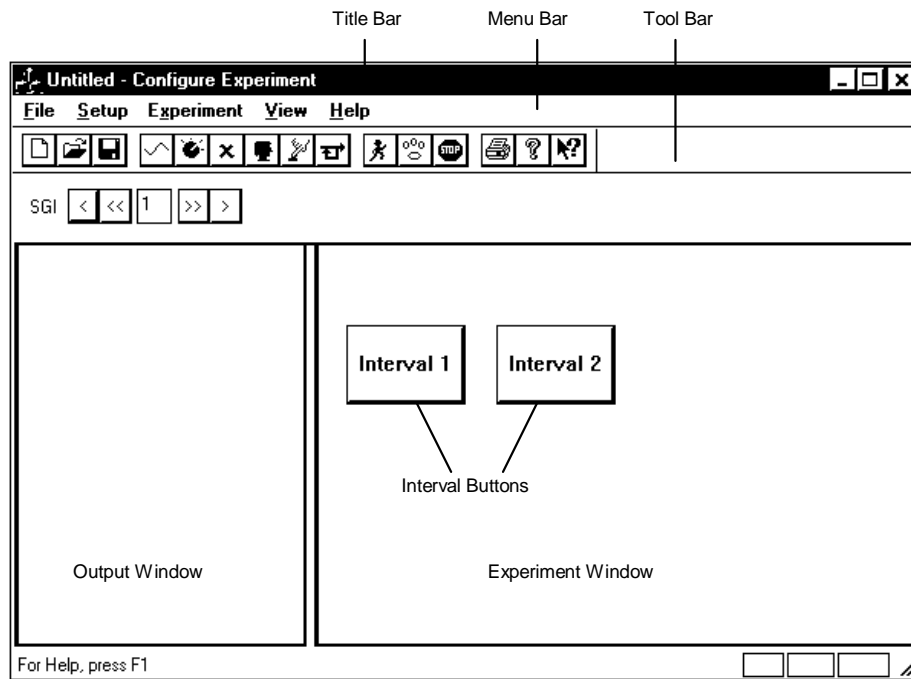
To run an experiment in run mode

1. Run PsychoSig.

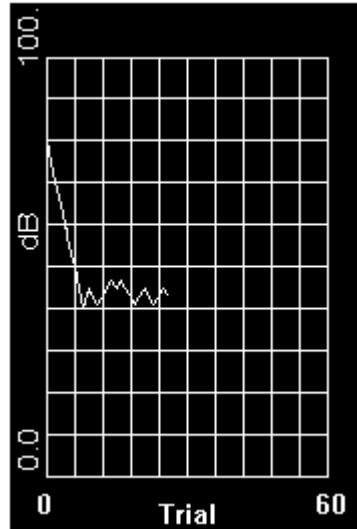
You will see the Startup dialog box.



2. Click Run an Experiment.
3. Click OK.

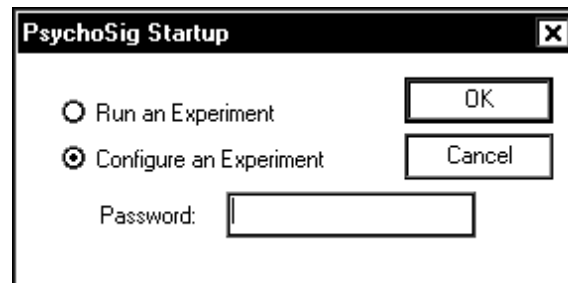
Configure Mode

Configure mode is designed for experimenters. Configure mode includes the Experiment Window and the Output Window. Interval buttons are displayed in the Experiment Window. The subject may respond to stimuli by selecting an interval button. As the subject responds, the data may be plotted in the Output Window (see below).



To run an experiment in configure mode

1. Run PsychoSig.
2. You will see the Startup dialog box.



3. Click Configure an Experiment.
4. Enter the configure mode password.
5. Click OK.

Running

To run a PsychoSig experiment, you must do the following three things:

- Open the PsychoSig file
- Calibrate the system
- Run the experiment

Opening the PsychoSig File

To open the PsychoSig file

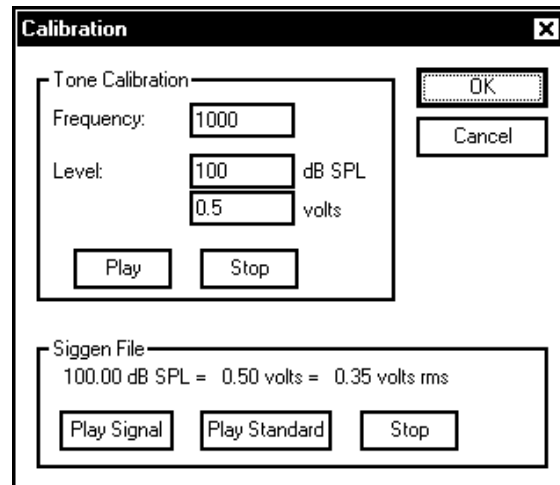
1. Choose Open from the File menu.
2. Choose the desired PsychoSig file from the directory listing.
3. Click OK.

Calibrate the System

PsychoSig provides a means for calibrating your system using an external attenuator. From the Calibration dialog box, you may generate a calibration tone. You may also play the experimental stimulus and the standard stimulus.

To access the Calibration dialog box

- Choose Calibrate from the Experiment menu.



During SigGen signal design, you are asked to specify a voltage-to-dB relationship. This relationship is saved with your SigGen file. The PsychoSig Calibration dialog box reads the calibration information from the SigGen file specified for Channel 1 and uses it during calibration.

To calibrate your system using a tone

1. Set your attenuator to 0 dB attenuation.
2. Enter the desired frequency.
3. Click Play.
4. Measure the output sound pressure level.
5. Adjust the attenuator until the output sound pressure level equals that displayed in the Level field.
6. Click Stop.

To change the output level of the tone

1. Enter a value in either the dB SPL field or the volts field.
2. Press Tab.

The value in the other Level field will be modified based on the volts-to-dB relationship defined in the Channel 1 calibration field.

To calibrate your system using the SigGen stimulus

1. Set your attenuator to 0 dB attenuation.
2. Click Play Signal for the experimental signal or Play Standard for the standard signal.

The signal for the first condition (SGI=1) will be played continuously.

3. Measure the output sound pressure level.
4. Adjust the external attenuator until the output sound pressure level equals that displayed in the “SigGen file” box.
5. Click Stop.

Run the Experiment

Once you have configured your equipment and prepared the subject, you are ready to run the experiment.

Run Modes

During experiment setup, you will have chosen one of three running modes:

- Automatic
- Manual
- User Specified

PsychoSig will present conditions (SGIs) based on the mode you have chosen.

Automatic. If this mode has been chosen, PsychoSig will present all conditions (SGIs).

Manual. If this mode has been chosen, PsychoSig will present only the condition (SGI) specified in the SGI field.

SGI

See the Chapter 3 section, **Condition Control** for details

User Specified. If this mode has been chosen, PsychoSig will present only the conditions (SGIs) selected in the Condition Control dialog of Setup Experiment.

Running***To run the experiment***

1. If running in manual mode, set the SGI field to the desired condition (SGI).

2. Choose Run from the Experiment menu.

Note: While running an experiment, PsychoSig's Experiment Window appears green. The Experiment Window appears blue when idle.

Ready to Begin a Condition (SGI)

Prior to the presentation of each condition (SGI), all interval buttons repeatedly depress and release in synchrony. This is a signal to the subject to begin the condition when ready.

To begin a condition

- Click any interval button.

PsychoSig will begin presenting trials.

Presenting Trials

The experimental stimulus and all standard stimuli are each randomly assigned to an interval and presented to the subject. As a stimulus is played, its interval button depresses to provide the subject with a visual cue.

The experimental variable will be presented at its defined start value during the first trial of each condition. This variable will vary across trials based on the defined variable parameters and the subject's response.

Responding to Trials

Subjects may respond to a trial in one of three ways:

- By clicking the desired interval button.
- By depressing a keyboard key.
- By interacting with a parallel interface.

Condition Completion

The condition is completed when the following criteria are met:

- The maximum number of trials has been presented.
- The maximum number of reversals has occurred.

The first condition will be presented until completed. Upon completion, both interval buttons will repeatedly depress and release in synchrony, indicating to the subject that the next condition is about to begin.

To begin subsequent conditions

- Have the subject click either interval button.

PsychoSig will continue with the next condition.

Termination of the Experiment

PsychoSig will continue the experiment until all conditions have been completed. However, the experiment may be terminated or paused at any time.

To manually terminate the experiment

- Choose Abort from the Experiment menu.

To pause the experiment

- Choose Pause from the Experiment menu.

Chapter 5 Data Collection

PsychoSig stores summary data into the user-specified data file (*.dat* file). The data is saved in text format.

The Results File

When each condition (SGI) terminates, either normally or by aborting, the following information is written to the data file:

- Date and time the condition ended
- Termination status (ABORTED, COMPLETED)
- SigGen file name(s)
- Condition (SGI) number
- Presentation mode (Monaural, Binaural)

Single-channel experiments are listed as Monaural, while two-channel experiments are shown as Binaural. PsychoSig makes this assumption, as it has no way of knowing if a single-channel experiment has been presented binaurally (a diotic presentation).

- Value of SigGen variables for this condition
- Starting value and range of the dynamic variable
- Tracking method and step sizes
- Number of trials run and reversals that occurred
- The tracking algorithm (number up/down)
- Subject name with comments
- Mean, Standard Deviation, and Standard Error
- Percent correct and incorrect responses for each interval
- Initial value of the experimental variable
- Value of the experimental variable at each reversal (those that occurred under the initial step size are bracketed[])

The statistics are calculated on the last even number of final-step-size reversals. If the statistics cannot be validly computed, values of “999.90” are displayed.

The data for all completed conditions will appear in the Output Window. Results from previous experiments are not displayed in this window, even though they are stored in the output file.

Viewing Results through a Text Editor

PsychoSig saves data files (.dat files) in text format. You may view data files using any text editor.

Note: Great care must be taken when viewing PsychoSig data files through a text editor. Data may be altered. When possible, use text editors in read-only mode.

Printing Results

Text data displayed in the Output Window may be printed. You can also preview the output before printing.

To print result data

1. Display desired data in the Output Window.
2. Select the Output window by clicking once in it.
3. Choose Print... from the File menu.
4. Select the applicable print options for your printer
5. Press OK.

To preview the result data before printing

1. Select Text from the View Output menu.
 2. Select the Output window by clicking once in it.
 3. Choose Print Preview from the File menu.
 4. Press the Print button and follow steps 4 and 5, above
- or
5. Click the Close button to return to the PsychoSig main window.

Part

2

Illustrative Examples

Chapter 6 Quick Start Example

The Quick Start example presented in this section illustrates a simple forced-choice psychoacoustic experiment as designed via PsychoSig. The Quick Start example is designed to introduce important concepts. Ready-to-use application files are provided.

Learn New Concepts



The example in this section provides step-by-step instructions you may use to build the Quick Start example from scratch. Along the way, you will be introduced to important concepts. These concepts are always indicated with the icon currently seen in the left margin.

Below is a list of the new concepts introduced in this example.

Example 1: Forward Masking

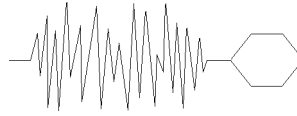
- Value List
- Repeat Factor
- Boundary Control
- Loop
- Dynamic Variable
- Additive Tracking
- Calibration

Get a Quick Start



Completed SigGen and PsychoSig files are provided for the example in this section. If you prefer, you may use these files, bypassing the step-by-step instructions. Quick Start file names are listed at the beginning of the example. Look for these files whenever you see the Quick Start icon currently displayed in the left margin. Instructions for accessing these files and running the applications appear in boxes and are always located next to a Quick Start icon.

Example 1: Forward Masking



This experiment is designed to gather forced-choice psychoacoustic data in response to two paired stimuli: a 400 millisecond standard stimulus and a 400 millisecond experimental stimulus.

Standard Stimulus

The standard stimulus consists of 300 milliseconds of masking noise presented at 80 dB SPL followed by 100 milliseconds of silence.

Experimental Stimulus

The experimental stimulus consists of 300 milliseconds of masking noise followed by a tone. Experimental conditions will be created by systematically varying two parameters: *DeltaT*, the onset of the tone, and *Frequency*, the frequency of the tone.

The values for both variables are presented below.

DeltaT	Frequency
■ 330 milliseconds	■ 500 Hz
■ 310 milliseconds	■ 1000 Hz
■ 300 milliseconds	■ 3000 Hz

Thus nine experimental conditions will be created.

DeltaT	Frequency
1. 330 milliseconds	500 Hz
2. 330 milliseconds	1000 Hz
3. 330 milliseconds	3000 Hz
4. 310 milliseconds	500 Hz
5. 310 milliseconds	1000 Hz
6. 310 milliseconds	3000 Hz
7. 300 milliseconds	500 Hz
8. 300 milliseconds	1000 Hz
9. 300 milliseconds	3000 Hz

For each condition, the value of *Level*, the level in dB SPL of the tone, will vary dynamically. The initial *Level* value will be 80 dB SPL. Following every incorrect response, *Level* will increase by 5 dB. After every correct response, *Level* will decrease by 5 dB. After three reversals, the value of *Level* will be increased/decreased by 2 dB following incorrect/correct responses. The experiment will terminate when any of the following conditions occurs:

- 12 reversals

- 30 trials
- Experiment is aborted

Quick Start

The Quick Start files necessary to run this experiment are as follows:

SigGen signal file	<code>tdt\siggen\psysig\files\ex1\mask.sig</code>
PsychoSig configuration file	<code>tdt\siggen\psysig\files\ex1\mask.pa</code>

To run the experiment, you will need to perform the following steps:



- ✓ *Value List*
- ✓ *Repeat Factor*
- ✓ *Boundary Control*
- ✓ *Loop*
- ✓ *Dynamic Variable*
- ✓ *Additive Tracking*
- ✓ *Calibration*

1. Build the SigGen Signal.
 - a. Run SigGen.
 - b. Define the signal parameters.
 - c. Define variables.
 - d. Create the segments and components.
 - e. Save the SigGen File.
2. Configure and run the PsychoSig experiment.
 - a. Run PsychoSig.
 - b. Assign the SigGen Signal.
 - c. Define experimental variable parameters.
 - d. Define experiment parameters.
 - e. Define interval parameters.
 - f. Specify feedback.
 - g. Enter subject information.
 - h. Save the *.pa* file.
 - i. Calibrate the system.
 - j. Run the experiment.

Note: Only those parameters to be entered or selected are given below. All other parameters will remain set to their default values.

Building the SigGen Signal

In this example, you will use TDT's signal generation software, SigGen, to create the stimulus signal. You will build one stimulus signal, *mask.sig*. This signal will serve as the basis for both the standard signal and the experimental signal. The duration of the entire stimulus will be 400 milliseconds. The stimulus will consist of two segments, a 300 millisecond masking noise and a tone presented at some point during the remaining 100 milliseconds. The standard signal will be created by setting the level of the tone to 0 dB. Signal parameters will vary as described in the previous section.

Run SigGen

To run SigGen

- Double-click the SigGen icon.

To build the SigGen signal from scratch

- Choose New from the File menu.


 tdtlsiggen\psysig\
 files\ex1\mask.sig

To follow along using a Quick Start file

1. Choose Open from the File menu.
2. Select the file listed in the left margin.

To bypass the SigGen signal design process

- Exit SigGen by choosing Exit from the file menu and skip to **Designing and Running the PsychoSig Experiment**. (Look for the Quick Start icon!).

Define the Signal Parameters

To define the signal parameters

1. Select Signal from the Modify menu of the main window.
2. Enter or select the following parameters in the Signal Parameters dialog box:

Name:	<i>Forward Masking</i>
Sample Period:	20 μ seconds
<u>Timing</u>	
Duration:	400 milliseconds
<u>Calibration</u>	
Level:	90 dB = 9 volts

Note: This is a sample calibration setting. You should set the calibration values according to the output of your system.

Define the Variables

This example will use three variables. The first, *DeltaT*, will vary the onset of the tone. The second, *Frequency*, will vary the tone frequency. The third, *Level*, will cause the tone level to vary dynamically.

Controlling Tone Onset



Tone onset will be controlled through use of the variable, *DeltaT*. The values of this variable will be determined through a method known as *Value List*. *Value List* allows you to specify a sequential list of values.



For each value of *DeltaT*, the tone will be presented at three frequencies. Thus, a *Repeat Factor* of 3 must be defined for the variable *DeltaT*.



Stimulus presentation will be controlled through the use of a feature called *Boundary Control*. When boundary control is enabled, the condition is terminated once the boundary conditions have been exceeded.

To define the variable, DeltaT

1. Click the Edit... button in the Variables group box of the Signal Parameters dialog box.
2. Enter or select the following parameters in the Signal Variable dialog box:

General

Name: *DeltaT*
 Units: ms
 Method: Value List

3. Click Edit List and enter the following:

330
310
300
4. Set the remaining parameters as follows:

<u>Value Limits</u>		<u>SIG Modifiers</u>	
Default/Start:	330	Repeat Factor:	3
Minimum:	300	<u>Termination Control</u>	
Maximum:	330	Boundary Control:	<input checked="" type="radio"/>

To accept the variable parameters and return to the Signal Parameters dialog box

- Click the OK button in the Signal Variable dialog box.

Controlling Frequency



Tone frequency will be controlled through use of the variable, *Frequency*. The values of this variable also will be determined through the *Value List* method.



Because the values of *Frequency* must vary for each value of *DeltaT*, *Frequency* must be defined with a Termination Control of *Loop*.

To define the variable, Frequency

1. Double-click on 2. in the Variables list box.
2. Enter or select the following parameters in the Signal Variable dialog box:

General

Name: *Frequency*
 Units: Hz
 Method: Value List

4. Click Edit List and enter the following:

500
1000
3000
5. Set the remaining parameters as follows:

Value Limits

Default/Start: 500
 Minimum: 500
 Maximum: 3000

Termination Control

Loop:

To accept the variable parameters and return to the Signal Parameters dialog box

- Click the OK button in the Signal Variable dialog box.

Controlling Tone Level

For each condition, the value of *Level*, the level in dB SPL of the tone, will vary based on subject response. The initial *Level* value will be 80 dB SPL. Following every incorrect response, *Level* will increase by 5 dB. After every correct response, *Level* will decrease by 5 dB. After three reversals, the value of *Level* will be increased/decreased by 2 dB following incorrect/correct responses. Because the value of *Level* varies as a function of subject response, it must be defined as a *dynamic variable*.

To define the variable, Level

1. Double-click on 3. in the Variables list box.
2. Enter or select the following parameters in the Signal Variable dialog box:

General

Name: *Level*
 Units: dB
 Method: Dynamic

Value Limits

Default/Start: 80
 Minimum: 20
 Maximum: 100

Note: It is not necessary to modify the default value of the Step Size field. Step size will be defined in PsychoSig.

To accept the variable parameters and return to the Signal Parameter dialog box

- Click the OK button in the Signal Variable dialog box.

To accept the signal parameters and return to the SigGen main window

- Click the OK button in the Signal Parameters dialog box.

Create the Segments and Components

Each SigGen signal consists of at least one segment. Each segment in turn consists of one to three components. In this example, the stimulus consists of two segments, a masking noise and a tone, each of which consists of one component.

Creating the Noise Segment

You will be creating a segment that consists of one component, gaussian noise. SigGen provides a method for gating the noise segment, Gate Type. You will be defining a Gate Type of Cos2 and a Gate Time of 5 milliseconds.

To create the segment

1. Choose Segment... from the Modify menu.
2. Enter or select the following parameters in the Edit Signal Segments dialog box:

Select: Seg[1]
Gate Type: Cos2
Gate Time: 5 msec
Duration: 300 msec

Creating the Noise Component

You may generate gaussian noise in either the time domain or the frequency domain. Generation method is specified in the Gen. Meth field. Time is the default generation method. Time domain generation is employed in this example.

Gen. Meth:

Time 

To create a component for the segment

1. Click the first button in the Components group box.
2. Enter or select the following parameters in the Component Parameters dialog box:

Call: Gauss
Level (dB): 80

3. Click the OK button to accept the component parameters.

Creating the Tone Segment

You will be creating a second segment that consists of one component, a pure tone.


To create the segment

1. Click New.
2. Enter or select the following parameters in the Edit Signal Segments dialog box:

Select:	Seg[2]
Gate Type:	Cos2
Gate Time:	5 msec
Start:	<i>DeltaT</i>
Duration:	30 msec

Creating the Tone Component

You may generate a tone in either the time domain or the frequency domain. Time is the default generation method. Time domain generation is employed in this example.

Gen. Meth:
 

To create a component for the segment

1. Click the first button in the Components group box.
2. Enter or select the following parameters in the Component Parameters dialog box:

Call:	Tone
Level (dB):	<i>Level</i>
Frequency (Hz):	<i>Frequency</i>

3. Click the OK button to accept the component parameters.

To return to SigGen's main window

- Click OK in the Edit Signal Segments (Seg[2]) dialog box.

Save the SigGen File

You will be using this SigGen File to generate a stimulus signal through PsychoSig.

To save the SigGen file

1. Chose Save from the File menu.
2. Enter `C:\TDT\SIGGEN\PSYSIG\FILES\EX1\mask.sig` in the File Name field.

Designing and Running the PsychoSig Experiment

Once you have designed the stimulus signal with SigGen and saved the SigGen file, you are ready to set up the PsychoSig experiment and begin collecting data. This example constructs a simple two interval forced-choice experiment. A standard stimulus and an experimental stimulus each will be randomly assigned to one of the two intervals. The standard signal will consist of 300 milliseconds of noise followed by 100 milliseconds of silence. The experimental signal will consist of 300 milliseconds followed by a tone. The experimental variable will be *Level*, the level of the tone. This variable will be tested in nine conditions, as described previously.

Run PsychoSig

To run PsychoSig

1. If SigGen is running, select Exit from the SigGen File menu.
2. Double-click the PsychoSig icon.
3. Choose Configure an Experiment from the PsychoSig Startup dialog box.
4. Enter the configure mode password.
5. Click OK.

Note: To run this experiment, you must either create the PsychoSig file by following along with the step-by-step instructions or open the existing Quick Start file.



`tdt\siggen\psysig\files\ex1\mask.pa`

To use a Quick Start file

1. Choose Open from the File menu.
2. Select the file listed in the left margin.

To bypass experiment setup and begin running the experiment

- ▶ Skip to **Calibrate the System**.

Assign the SigGen Signal

You must assign the desired SigGen stimulus signal.

To assign a SigGen signal

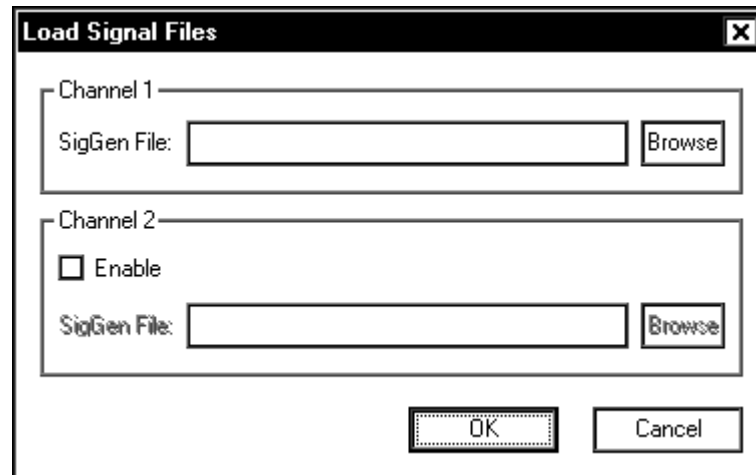


1. Click the signal icon on the toolbar

or

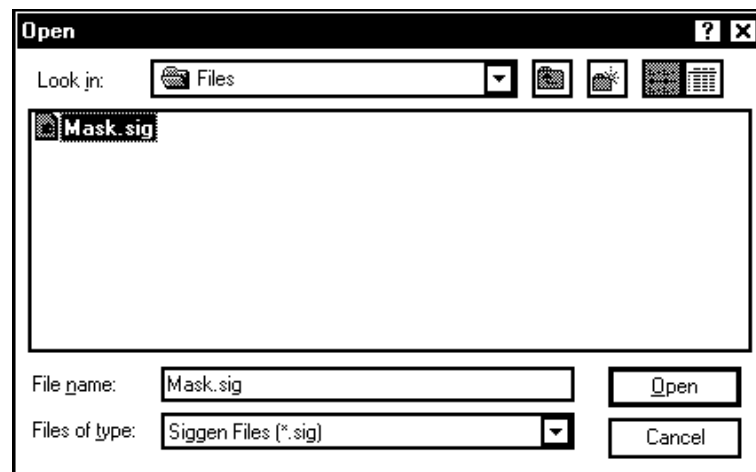
Choose Signal from the Setup menu.

You will see the Load Signal Files dialog box.



2. Click Browse in the Channel 1 section.

You will see the standard Windows Open dialog box.



3. Select *Mask.sig* from the *tdt\siggen\psysig\files\ex1* directory.
4. Click the Open button.
5. Click Open in the Load Signal Files dialog to load the file.

Define Experimental Variable Parameters

Once you have assigned the SigGen stimulus signal, PsychoSig reads the variable information contained in the signal file and opens the Dynamic Variable Settings dialog box. You may also access this box by choosing Variable from the Setup menu.

The screenshot shows the 'Dynamic Variable Settings' dialog box. At the top, it displays 'Variable: Level' and 'Units: dB'. Below this are 'Signal Parameters' and 'Standard Parameters' sections. The 'Signal Parameters' section is divided into 'Values' and 'Tracking'. The 'Values' section has input fields for 'Initial Value: 80', 'Max Value: 100', and 'Min Value: 20'. The 'Tracking' section has a 'Method' dropdown set to 'Additive', and input fields for 'Initial Step Size: 5', 'Final Step Size: 2', 'Increment: 1 Incorrect', 'Decrement: 2 Correct', 'Use Final Step: 3 Reversals', and 'Stop: 30 Trials or 12 Reversals'. The 'Standard Parameters' section has a 'Variable Value: 0' input field. 'OK' and 'Cancel' buttons are located at the top right.

PsychoSig has determined from the SigGen file that the dynamic variable is *Level* and that the unit of measurement is dB.

Signal Parameters – Values

The Initial Value, Max Value, and Min Value fields default to those values set in the SigGen file. You may override these values. This example will use the default SigGen settings. PsychoSig will begin each trial with *Level* set to the initial value of 80 dB SPL. *Level* will not be allowed to exceed the Max Value of 100 dB SPL or to fall below the Min Value of 20 dB SPL.



Signal Parameters – Tracking

In this example, you will use an *additive tracking* method. This means that when the value of Level changes, it will always change by addition or subtraction of the current step size. PsychoSig defaults the Initial Step Size to 5. Final Step Size defaults to 2. This example uses the default values. The value of *Level* will be increased following 1 incorrect response. It will be decreased following 2 correct responses. The Final Step Size of 2 will take effect after 3 reversals. The condition will terminate after 30 reversals or 12 trials.

Standard Signal Parameters

The standard signal does not contain a tone segment. By setting Variable Value equal to 0 dB SPL, the tone is effectively eliminated from the standard stimulus.

To set up the variable parameters

- Enter or select the following parameters in the Dynamic Variable Settings dialog box:

Tracking

Stop: 30 Trials

Standard Parameters

Variable Value: 0

To complete entry of this information

- Click OK in the Dynamic Variable Settings dialog box.

To return to the main window

- Click OK in the Load Signal Files dialog box.

Define Experiment Parameters

You are now ready to define parameters that affect the experiment as a whole. These parameters include the number of intervals and timing parameters.

In this example, you will be using two intervals. You will present all nine conditions. Timing parameters will remain at their default settings. No sample trial will be presented.

Note: You must define a results file (*.dat* file) prior to running the experiment.

To define experiment parameters

1. Click the experiment setup icon on the toolbar

or

Select Experiment from the Setup menu of the main window.

2. Enter `c:\tdt\siggen\psysig\files\ex1\mask.dat` in the Results File field.
3. Leave all other parameter settings at their default values.

To return to the PsychoSig main window

- Click OK.

Define Interval Parameters

In the General Experiment Parameters dialog box, you define the number of intervals. In the Interval Parameters dialog box, you define the interval interface. Subjects may select intervals by clicking a button on the screen, by pressing a key on the keyboard, or through interaction with a parallel interface channel of your choosing.

In this example, you will use the default values for interval parameters. PsychoSig will automatically place two interval buttons in the Experiment Window and label them “Interval 1” and “Interval 2.”

To define interval parameters

1. Click the interval icon on the toolbar

or

Choose Interval from the Setup menu.

2. Click the desired interval button file tab.
3. Make desired changes.

Note: For this example, it is not necessary to make changes to this screen

 A screenshot of the 'Interval Properties' dialog box. The dialog has a title bar with 'Interval Properties' and a close button. It contains several sections:

- Interval 1 | Interval 2**: Two tabs at the top.
- Stimulus**: A checkbox labeled 'Standard Only' which is unchecked.
- Button Appearance**:
 - Upper Left Corner**: X: 5, Y: 20.
 - Size**: Width: 20, Height: 20.
- Style**:
 - Text**: Selected with a radio button. The text 'Interval 1' is shown in a preview box.
 - Bitmap**: Unselected with a radio button. A 'Browse' button is next to an empty text field.
- Keyboard Interface**: 'Map to Key:' is set to '1'.
- Parallel Interface**:
 - Output Bit:** 5. Use Negative Logic.
 - Input Bit:** 1. Use Negative Logic.

 At the bottom are 'OK', 'Cancel', and 'Help' buttons.
To return to the PsychoSig main window

- Click OK.

Enter Subject Information

You can optionally enter notes about the subject prior to running an experiment. Subject information is entered from the Subject dialog box.

To enter subject information



1. Click the subject icon on the toolbar

or

Choose Subject from the Setup menu.

2. Enter the desired subject identifier in the Name field.
3. Enter any optional comments.

To return to the PsychoSig main window

- Click OK.

Specify Feedback

You may choose to provide feedback for correct and incorrect responses. Feedback may be visible on the screen, audible through headphones or a speaker, or may be delivered through a parallel interface channel of your choosing.

You have been provided with two bitmaps for use as visual feedback, *right.bmp* and *wrong.bmp*.

Note: In order to ensure that the feedback does not obscure one or both of the interval buttons, you must define screen coordinates appropriately.

To specify feedback

1. Click the feedback icon on the toolbar

or

Choose Feedback from the Setup menu.

2. Check Show a Bitmap.
3. Enter the following:.

Upper Left Corner

Y: 50

Size

Width: 50

Height: 30

Bitmap Files

Correct: *c:\tdt\siggen\psysig\files\ex1\right.bmp*

Incorrect: *c:\tdt\siggen\psysig\files\ex1\wrong.bmp*

To return to the PsychoSig main window

- Click OK.

Save the Configuration

Once you have set up the experiment, it is a good idea to save the PsychoSig configuration to a file.

To save the configuration file



1. Click the save icon on the toolbar

or

Choose Save from the File menu.

2. Enter `C:\TDT\SIGGEN\PSYSIG\FILES\EX1\mask.pa` in the File Name field.

Calibrate the System



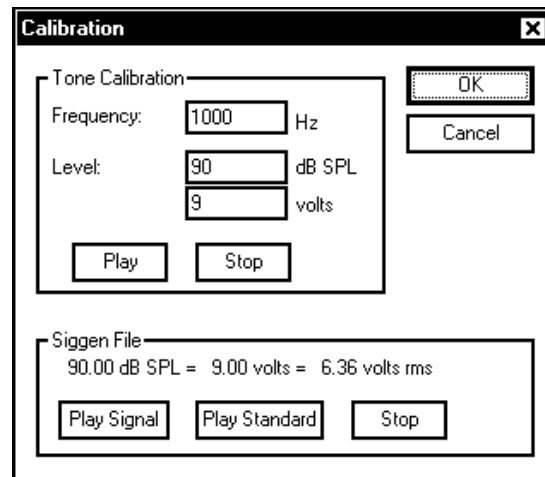
The remaining instructions for this example illustrate the process of data acquisition and analysis. If you are using a Quick Start file, you must execute these step-by-step instructions.



PsychoSig provides several powerful methods of system *calibration*. You may calibrate using tones of various frequencies. You may also calibrate the system through use of the experimental signal or the standard signal.

To access the Calibration dialog box

- Choose Calibrate from the Experiment menu.



To calibrate using a tone

1. Enter or select the following parameters in the System Calibration dialog box:

Tone Calibration

Frequency: desired frequency

Level: desired level

When you enter information in the “dB SPL” field, PsychoSig will automatically change data in the “volts” field to match the relationship defined in the SigGen file.

2. Click the Play button to play the calibration tone.
3. Adjust your attenuator until the output equals the amount defined in the Level field.
4. Click Stop.

To calibrate using a stimulus signal

1. Click Play Signal or Play Standard.
2. Adjust your attenuator until the output equals the amount defined in the Level field.
3. Click Stop.

To return to the main PsychoSig window

- Click OK.

Run the Experiment

Before running the experiment, you should check the hardware configuration. Make sure all equipment is properly connected and that the subject is ready to begin.

Running

You may run from either configure mode or run mode.

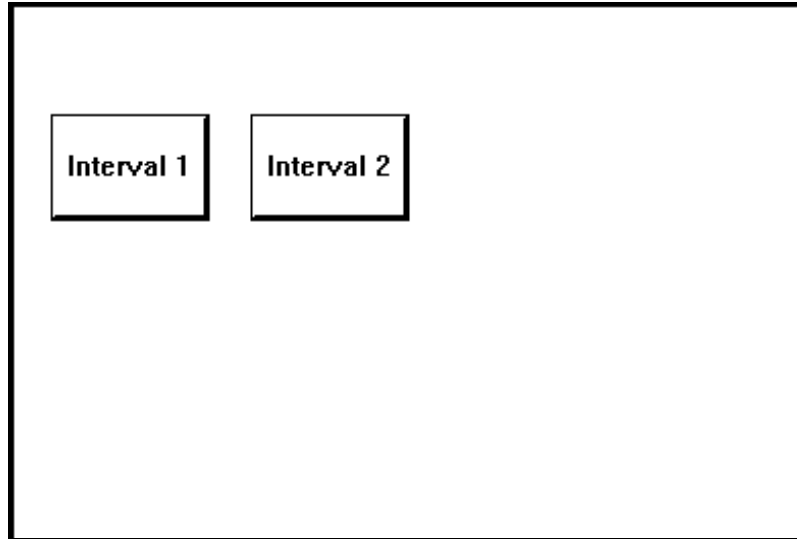
To begin stimulus presentation

1. Run PsychoSig in either configure mode or run mode.
2. Make sure that the file *mask.pa* is open.
3. Click the run icon on the toolbar



or

Choose Run from the Experiment menu.



The screen will turn from blue to green and both interval buttons will depress in synchrony. This indicates to the subject that the first condition is about to begin.

To begin the first condition

- Have the subject click either interval button.

The subject will be presented with two stimuli, the experimental stimulus and the standard stimulus. Each of these stimuli will be randomly assigned to one of the two intervals. As the stimulus is played, the corresponding interval button will depress, providing the user with visual confirmation of the stimulus interval.

The subject responds by clicking the interval button believed to be correct. Feedback stating “Right” or “Wrong” will appear in the lower part of the screen based on the subject’s response.

The first condition will be presented until completed. Upon completion, both interval buttons will depress in synchrony, indicating to the subject that the next condition is about to begin.

To begin subsequent conditions

- Have the subject click either interval button.

PsychoSig will continue with the next condition.

Condition Completion

PsychoSig will run a condition until certain criteria have been met. Trials will be presented until:

- 12 reversals occur.
- 30 trials are completed.
- The experiment is terminated manually.

Termination of the Experiment

Because you have configured this experiment to execute all conditions automatically, PsychoSig will continue the experiment until all conditions have been completed. However, the experiment may be terminated or paused at any time.

To manually terminate the experiment



- Click the abort icon on the toolbar

or

Choose Abort from the Experiment menu.

To pause the experiment



- Click the pause icon from the toolbar

or

Choose Pause from the Experiment menu.